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UNLOCKING EFFICIENCY IN OFFICE DISTRICTS: A COMPREHENSIVE APPROACH TO EFFICIENCY PROGRAMS

Elena Alschuler
Harvey Michaels

MIT Energy Efficiency Strategy Project
77 Massachusetts Avenue
Cambridge, MA 02139
617-253-2084 April 2012
http://web.mit.edu/energy-efficiency

To date, ratepayer-funded programs for commercial buildings have achieved savings equivalent to 12% of efficiency's outstanding cost-effective potential. Energy efficiency programs typically provide technical analyses and financial incentives to influence the owner's evaluation of a potential investment in efficiency. But savings have remained unrealized because energy efficiency is not a purely rational decision made by a single actor. In office buildings, energy consumption is determined by the actions of multiple stakeholders, including owners, facility staff, tenants and office workers, who each face nonfinancial barriers. A more comprehensive approach to the energy-related system in an office building should include social interventions such as information feedback, personal assistance and rewards, and social engagement.

A comparison of five of the most successful efficiency programs in cities across the country reveals that social interventions do have direct energy-saving benefits. However, it is difficult to measure the inputs and impacts of social programs to the rigorous standards required for the use of public funds. As a result, non-profit and local government-led programs have experimented more in this area, and their programs provide proof of concept. Both a better typology of program activities and a more standardized measurement process are needed to support widespread use of social interventions.

The Smart Energy Now smart metering pilot program in downtown Charlotte, NC is the first ratepayer-funded pilot to focus exclusively on social interventions in office buildings. Duke Energy is also conducting rigorous program evaluation, measurement and verification. The Energy Efficiency Strategy Project's research informed the program design, and we are now following its implementation to learn lessons for a replicable model.[1]

[1] This research was carried out as part of the Energy Efficiency Strategy Project (EESP), based at the MIT Department of Urban Studies and Planning and led by Harvey Michaels (hgm@mit.edu). We are grateful for the support for this work provided by Duke Energy, CISCO Systems, Edison Foundation Institute for Electric Efficiency, NSTAR Electric and Gas, and the U.S. Department of Energy and its National Renewable Energy Lab.

I. Introduction & Overview

Opportunity. Energy efficiency has been described by Secretary Chu as "the fruit lying on the ground." It is in fact the cheapest supply option, at 3.5 cents per kWh, approximately half the cost of natural gas, the cheapest traditional fuel[2]. Efficiency also has broad economic benefits. By reducing generation, efficiency also avoids the construction of new power plants and addresses constrained energy transmission systems. At the same time, energy efficiency projects create local contracting jobs and generate cost savings for businesses and homeowners, and the resulting income is then reinvested into local economies. Due to these triple bottom line benefits, energy efficiency is one of the best investments we could make.

Large commercial buildings often present the greatest opportunities for efficiency, but these buildings also face the greatest complexities. Commercial buildings account for 25% of the total end-use efficiency potential in the US, with another 35% of the potential in the residential sector and 40% in the industrial sector[3]. There is significant "low hanging fruit" in commercial buildings. Most existing office buildings could easily reduce their energy consumption by 10-20%[4] at little or no cost. Quick-payback energy saving measures include changes routines in lighting and office equipment use, base building operations and maintenance, and purchasing practices.

McKinsey estimates that in commercial buildings, more than 2,290 trillion BTUs of annual savings would be both technically achievable and cost-effective by 2020 (1,740 BTUs from electric savings alone)[5,6]. An investment in all cost-effective efficiency would require spending $125 billion to achieve $290 billion in returns. These investments would reduce end-use consumption in commercial buildings by approximately 29%, and would avoid emitting more than 1.1 billion tons of greenhouse gasses annualy, equivalent to 6% of the United States' projected 2020 emissions[7].

Yet energy efficiency has proven difficult to deliver. Efficiency potential is disbursed among 4.9 million commercial buildings around the country, which contain more than 3 billion devices[8]. Each building has varying physical conditions and efficiency opportunities. Building owners also have unique financial situations, and their decisions are influenced by different local economic and regulatory contexts. This creates high transaction costs for undertaking efficiency – for potential customers, efficiency program administrators, and implementation contractors alike.

Therefore, in order to realize the full economic and environmental potential of energy efficiency, the public sector has had to intervene. From a policy perspective, the cost of generation is often seen as a threshold, below which it is in the public's interest to invest in efficiency. Therefore, starting in the 1980s, energy efficiency programs have been used as demand resource investments. Most programs are ratepayer funded, meaning they are funded through a small fee on electric bills called a systems benefit charge.

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[2] US Energy Information Administration. *Energy Outlook.* "Levelized cost of New Generation Resources." 2011.
[3] McKinsey & Company *Unlocking Energy Efficiency in the US Economy.* 2009 p.iv
[4] Pacific Northwest National Laboratory. "Energy Efficiency Potential in Existing Commercial Buildings: Review of Selected Recent Studies." *PNNL-18337*. 2009.
[5] Approximately 76% of savings would result from electric efficiency, with the remainder from gas and other fuels.
[6] McKinsey & Company *Unlocking Energy Efficiency in the US Economy.* 2009 p.i
[7] US Energy Information Administration. *Carbon Dioxide Emissions by Sector and Source, United States, Reference case. http://www.eia.gov/forecasts/aeo/data.cfm#co2emsec Accessed 3/6/12.*
[8] McKinsey & Company *Unlocking Energy Efficiency in the US Economy.* 2009 p.v

Ratepayer-funded program budgets totaled $6.8 billion in 2011, a 25% increase over the previous year[9]. Energy savings were achieved at an average cost of 3.5 cents per kilowatt-hour. A kilowatt-hour of efficiency costs less about half of a kilowatt-hour of electricity generated using combined cycle gas turbines, which is the cheapest form of generation at 6.3 cents/kWh[10]. The cost of efficiency is mostly driven by the financial incentive provided for efficiency improvements, often between 10-50% of the up front capital cost. These financial incentives "purchase" efficiency over the lifetime of the measure installed.

Even though efficiency costs much less than generation, it has not been able to achieve scale. In 2010, the annual savings from all current and previous participants in ratepayer funded commercial building programs was only 60 TWh[11] (203 TBTU). In other words, the savings achieved by commercial efficiency programs to date is equivalent to **twelve percent** of the outstanding cost-effective potential.

