Moving Beyond the Menu to Capture Savings from Soup to Nuts

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ABSTRACT

This paper presents the results of the first part of a research study of whole system energy efficiency programs[1] conducted for the Massachusetts electric and gas utilities. The Massachusetts utilities were interested in understanding the market barriers for energy efficiency programs that promote the optimization of individual energy end-use systems (e.g., HVAC or lighting) in the commercial and industrial (C&I) sector. While many C&I programs offered incentives for a comprehensive array of energy efficient measures and incentivize customers to achieve savings at the building level (e.g., whole building programs), most did not zero-in on exhausting all savings opportunities within an energy system. Specifically, the Massachusetts utilities were focused on programs that, in addition to the installation of energy efficiency measures, provided other services such as custom design services or operation and maintenance (O&M) actions that capture all cost effective savings for the energy system.

For this study, DNV KEMA conducted an objective literature review of whole system type programs and initiatives offered by other utilities and states. The objective of the review was to identify programs that were designed with the intent and incentives to encourage C&I customers to exhaust the energy savings opportunity within a specific end use systems. The results of this paper were subsequently the basis for conducting in-depth interviews with program administrators and stakeholders of the selected programs and to ultimately testing the feasibility of implementing similar programs in Massachusetts.

Project Background and Objectives

This paper stems from a study conducted in 2012-2013 for the Massachusetts electric and gas utilities as part of the Large Commercial and Industrial Evaluation Contract. While the Massachusetts utilities have a long history of offering prescriptive and custom programs that achieve savings both through the installation of individual types of equipment and at the whole building level, the programs had not focused on ensuring all cost effective energy efficiency equipment or O&M activities were implemented to fully optimize the energy system. The focus of this study was to identify whole system based programs and the key program design features that were successful (or unsuccessful) in overcoming market barriers to promoting system optimization and greater energy savings in the C&I market, including:

- Type of program
  - Retrofit
  - New construction
- Type of program marketing
  - Educational components for contractors and design community
  - Marketing materials or tools to target financial decision makers
- Incentive design
- Compliance and verification requirements

[1] Whole building level refers to programs that provide incentives for achieving a specified level of savings. The savings may be achieved through the installation of energy efficiency equipment across end uses (e.g., HVAC, lighting, shell measures) or within a specific type end use. However, these programs did not specific target or require the adoption of all cost effective energy efficient equipment or O&M actions that could potentially optimize the operation of the energy system.

- Type of requirement – metering, ENERGY STAR certified, Leadership Energy Environmental Design (LEED) certified, visual inspection, etc.

Program Selection Criteria

The DNV KEMA team screened approximately 35 C&I energy efficiency programs as part of the selection criteria. The information sources used for the study included:

- Database of State Incentives for Renewables & Efficiency (DSIRE)
- Northeast Energy Efficiency Partnerships (NEEP)
  - Evaluation, Measurement and Verification Forum Library
- American Council for an Energy-Efficient Economy (ACEEE)
- California Measurement Advisory Council (CALMAC)
- Social Science Research Network
- International Energy Program Evaluation Conference (IEPEC) proceedings
- Prior Publically Available Evaluation Studies

Programs that met the following conditions were then included in the literature review:

1. Met the definition, from "Whole System Design: An Integrated Approach to Sustainable Engineering":

   Contrary to a prescriptive approach to energy efficiency, which encourages optimizing single components or sets of components within a system, ***a whole system approach*** *is a process through which interconnections between sub-systems and systems are actively considered, and solutions are sought that address multiple problems via one and the same solution (Stasinopoulos 2009).*
2. Targeted to broad-based customer segments in the C&I market. Several programs that were screened offered whole system programs to manufacturers and industrial customers. However, the focus of this study was to identify whole system programs that included commercial customers, not just customers with production process applications.
3. Programs encompassed a comprehensive array of prescriptive or custom energy efficiency measures within a specific end use system. While this criterion was not unique to whole system programs, it was imperative that programs include a wide variety of energy efficiency options in order to capture the full savings within a specific end-use system.
4. Programs offered additional services beyond financial incentives such as custom engineering studies, operation and maintenance review and recommendations, etc.
5. Programs included engineering studies or pre-implementation savings modeling, but exclude retro-commissioning M&V requirements. The screening process initially included retro-commissioning programs. However, after discussions with the Massachusetts utilities and the Massachusetts Energy Efficiency Advisory Council consultant, it was determined that the study should focus on programs that undertake whole system approaches without the post-installation activities required for retro-commissioning programs.