Some skeptics think that achieving a few percentage points of the total potential each year is the best realistic pace for efficiency. But, not surprisingly, there is increasing interest in finding ways to deliver more efficiency without significantly increasing program costs. Efficiency remains the cheapest and least environmentally harmful option for meeting demand growth. But public budgets are tight. Funding from the 2009 American Recovery and Reinvestment Act is running out, and other Federal and state sources are decreasing, given less tax revenues as a result of the broader economic downturn. Ratepayer funded efficiency programs must therefore find ways to deliver more efficiency, to a greater portion of the market, without significantly increasing program costs.

Scaling up efficiency in commercial buildings requires a fundamental change to the paradigm that guides efficiency program design and evaluation. Ratepayer funded programs have primarily focused on providing direct financial incentives for energy efficiency. But in order to break-through the <1%/year pace of efficiency, programs must address non-financial barriers to efficiency that are not accounted for in a strict cost-payback analysis. Efficiency programs need to provide information feedback, make the process easier, and help align relationships among building stakeholders.

Social interventions can directly result in energy saving behaviors, and increase the likelihood of capital investment. A number of office district efficiency programs around the country have been using these interventions with notable success. However, social intervention-based programs have been primarily been led by non-profits and local governments. Ratepayer-funded programs have been limited in their ability to experiment with social interventions because of the way program activities are categorized and how impacts are measured.

Smart Energy Now, a new smart metering pilot in Charlotte NC, is utilizing many of the best practices in social interventions. The program is also being measured and evaluated to the standards required for the use of public funds. The MIT Energy Efficiency Strategy Project's research was used to inform the program design, and we now are following the pilot's progress. Further research will examine the effectiveness of specific activities, and help develop a framework for a replicable program model.

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[9] Institute for Electric Efficiency, *Summary of Ratepayer-Funded Electric Efficiency Impacts, Budgets, and Expenditures.* 2012.

[10] US Energy Information Administration. *Energy Outlook.* "Levelized cost of New Generation Resources." 2011.

[11] IEE CEE *Summary of Ratepayer-Funded Electric Efficiency Impacts, Budgets, and Expenditures.* 2012. 2

The following sections of this paper detail the limitations of the traditional approach, propose a new model for social interventions, review case studies comparing the approaches, and take a closer look at the Smart Energy Now pilot. It concludes with implications for a replicable program design.

II. Limitations of The Traditional Approach to Energy Efficiency Programs

Approach. Historically, energy efficiency program design has been guided by the Physical-Technical-Economic Model (PTEM)[12] of consumption. This approach is based on the concept of the building as a single unit containing a system of interconnected equipment. The PTEM Model assumes that there is a corresponding single decision-maker who controls all aspects of energy-related investments and consumption in the building. This rational economic actor purchases energy efficiency in a perfectly competitive market. In other words, he or she makes decisions based on perfect information (such as electric rates, available technologies, investment costs, and resulting savings) and does not face any transaction costs or barriers.

Under the PTEM approach, an investment in efficiency is seen like any other kind of investment. In a typical investment scenario, an investor pays money up front in order to receive a stream of income in the future. For riskier projects, an investor will require greater returns. In the case of efficiency, a building owner would be considering investing in new equipment in order to receive energy cost savings in the future.

Interventions. The PTEM approach assumes that actors are not investing in efficiency because the returns are not sufficient given the perceived risks. Therefore, ratepayer-funded programs tend to provide two main types of interventions: technical analyses and financial support. Technical analyses are used to help owners identify worthwhile investments and feel confident that savings will be achieved. Financial support, in the form of grants or debt, decreases upfront costs and increases the return on investments.

Figure 1: Traditional Approach to Efficiency

The primary purpose of financial incentives and technical analyses is to influence the owner's evaluation of a potential investment in efficiency. Energy efficiency projects cost money up front, but generate savings that fully cover costs over time. Energy efficiency investments are therefore often discussed in terms of their "simple payback," which indicates the number of years that it takes for the savings resulting from an efficiency investment to cover the total cost of that investment. After the payback period, all ongoing savings are profits. The simple

[12] Lutzenhiser, L. "Social and Behavioral Aspects of Energy Use." *Annual Review of Energy and the Environment* 18:247-89. 1993.

payback of an energy efficiency investment is calculated as (annual savings) / (total cost), and is typically not adjusted for the time-value of money or financing expenses.

In an office building, energy-saving improvements may include equipment maintenance and system controls, lighting and office equipment, heating, cooling and ventilation, and improvements to energy-intensive uses such as data centers and refrigeration. Many efficiency projects have an almost immediate payback – they are very low cost and generate immediate and ongoing savings. Retro-commissioning projects focus on equipment maintenance and repairs and operational settings and routines. Retro-commissioning typically has a payback less than one year. It is often combined with simple measures such as lighting and control systems to achieve paybacks of 1-2 years. Retrofit projects that use savings from cheaper improvements to cross-subsidize more expensive improvements, such as upgrading heating and cooling systems, can often achieve paybacks between 5-10 years. Deep retrofits that seek to make the building as efficient as possible, and may include improvements to the building shell or windows, may have paybacks up to 20 years or longer.

Conceptually, when considering how to use his or her limited funds, an owner would compare the risks and returns of an investment in efficiency with that of other potential investments. Money could be spent on other building improvements that address capital needs or make it more attractive to tenants, reinvested into the organization's broader business (in the case of an organization that owns its building and whose main business is not real estate), or invested other financial instruments.

In fact, simple payback years can be translated into common metrics that are used to compare and evaluate the returns on many kinds of investments. The internal rate of return (IRR) calculates the annual effective compounded returns as a percentage of an investment. It can be used to compare different investments, including stocks, bonds, real estate and venture capital.

Figure 2: Comparison of Investments

Efficiency Investments	Payback (yrs)	= IRR (%)	Other Financial Markets
Retrocommissioning	1	100%	
	2	50%	
Quick-Payback EE	3	33%	High-risk, high reward investments such as
	4	24%	venture capital and real estate development
Retrofit	5	18%	
	6	14%	
	7	11%	- Average return from stock market (1970-2010)
	8	9%	
	9	7%	- Italian long term bond' "crisis" threshhold
Comprehenive Retrofits	10	6%	(Nov 2011)
(10+)		5%	
		4%	- Corporate bonds (4-7%)
		3%	
		2%	- US long term Treasury Bonds
		1%	(essentially risk-free)

Compared to other financial markets, energy efficiency is a great investment. Quick payback and retro-commissioning can achieve returns between 33% and 100% in a very short time period, which is basically unheard of in other sectors. These returns compare with the expected

returns on raw land speculation, venture capital, and some of the most aggressive and risky hedge funds. A retrofit with a 5-10 year payback is roughly equivalent to investing in the stock market, and a comprehensive retrofit is like purchasing a corporate or government bond.

When investing in efficiency, any actor could choose a payback period that matches their risk tolerance and return timeframe. Incentives further increase the returns, making all measures more attractive. A 50% subsidy cuts the payback period of an investment in half, doubling the IRR. Yet increasing incentives has not drastically increased program participation. Michaels and Ornstein write that, "The plateau of indifference in customer discount rates shows that rate of return does not affect penetration within a wide band on [efficiency] measures" [13]. So why isn't more efficiency happening?

Limitations. If a perfectly competitive market existed, we would expect far greater investment in energy efficiency than is occurring. Savings from improvements can typically pay back costs within a few years and then generate ongoing returns for the building. But overall, programs that focus on physical system and address financial barriers have had limited success – savings to date are equivalent to only 12% of the remaining cost-effective potential.

The comparison of efficiency investments to other types of investments reveals the limitations of the traditional rational economic approach. *Ensuring sufficient returns is not the problem.* Capital investments in energy efficiency are challenging because they are:

- Hard to identify and evaluate. People do not have detailed information about their own building's characteristics and performance in comparison to other buildings. By contrast, there is lots of information on publicly traded commodities such as stocks and bonds that enable people to identify a "good investment."

- Small investments with high transaction costs. Owners must spend a lot of time and effort to achieve small dollar returns. Owners must evaluate the investment options, select and oversee consultants and contractors, obtain financing, and oversee implementation. But the resulting savings may not be meaningful. Energy costs are often only 1-3% of a building or organization's total operating budget[14].

- Perceived as high risk. Owners often do not trust that equipment will perform as expected or that the full savings will be achieved. There can be large variations between building performance as predicted by a model and the actual performance after the building is constructed or a major renovation is completed. Engineers and architects often joke, "The building was perfect until you put people in it."

The challenges the building owner faces are all caused by an underlying dynamic that is overlooked in the PTEM perspective. Efficiency programs assume that efficiency investments are made in a classic competitive market, which is characterized by a single decision-maker, perfect information and no transaction costs. In reality many actors influence building operations and decisions about investments, and they also face significant information and transaction barriers.

[13] Michaels, H. and A. Ornstein. *Marketing Energy Efficiency to Commercial Customers - What Have We Learned?* ACEEE Summer Study 1992
[14] Ibid.

Measurement and Verification. The current regulatory framework and evaluation process for ratepayer-funded programs reinforces this traditional approach. Fundamentally, programs must be able to link a specific action to a predicable and persistent level of energy savings. Financial incentives and technical analyses both naturally generate a document or record of the activity. These interventions can also be directly linked to equipment purchases with predictable energy savings compared to the less efficient equipment it replaces. The activities and results of traditional interventions are therefore easier to measure. This also makes it possible to apply resource cost tests that provide a ratio of public dollars to benefits.

III. A New Model: Social Interventions

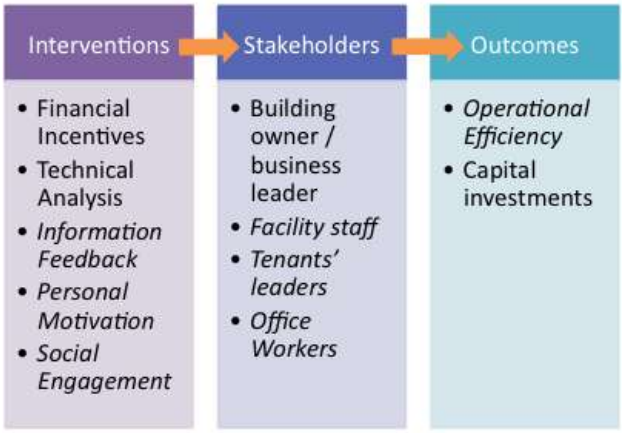
Approach. Energy savings have largely been unrealized because energy consumption is determined by the actions of *multiple stakeholders* – owners, facility staff, tenants, and office workers. These stakeholders have distinct roles and routines, control different aspects of energy use, and may or may not be responsible for related costs. Moreover, each actor faces significant *nonfinancial barriers* to efficiency such as insufficient information, high transaction costs in terms of time and effort, and an absence of reinforcement through organizational roles and social norms. An efficiency program that successfully addresses these barriers for all building stakeholders could promote collaborative effort towards efficiency and unlock substantial savings.

As part of MIT's Energy Efficiency Strategy Project (EESP), we have developed more complete paradigm of energy-related system of office building – as including physical and social systems, and facing both financial and non-financial barriers. While we are proposing a new comprehensive approach to office building efficiency at the district scale, none of the individual tactics are new. The social interventions presented in the *Community Action-Feedback Model*[15] combine proven strategies from other conservation and behavior-related efforts, and adapts them for the office building setting. The proposed strategies were identified by researching academic theories and experiments, investigating national best practices, hosting and participating in several interdisciplinary workshops, and drawing upon the professional experience of Duke Energy's Smart Energy Now consulting team.

The EESP contends that the traditional efficiency program model should be expanded to include new types interventions and to target more stakeholders, as shown in italics.

[15] Alschuler, E., K. Donnelly and H. Michaels. (2011). *A Community Action-Feedback Model for Operational Efficiency in Office Buildings.* Cambridge, MA: MIT Energy Efficiency Strategy Project.

Figure 3: Comprehensive Approach to Efficiency



Stakeholders. Office building stakeholders shape energy consumption as they go about their daily activities. Each has control over different aspects of energy consumption and related decisions.

- Owners/ Leaders set priorities for building maintenance and operations and must approve any substantial capital investment. But executive-level decision makers have differing levels of interest, priorities and return expectations for investments in efficiency depending on their business plan and their organization's culture. They may care most about increasing rents, decreasing operating costs, or green branding.