The screening process identified ten C&I programs that met the whole-system approach criteria specified above and warranted further review.

Programs Reviewed

DNV KEMA reviewed ten C&I whole-system approach programs in seven states. These programs provide a cross section of current practices by other utilities and energy efficiency organizations. Programs details are provided in Table 1.

Table 1. C&I Programs Reviewed

State/Country	Utility/Organization	Program Name	Retrofit or New Construction	Target Market Segments
California	PG&E, SCE, SDG&E	Savings by Design: Systems Approach	New Construction	Non-residential new construction
California	PG&E, SCE, SDG&E	Savings by Design: Whole Building Approach	New Construction	Non-residential new construction
Colorado	Xcel Energy	Business New Construction Product	New Construction	Commercial buildings > 50,000 square feet
Michigan	DTE Energy	2012 New Construction & Major Renovation Program: Whole Building	New Construction and Renovation	Large commercial and industrial business customers
Michigan	DTE Energy	2012 New Construction & Major Renovation Program: Systems Approach	New Construction and Renovation	Small to mid-sized commercial business customers
Minnesota	Xcel Energy	Heating System Optimization	Retrofit	All commercial buildings
New Jersey	Statewide	Pay for Performance Program: Retrofit	Retrofit	Buildings must have had peak demand > 100 kW in the past 12 months
New Jersey	Statewide	Pay for Performance Program: New Construction	New Construction	Building must have 50,000 square feet or more of planned space
New York	Con Edison	Commercial and Industrial Energy Efficiency Program: Custom Program	Retrofit	All commercial and industrial customers
Washington	Puget Sound Energy	New Construction Grant Program: Whole-building Custom Approach	New Construction	Large, complete new commercial facilities, new additions or major renovations of over 100,000 square feet

Table 2 summarizes how each program met the screening criteria. In some cases, such as Xcel's Business New Construction program, a program may have not met each criterion but exhibited whole system design features that warranted further review and were included in the literature review.

Table 2. Summary of Selection Criteria by Program

Utility/Organization	Program Name	Broad Customer Segments	Comprehensive End Uses	Comprehensive Measures within an End-use	Promotion of Non-equipment Energy Savings Actions	Incentive Structure	Engineering Study/Energy Modeling
PG&E, SCE, SDG&E	Savings by Design: Systems Approach	Yes	Yes	Yes	Yes	Based on a per kWh kW or Mcf saved for each end use	Yes - ENERGY STAR Portfolio Manager (E*PM)
PG&E, SCE, SDG&E	Savings by Design: Whole Building Approach	Yes	Yes	Yes	Yes	Based on square footage	Yes - ENERGY STAR Portfolio Manager (E*PM)
Xcel Energy	Business New Construction Product	No - industrial excluded	Yes	Yes	Yes	Based on per kWh or kW saved	Yes - eQuest or DOE2 building simulation tools
DTE Energy	2012 New Construction & Major Renovation Program: Whole Building	Yes	Yes	Yes	Yes	Based on per kWh or Mcf saved	Yes - eQuest or DOE2 building simulation tools
DTE Energy	2012 New Construction & Major Renovation Program: Systems Approach	Yes	Yes	Yes	Yes	Based on per kWh or Mcf saved	No formal modeling only spreadsheet calculations
Xcel Energy	Heating system optimization	No - industrial excluded	No	Yes	Yes	Based on per kWh or Mcf saved	Yes - custom engineering study
New Jersey	Pay for Performance Program: Retrofit	Yes	Yes	Yes	Yes	Based on square footage	Yes - ENERGY STAR Portfolio Manager (E*PM) and post-implementation savings verification
New Jersey	Pay for Performance Program: New Construction	Yes	Yes	Yes	Yes	Based on square footage	Yes - ENERGY STAR Portfolio Manager (E*PM) and post-implementation savings verification
ConEdison	Commercial and Industrial Energy Efficiency Program: Custom Program	Yes	Yes	Yes	Yes	Based on per kWh or kW saved	Yes - custom engineering study
Puget Sound Energy	New Construction Grant Program: Whole-building Custom Approach	No - only large commercial (>100,000 square feet)	Yes	Yes	Yes	Based on square footage	Yes - building simulation study