- Facility staff members have the greatest direct control over building operations and efficiency. However, staff compensation is typically not related to the building's energy performance or net operating income. In fact, facility staff members' interests may sometimes run counter to efficiency. They must typically ask permission to implement new programs or make investments. They may 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.

- Tenant organizations in multi-tenant buildings have varying levels of control over the energy systems in their space. In addition, lease structures determine how operating costs are allocated between the owner and tenant. Different lease clauses can cause a disincentive for either the owner or tenants to invest in efficiency or operate equipment efficiently. This "split incentive" dynamic underlies many owners' reasoning that they are unable to capture the savings identified through audit recommendations[16].

- Office workers can drive efficiency through changing their everyday habits. Lighting and office equipment alone can account for 25-50% of total office building consumption[17].

[16] Energy Aligned Leases can address the financial split incentive between owners and tenants.
[17] Building Energy Data Book (Oct 2009), Environmental Defense Fund (2010), DOE Energy Information Administration, Building End-Use Consumption Survey (1999)

Support from building occupants can also be crucial to successful implementation of measures such as lighting automation or changing temperature set-points. However, workers are 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. Even if they are motivated, they are unlikely to know the range of energy-saving actions that they could take, and the relative impacts of each action.

Each stakeholder faces non-monetary barriers to efficiency such as a lack of contextualized information about building performance, a complicated and time-consuming process with insufficient personal rewards, and the need to establish efficiency as a shared goal and get buy-in from other stakeholders. Efficiency programs therefore need to intervene in social system to remove these barriers.

Social Interventions. The comprehensive approach to interventions is based on research conducted last year into the non-monetary barriers to operational efficiency. The *Community Action Feedback Model* proposed social strategies to address three main barriers: information, personal motivation, and social endorsement. The barriers were identified based on research theories and research about learning and decision-making and the psychology and sociology of resource use. The strategies for addressing them were identified through case studies of efficiency programs in other real estate sectors (such as residential buildings or college dorms).

Adapted for the office-building sector, the social intervention strategies are:

- Information Feedback. Metering and benchmarking can be used to establish an energy performance *feedback loop* that provides meaningful, contextualized information about energy use. This can be combined with *education* to help better decision-making.

- Personal Motivation. Programs can provide *implementation assistance* to make the efficiency process less complicated and time consuming. *Rewards and recognition* also help motivate individuals. *Pledge and tracking systems* help people set goals and compare their progress to others.

- Social Engagement. *Shared goals* establish efficiency as a priority and help stakeholders mobilize and coordinate. Along the same lines, peer groups such as friendly competitions, green teams and professional networks provide a *shared experience* and support for actions.

Aligning social forces towards efficiency can directly result in energy savings through changes in routines, operations and purchasing practices. When efficiency is a shared priority, people are also more likely to undertake capital measures, leading to a greater private investment per every public incentive dollar.

In practice, the importance of different barriers may vary by building. But most cities have efficiency programs in place that provide some of these interventions. Therefore, in order to enable efficiency on a large scale, new program efforts should seek to identify and address the most important ongoing barriers to efficiency for specific stakeholder groups. In other words, when all resources and programs available to a city are viewed holistically, they should offer comprehensive strategies for all stakeholders.

Measurement & Verification. As discussed further, the high standards required for ratepayer-funded program design and evaluation are one of the main limitations to trying non-financial approaches. To date, it has been hard to isolate specific actions that promote operational efficiency, and even harder to connect them with savings and prove that the savings are persistent. But this does not mean that social interventions do not have energy saving impacts.

IV. Case Studies Comparing the Approaches

Case Studies. An examination of five of the most successful efficiency programs underway in cities across the country reveals that social interventions can directly result in energy savings, and increase participation in traditional technical analysis and financial incentive programs. Ratepayer funded programs such as those delivered by NSTAR in Massachusetts and NYSERDA in New York, can be used as benchmarks for success. These can be compared to three non-profit and local government-led programs that are focusing exclusively on non-monetary interventions: The Building Owner and Manager Association's (BOMA's) Kilowatt Crackdown in Seattle, ICLEI (Local Governments for Sustainability) and the City of Chicago's Green Office Challenge, and the Environmental Defense Fund's (EDF's) national Climate Corps program. A closer look at these efforts reveals interesting trends in the types of actors and partnerships that are delivering efficiency programs, the roles and resources of each, and innovative practices.

The diagram below compares programs based on the implementing entity, the types of traditional and social interventions undertaken, and the types of stakeholders targeted.

Figure 4: Comparison of Office District Efficiency Programs

Program	NSTAR	NYSERDA	Green Office Challenge	Kilowatt Crackdown	Climate Corps
City	**Boston**	**NYC**	**Chicago**	**Seattle**	**National**
Lead Implementers	NSTAR	NYSERDA	City & ICLEI	NEEA &BOMA	EDF
Key Partners	City	City	Office Depot	Utilities	Companies
Traditional Interventions					
Technical analysis	X	X			X
Financial incentives	X	X			
Social Interventions					
Information					
Information feedback		*	X	X	X
Education		X	X	X	X
Motivation					
Implementation assistance		X	X	X	X
Individual reward			X	X	
Progress tracking			X	X	
Relationships					
Common goal			X		
Collaborative efforts			X	X	X
Stakeholders					
Owner/Leader	X	X		X	X
Facility Staff			X	X	X
Tenants	X	X	X		
Occupants					X

** Benchmarking required by NYC law*

Preliminary research indicates that non-monetary interventions do have direct energy-saving benefits through changes to energy-related routines, operations and purchasing practices. Moreover, they increase the likelihood of capital investment. Yet it seems that non-profit and local government-led programs have focused much more strongly on social interventions than ratepayer-funded programs. This trend reveals a bias in ratepayer program evaluation that reinforces a focus on traditional interventions.

A description and detailed findings for each program are described below:

NSTAR. Massachusetts recently claimed the title of #1 in the ACEEE's State Energy Efficiency Scorecard. In Massachusetts, utilities are responsible for implementing ratepayer funded incentive programs, and NSTAR is an example of the best traditional incentive programs. NSTAR provides expert financial incentives and assistance with engineering and commissioning tasks for businesses undertaking energy efficiency projects. For Boston, NSTAR's incentives for existing office buildings include[18]:

- Cost-share for whole building audit, commissioning, and other technical analyses
- Retrofit program – up to 50% cost share for prescriptive rebates and up to 75% cost-share for comprehensive retrofits.
- Small Business direct install program – packages financial incentive up to 70% of project costs, with 2-year interest-free financing and turnkey services from audit through installation

NSTAR reports spending about $90M on efficiency program implementation annually, in order to achieve 191 GW of efficiency[19]. The company reports achieving a benefit-cost ratio of 4.97 for its commercial and industrial programs, meaning the benefits were approximately five times greater than the associated costs.

NYSERDA. In New York City, energy efficiency programs are primarily delivered by the New York State Energy Research and Development Agency (NYSERDA). NYSERDA is considered one of the most successful efficiency programs, and New York ranks third in the ACEEE's State Energy Efficiency Scorecard[20]. NYSERDA offers both technical assistance and financial incentives, and uses an outreach program called Focus CRE to streamline its marketing and project support services. In recent years, NYSERDA has successfully combined efforts with the city government to promote energy efficiency. New York City's Greener Greater Buildings Plan (GGBP) legislation requires that all large building owners undertake benchmarking and retro-commissioning, install tenant sub-meters, and upgrade their lighting over the next decade.

[18] "NSTAR: Electric Programs," NSTAR, accessed Dec 13, 2011. http://www.nstaronline.com/business/energy_efficiency/electric_programs/
[19] 2009 Energy Efficiency Annual Report, NSTAR Electric. P.3
[20] 2011 State Energy Efficiency Scorecard, ACEEE

NYSERDA's incentive programs for existing office buildings are primarily technical interventions in the form of financial support for technical analyses and equipment upgrades.

- FlexTech provides a 50% cost share for technical analyses including benchmarking, energy audits, commissioning and LEED accreditation studies.
- The Existing Facilities pre-qualified offering provides rebates for individual equipment purchases, and requires very little paperwork beyond receipts.
- The Existing Facilities performance-based option provides up to $0.16/kWh for annual energy savings below baseline consumption, capped at 50% of project costs.

Both NSTAR and NYSERDA's performance-based retrofit incentive programs provide rich incentives. But only large projects qualify to participate and they must model and track their energy use before and after the improvements. Because rebates are based on achieved performance, the participant also takes on more risk in their investment.

NYSERDA also has sector-based "Focus" programs that provide the social interventions needed to achieve the technical interventions. The Focus on Commercial Real Estate program provides dedicated marketing and account management services for the largest owners and managers in New York City to streamline access NYSERDA's incentive programs. A Focus CRE Account Manager works with each client firm to understand the overall real estate investment strategy for their portfolio of buildings, and incorporate all potential NYSERDA assistance and incentives into their capital investment process. Focus CRE staff also provide project implementation assistance by reviewing benchmarking and audit results, assisting with capital planning, helping to select auditors and installation contractors, and conducting tenant outreach. Yet Focus CRE is ultimately measured based on the resulting participation in NYSERDA's incentive programs.

In New York, SBC funds are allocated in 5-year tranches to a portfolio of programs called Energy $mart. The current cycle, SBC III, allocates $1.18 billion for July 2006 through June 2011, equivalent to $237 million annually. Approximately $42 million of this annual budget is allocated to the commercial programs discussed above.

Figure 5. NYSERDA Programs for Commercial Office Buildings
SBC III: July 1 6002 – June 30, 2011
Achievements through March 31, 2011[21]

	Budget ($M)	Spent ($M)	Spent (%)	Savings (GWh)	Goal (GWh)	Progress
Flex Tech	31	15	48%	543	466	116%
Existing Facilities	165	90	55%	672	576	117%
Focus*	17	12	70%	N/A	N/A	N/A
Total	212	117	55%	1,214	1,042	117%

**Includes CRE and other Focus Programs*

Note that the Focus CRE Program does not have any savings directly attributed to it. NYSERDA writes that:

[21] NYSERDA SBC Program Evaluation and Status Report 2Q 2011, Section 3

> Energy Smart Focus is primarily a sector-based energy information and services program. Energy and demand savings that may be attributable to the Focus Program are currently tracked and reported under the other New York Energy $mart programs[22].

In other words, Focus is designated as a "marketing program" with no direct energy savings because it deals with the social system and not the technical system. Reporting standards require NYSERDA to allocate savings to dollars spent, and only a portion of funds are free to be used for "market transformation" activities without directly measurable benefits.

ICLEI Green Office Challenge. The Green Office Challenge is a great example of a city government taking on a leadership role in promoting commercial building efficiency. The Green Office Challenge focuses exclusively on social interventions through a friendly competition format. The program promotes benchmarking, provides implementation assistance, and enables public recognition.

Mayor Richard M. Daley initiated the Green Office challenge as part of the Chicago Climate Action Plan, which identified energy efficiency in buildings as one of five core sustainability strategies for the city. ICLEI, the association of Local Governments for Sustainability, helped design the program and provides training and technical assistance to the participants. Office Depot also helped design the program, and is its primary funder. Ranked by Newsweek as America's greenest large retailer, Office Depot views sustainable purchasing practices as having potentially transformative impacts all the way up the supply chain[23].

The Green Office Challenge is a friendly competition for property managers and tenants[24]. The property manager program is based on benchmarking and establishes base and stretch percentage reduction goals in four categories: energy, waste, water and tenant engagement. Participants can combine base and stretch goals for different levels of achievement and recognition. Similarly, the tenant program uses a "scorecard" of 50 strategies organized into five categories: waste, energy, transportation, outreach and property manager engagement. Participants track their activities and earn points to improve their score. The reduction goals and recommended actions are closely aligned with Energy Star and LEED.