A brief overview of each program is presented below.

Savings by Design (Pacific Gas & Electric (PG&E), Southern California Edison (SCE) and San Diego Gas and Electric (SDG&E)

The Savings by Design program offered two approaches to whole system design: a whole building approach and an individual system approach (California Public Utilities Commission 2013).

Both approaches[2] encouraged decision makers to optimize the energy efficiency of whole systems within their buildings, providing incentives to design systems that exceed the California Energy Code baseline (Hershong 2009). This program was marketed using a variety of methods including: the C&I account representatives to customers. In addition to direct marketing, information about the program was included in company newsletters and press releases, and a substantial amount of literature was available on utility websites for building owners and designers interested in the program.

Savings by Design's whole building approach required that building designers use a performance based engineering model to design a building. The model exceeded the requirements of the California State Energy Standard, Title 24 (Hershong 2009; California Public Utilities Commission 2013). This approach was most appropriate for large, complex projects; where the program's incentives reduced some of the upfront costs required for the design and modeling phase. However, for small commercial new construction projects where the expected savings were smaller relative to large customers, the cost of the engineering study even with the incentive was a deterrent for participation (The Cadmus Group 2011).

Savings by Design's systems approach encouraged designers to optimize the energy efficiency of complete systems within a building. This approach was targeted toward customers with less complex building systems such as small commercial new construction customers. Utility representatives used a basic modeling tool to estimate the energy usage of a proposed system and compared that value to a program-defined baseline system based on Title 24. Since modeling an individual system did not require developing a whole building model, it could be done either later in the design process or after other systems had been installed.

Program evaluations were completed for both SDG&E's and SCE's Savings by Design Programs. The majority of SDG&E participants followed the whole building approach while the majority of SCE participants followed the systems approach (The Cadmus Group 2011; The Cadmus Group 2008). However, the evaluation recommendations for the two utilities were similar – provide opportunities for review of the design plans early in the project development stage to allow sufficient time to incorporate modifications into the design stage and align the payment of incentives with the timing of stakeholder (e.g., design firms) involvement.

Business New Construction Product (Xcel Energy)

This program was designed to influence building owners, architects and engineers to include energy efficient systems in their designs for new construction or major renovation (Public Service Company of Colorado 2011). The building design required with a 15% reduction in peak demand compared to a baseline building compliant with ASHRAE 90.1-2004. The program provided incentives for energy modeling services, as well as payments for reduction in energy usage and peak demand compared to the baseline.

The 2006 program evaluation noted that energy design assistance was both the most cost effective of Xcel energy's Colorado programs, and had generally satisfied participating customers (Summit Blue Consulting LLC. 2006).[3] The evaluation recommended the following:

- Engage in direct marketing and in building relationships with the design community to increase market potential
- Undertake administrative improvements to streamline the application and customer incentive processes
- Clearly identify in technical reports the energy efficiency benefits for proposed design changes or measures to demonstrate the cost effectiveness of the proposal and help assure non-technical and often skeptical building owners

[2] Whole building approach permits but did not require participants to use a whole system approach to meet their savings goals.

[3] Xcel is not required to publically file program evaluations. The 2006 evaluation was the last publically available study.