The first round of the competition was held in 2009-2010, and more than 150 property managers and tenant companies participated. Participants reduced their energy usage by an average of 7.9%, and collectively saved more than 72 million kilowatt hours of electricity, resulting in $5.1 million in cost savings.[25]. ICLEI and Office Depot are now working with local governments to roll out the program in Charleston, SC; Nashville, TN; San Diego/Port of San Diego, CA and Arlington County, VA.[26]

The Chicago program is unique in comparison to ratepayer-funded programs in several ways. The program provides social interventions, including information feedback through

[22] ibid, p.3-6
[23] Office Depot Company Press Release "Office Depot and ICLEI USA Launch National Green Business Challenge with Cities Across the Country" 4/20/2011.
[24] Chicago Green Office Challenge web site, accessed 12/13/11. http://www.chicagogreenofficechallenge.org/
[25] ICLEI http://www.icleiusa.org/climate_and_energy/climate_mitigation_guidance/green-business-challenge/local-government-green-business-challenge-programs
[26] "Chicago's Green Office Challenge Expands to Nashville, San Diego, Others" Environmental Leader 2/18/2010

benchmarking, implementation guidance, and public recognition. It also focuses on property managers and tenants as key decision-makers and implementers, and even dedicates a category on the scorecard to their relationship with each other. Finally, the Green Office Challenge is agnostic to what type of efficiency opportunities are pursued (capital investment or operating changes) so long as the ultimate percentage reduction is achieved.

Along the same lines, the program does not provide financial incentives or directly conduct technical analysis. The primary need was assumed not to be technical interventions, as people could figure out the opportunities and make investment decisions about their own buildings. Therefore, a support, guidance and recognition-focused program was used to incentivize action and resulted in significant energy savings.

BOMA Kilowatt Crackdown. Launched in 2008, Seattle's Kilowatt Crackdown is a proven example of a successful friendly competition program for office districts. Like the Green Office Challenge, the Kilowatt Crackdown tracks building performance against a baseline year. However, it is focused entirely on energy use, and uses Energy Star's Portfolio Manager as the primary tracking tool, as opposed to a point system. The Kilowatt Crackdown is a partnership between the Building Owners and Managers Association of Seattle and the Northeast Energy Efficiency Alliance (NEEA), with endorsement from the city of Seattle.

The Kilowatt Crackdown centers on annual improvement in a building's EPA Portfolio Manager benchmarking score. Program staff provides training on the benchmarking tool, workshops, technical assistance, emails and reminders, on-line progress tracking, and prizes for reaching milestones (such as updating the building's the benchmarking score monthly). Participants can also request assistance from "coaches" who can review Portfolio Manager data and assist with identifying opportunities and planning projects. If a property qualifies for the Energy Star label as a result of the contest, they receive free engineering certification and assistance with obtaining the label. The program also conducts public advertising campaigns to recognize participants. At the end of the year, awards are given in several categories according to building size, as well as best score, most improved, and climate leader (for expanding beyond energy). The grand prizewinner receives the "Kilowatt Cup" a trophy made by a local artist using entirely recycled materials. Other prizes were donated and include private suite parties at Seattle Mariners games, tickets to the BOMA golf tournament, and gift certificates to Home Depot.

BOMA Seattle is the primary brand of the program; the local BOMA chapter provides marketing and access to its membership. BOMA's Seattle is very active, and in some ways the organization sets the social norms for real estate owners and managers. The Kilowatt crackdown incorporates its efforts into regularly scheduled BOMA events and meetings. This has been a very effective recruiting strategy, as 20% of the Puget Sound office market participated in the first round of the contest[27].

However, most BOMA chapters have very low staff capacity; BOMA Seattle only has one part-time staffer[28]. Therefore, NEEA's commercial building effort, called BetterBricks, provides most

[27] "Winners of the BOMA Kilowatt Crackdown Announced," Better Bricks Press Release 5/18/2009
[28] Jack Davis, JDM Associates, conversation with author 12/9/2011.

of the day-to-day budget, resources, marketing and staff support for the program. NEEA is a non-profit regional energy efficiency organization funded by the utilities, including Puget Sound Energy, Snohomish County PUD, Seattle City Light, and Tacoma Power. NEEA works closely with BOMA to design and deliver trainings for Energy Star Portfolio Manager and the BOMA Energy Efficiency Program (BEEP), an operational efficiency program that details no- and low-cost ways to reduce energy use.[29]

The primary costs of the Kilowatt Crackdown are for implementation support, which is provided in-kind by NEEA. Like NYSERDA, NEEA is able to use utility efficiency funds' *marketing* budget to deliver the program. The Kilowatt Crackdown has also been effective in partnering with local utilities for project implementation. NEEA uses its existing communication channels with its funder utilities to update them on the progress of program participants. Utilities are notified which buildings in their service territory are participating, and in some cases benchmarking data is also shared. In some territories, staff from the utilities' energy efficiency programs follows up directly with the building contact person[30].

Because the program focuses on the building's Portfolio Manager score, it is agnostic to the kind of improvements implemented in the buildings (capital or operating). Nevertheless they have achieved notable results. The 53 properties that competed in the first round represent over 18 million square feet or 20 percent of the Puget Sound office market. The combined energy savings from these buildings is equal to the annual electric consumption of 1,000 Northwest homes or over 700,000 gallons of gasoline. Including the winner, 31 participating properties qualified for the ENERGY STAR® label; the average ENERGY STAR rating among competing buildings increased from 71.3 (Dec. 2007) to 73.9 (Dec. 2008) [31].

The program has now expanded to Portland, OR; Minneapolis, MN; Louisville, KY; Phoenix, AZ; and Charlotte, NC, and is adding new on line features such as a public status board showing progress against project milestones such as keeping data up to date an completing an audit.

EDF Climate Corps. The Environmental Defense Fund's Climate Corps has taken a different approach by targeting large organizations nationwide. EDF selects and trains MBA and MPA students and places them in summer internships at large corporations, non-profits and government agencies to develop energy efficiency plans. While this program focuses on individual organizations, it uses many of the same core social interventions and in a similar building stock and organizational context. The Climate Corps provides companies with dedicated technical analysis, project planning and implementation assistance for energy efficiency projects, while providing students with applied work experience and access to decision-makers at large organizations.

Climate Corps Fellows begin by attending a three-day training on the basics of energy efficiency, which includes guest speakers, tours of buildings' energy systems, and review of the expected

[29] "BOMA Seattle King County Extends an Energy Challenge to Office Properties," Better Bricks Press Release 9/26/2007
[30] Jack Davis, 12/9
[31] Better Bricks Press Release "Winners of the BOMA Kilowatt Crackdown Announced" 5/18/2009

deliverables for the fellowship[32]. Fellows then work with their host organization over 10-12 weeks to identify and plan energy efficiency projects, resulting in a written report and financial model. All fellows utilize a uniform project process overseen by EDF, which includes:

- Gathering data, benchmarking and auditing, and interviews with key stakeholders;
- Recommending efficiency investments and modeling their financial impact;
- Presenting the business case for energy efficiency to decision-makers; and
- Advising on project implementation strategies, including identifying operational and financial, and designing occupant engagement and education strategies.

EDF provides a *Climate Corps Handbook* to assist fellows in identifying opportunities, developing models, and creating reports and implementation plans. After the summer, fellows are asked to follow up with the host organization after six months and one year to track implementation progress and report back to EDF.

The host organization commits to paying the student $1,250 per week and covering the travel costs for the fellow to attend the training[33]. EDF's only costs are therefore program administration, including conducting the training, matching students to organizations, and overseeing their work. Fellows may list preferences for host organizations, but ultimately EDF works with the clients to finalize the placements.

In 2010, EDF placed 51 graduate students with 47 companies, including eBay, Verizon, Bloomberg, Staples, Target, Cisco, and Pepsico, among others[34]. Collectively, the fellows identified $350 million in potential net operational cost savings, representing reductions in energy use of 678 million kilowatt hours annually, or enough to power 60,000 homes. This is equivalent to avoiding over 400,000 metric tons of greenhouse gas emissions annually, or taking more than 67,000 SUVs off the road. The program also serves as an important marketing and recruiting tool for the host organizations.

Measurement and Verification. The biggest barrier to implementing social interventions is that they are hard to measure. Both the underlying logic and the measurement and verification processes of ratepayer-funded programs leads to an emphasis on traditional interventions. Programs such as those delivered by NSTAR and NYSERDA are based on the PTEM approach to efficiency and primarily provide financial incentives and technical analyses. These types of interventions are easier to measure, and are considered "resource acquisition" activities because they directly purchase a verifiable amount of efficiency in the form of upgraded equipment.

As seen in Focus CRE, strategies such as targeted education and implementation assistance are increasingly being used to increase participation in traditional incentive programs. However, they are designed and measured as complementary activities that are ultimately part of the cost of delivering "resource acquisition" programs. Social interventions are seen as "market transformation" activities, not having as direct or easily measurable savings. The bulk of funding is used for resource acquisition, limiting ratepayer programs' ability to use social approaches.

[32] "Fellow Training" EDF Climate Corps, accessed 12/13/11. http://edfclimatecorps.org/fellow-training
[33] "Details for Companies" EDF Climate Corps, accessed 12/13/11. http://edfclimatecorps.org/details-companies
[34] "2010 Fellows and Results" Environmental Defense Fund Climate Corps, accessed 12/13/11. http://edfclimatecorps.org/2010-fellows-and-results

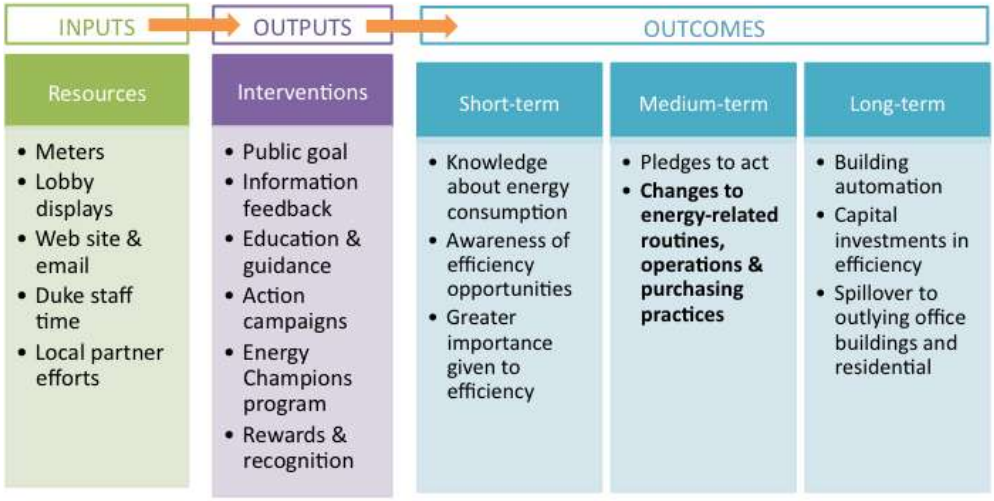
However, there is increasing evidence that social interventions do have direct energy saving benefits, and may even cost less than traditional interventions. Several non-profit and local government-led programs are focusing exclusively on non-monetary interventions. The case study programs are also agnostic to investment type, and therefore end up promoting the easiest and lowest cost actions, including operational changes. Because these programs are not accountable to public funds, they track high-level, self-reported numbers, as opposed to documenting every participant action that results in efficiency. The looser measurement and verification standards enable greater flexibility in both program activities and eligible energy-saving actions. Further research is needed to establish a direct connection between specific social interventions and energy savings so that they can be considered "resource acquisition" activities.

V. Further Research: Smart Energy Now

Smart Energy Now, a new ratepayer-funded pilot, is the first program to focus exclusively on social interventions in office buildings and to conduct rigorous measurement and verification of the results. Duke Energy aims to achieve a 5% reduction in energy consumption across Uptown Charlotte by installing advanced metering systems and providing information feedback and community engagement to promote operational efficiency. Duke Energy chose its headquarter city for the pilot because Charlotte "big enough to matter, and small enough to measure."

Program Design. Smart Energy Now is a three-year pilot led by Duke Energy. The program entailed installing advanced metering systems and public lobby displays in 63 office buildings in uptown Charlotte, totaling 20 million square feet (97% of the downtown office space). The buildings host more than 300 organizations, where more than 20,000 people work. The pilot promotes best practices in building operations, and changes in occupant routines and behavior, using the following approach:

Fig. 6: Smart Energy Now Program Logic Model



Social interventions are being tailored for each type of building stakeholder, as follows:

- Building Leaders. Smart Energy Now staff met individually with the leaders of each building while the pilot was still in its design phase to get their feedback and buy-in. Leaders were asked to commit to the goal, approve installation of the meters and lobby displays, and allow the program to engage with facility staff, tenants and office workers. Building leaders and facility staff have access to the 15-minute interval data for their building, and have a direct point of contact with a senior staff person at Duke Energy.

- Interventions with Facility Staff. Duke Energy led training sessions for facility staff covering basic typical energy consumption patterns and efficiency opportunities in office buildings, how to interpret interval data from the new meters, and incentives available from Duke Energy for capital measures. Duke Energy is now working with the International Facility Manager's Association (IFMA) and the Building Owners and Managers Association (BOMA) to establish a professional network and recognition program for facility staff, and facilitate sharing of best practices.

- Interventions with Office Workers. Smart Energy Now is designed to deliver social strategies though every interaction that office workers have with the program. Content is integrated across the web site, lobby display and engagement activities, including:
    - Shared goal. Smart Energy Now aims to unite people behind the goal of reducing downtown's energy use by 5%. The lobby display and web site also feature a ticker counting the number of people participating.
    - Information feedback. The web site and lobby displays show uptown's total consumption in understandable terms, such as miles driven or homes powered.
    - Education & Guidance. Visitors to the lobby display and web site are asked to commit to an action, such as finding a light that can be turned off permanently. The impact of each action is shown in terms of light bulb use and gallons of gas.

In the first four months, 5,000 people visited the displays and web site, and eight percent (400 people) pledged to take an action.

- Energy Champions Program. After attending a 90-minute training, Energy Champions are encouraged to implement a project or campaign in their office. This enables people to be creative and do projects that work with their office culture. The program also helps develop a social network among the Energy Champions. To date, the program has trained 400 Energy Champions.
- Action Campaigns. Action campaigns rally the community around one change at a time. The current campaign, titled "Flipping Out," aims to reduce unnecessary lighting, and will run for six weeks from February 6 to March 16. For the "Crab, You're It" game, plastic crabs were given out for people to put in coworkers' offices when the lights were left on.
- Rewards & recognition. The web site and lobby displays feature testimonials from energy champions. This generates positive feedback for energy champions and encourages dialogue. In addition, someone who pledges to act wins an ipad each month.

Outcomes. Smart Energy Now aims to have an immediate impact on building stakeholders' knowledge about energy use, awareness of opportunities, and importance given to energy efficiency. While changes in attitudes are difficult to measure, they are intermediate steps towards energy-saving actions. People are then more likely to change their daily routines, office equipment settings, and purchasing practices. Ultimately, the program is intended to build momentum towards efficiency, and lead to greater investment in building automation and capital measures. The culture of efficiency can also "spill over" to participants' homes.

Several themes relating to both interventions and outcomes have already become apparent in the first few months of implementation. First, it matters that Smart Energy Now is a community-wide effort, as it is tied to broader sustainability and economic development goals in most people's minds. Beyond this, the program has helped different buildings in different ways. Older buildings that did not have energy management systems are benefiting most from access to interval data. In other buildings, a stated goal from leadership is leading to better cooperation between departments. And other organizations are using the program as a way to increase worker engagement in sustainability. In regards to engaging office workers, interpersonal activities such as the Energy Champions program and action campaigns have been most successful. The web site and lobby display are increasingly being positioned as tools to support these efforts. Further research will explore these dynamics in more depth.

Measurement and Verification. Smart Energy Now was designed with comprehensive evaluation in mind. Baseline consumption patterns were established for the buildings, and office-building occupants were surveyed about their behavior, before the program began. Program activities are being measured by conducting surveys at the end of trainings, including a progress-tracking mechanism as part of campaigns, and asking Energy Champions to regularly report back on their projects. Ultimately, the advanced metering data is what makes it possible to isolate and verify consumption reduction. The program is also tracking resulting purchases and participation in financial incentive programs. Direct interviews and observations by evaluation staff will provide further insight.

Further Research. In the months ahead, the Energy Efficiency Strategy Project will be conducting a preliminary evaluation of Smart Energy Now, in order to provide early feedback on program strengths and challenges. We will be conducting interviews and focus groups with building owners, facility staff, Energy Champions, participants and non-participants, to understand the ways in which people have had contact with Smart Energy Now, and what actions if any they have taken as a result.

A closer look at Smart Energy Now can help establish a clear chain of causation between social interventions and reductions in energy consumption. The pilot provides an opportunity to test the success of specific program activities, identify necessary resources, and reveal the influence of contextual factors. The measurement and verification process provides insights into how social programs can be tracked in an accurate and uniform way.

VI. Conclusions

The traditional approach to energy efficiency has hit a wall. Financial incentives that make efficiency a very profitable investment have achieved savings equal to only 12% of the cost-effective potential that remains. In order to achieve scale, ratepayer funded programs must acknowledge the complex reality of multi-tenant office buildings, which have multiple stakeholders who often have limited information, time or motivation to pursue efficiency. A comprehensive approach to efficiency programs should supplement financial incentives and technical analysis with information feedback, personal motivation, and social reinforcement.

The case study research indicates that social interventions have direct energy-saving benefits. Program participants reported millions of dollars of cost savings, primarily from changes to energy-related routines, operations and purchasing practices. Moreover, some participants invested in capital measures without a financial incentive. Therefore, social interventions can be directly linked to energy savings, and should be considered "resource acquisition." The program costs needed to achieve these savings are primarily staff time and development of program materials. Therefore, interventions such as metering, benchmarking, education and implementation assistance are also likely more cost-effective than financial incentives.

However, program activities that focus on social interventions have been hard to measure and connect with energy savings. Social interventions primarily entail ongoing staff support for program administration, training, technical assistance and educational activities, creation of the web site and other program resources, and marketing efforts. These activities do not naturally result in a record of every interaction with a building stakeholder. Similarly, the resulting energy saving activities are also hard to track, as they can range from changes in occupant behavior and routines, to increased building automation, to capital investments.

Because social interventions are hard to measure, these activities have largely been relegated to "market transformation" funds, or taken up by groups that do not have the stringent reporting requirements. The challenge is therefore to find a way to measure the inputs and impacts of social programs that meets the level of accountability needed for the use of public funds. Standard practices will also enable consistent and valid measurement among programs.

The EESP's research proposes a common typology for different activities, such as education, campaigns and competitions, and green team programs. Applying the typology to different programs will support data collection, and encourage sharing of best practices, for similar types of activities. Ongoing measurement can also be built into program design in a way that reinforces activities.

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