2012 New Construction & Major Renovation Program (DTE Energy)

Like California's Savings by Design Program, DTE Energy's New Construction and Major Renovation Program offered two separate approaches to whole system design: a whole building approach and an individual system approach (DTE Energy 2013). Both options encouraged decision makers to optimize the energy efficiency of whole systems within a building, providing greater incentives for systems designed to be more efficient than a given baseline.

The whole building approach was intended for larger buildings in the design stage of new construction or major renovation. The program provided incentives for buildings modeled to exceed ASHRAE 90.1-2007 standards by at least 10%.

The individual system approach focuses primarily on smaller, less complex projects. These projects did not have to be in the early design stage, and the program provided incentives even when the whole building could not be modeled or if systems were designed at different times. DTE provided customers with a worksheet to calculate the efficiency of a system compared to the ASHRAE 90.1-2007 baseline. The system had to be modeled to exceed the baseline efficiency requirements by at least 10%.

Heating System Optimization (Xcel Energy)

Xcel Energy's Heating System Optimization Program was a retrofit program for natural gas customers in Minnesota (Xcel Energy 2013). The goal of the program was to increase the efficiency of the entire heating system while reducing natural gas usage. The program sought to find low-cost improvements within heating systems by:

- Performing a steam trap audit
- Optimizing condensate return systems
- Optimizing heating distribution systems
- Optimizing the utilization of heat
- Optimizing heat recovery
- Improving pipe insulation
- Preventing heat loss at vents
- Upgrading or optimizing boiler room equipment.

The program provided an incentive for building owners to undertake the system-focused study, with an additional incentive for making any suggested improvements. Further, Xcel also identified and provided any prescriptive rebates for which the building owner might qualify if equipment upgrades were identified by the optimization study.

Pay for Performance Program (New Jersey Clean Energy Program)

New Jersey offered its *Pay for Performance* program through its statewide *New Jersey Clean Energy Program*. Pay for Performance offered two separate tracks to building owners: one track for new construction and another track for retrofits (Consortium for Energy Efficiency 2011). The program's goals were to:

- Reduce the C&I sector's contribution to the system peak demand
- Build a network of energy efficiency professionals capable of delivering services to developers, building owners and their representatives
- Facilitate access to capital for comprehensive energy and energy-related improvements, funded by the New Jersey societal benefits charge and grants from the American Recovery and Reinvestment Act
- Package energy efficiency with other types of improvements such as advanced meters coupled with a real-time pricing or time of use electricity rate structure, distributed generation and renewable energy

- Improve the profitability of participating customers by implementing cost effective energy improvement measures which lower energy consumption and costs.

The Pay for Performance program offered large new construction projects of 50,000 square feet or greater incentives for building design, installation of measures and verification of the installation. Buildings were required to be 15% more efficient than an ASHRAE 90.1-2007 compliant building. The program also offered incentives for retrofit projects in buildings with peak demand of greater than 100 kW over 12 months. While the overarching goals of the program are similar to other C&I rebate programs, what distinguished the *Pay for Performance* from other programs reviewed in this study was its tying the final incentive payment to post-retrofit savings verification. The payment of incentives under the retrofit program required 15% reduction in energy based on a pre-retrofit and post-retrofit billing analysis.

Custom Retrofit Program (ConEdison)

ConEdison's *Custom Retrofit Program* was available to all commercial and industrial customers. The Custom Program focus on projects rather than on measures, with adjustments made for interactions among measures that would increase or decrease savings (Con Edison 2013). While this focus was common across other custom energy efficiency programs, the marketing and positioning of the program together with a heightened emphasis on identifying energy saving O&M activities in the engineering studies made this program unique. Furthermore, the incentive structure used a tiered approach based upon expected savings relative to pre-retrofit usage levels. For instance, energy savings of less than 10% would receive one level of incentive, while savings of 10% to 20% would receive a larger incentive payment. The program also provides incentives for natural gas savings compared to a pre-retrofit baseline.

Whole Building Custom Approach (Puget Sound Energy)

Puget Sound Energy's *Whole Building Custom Approach* provides opportunities for building owners to design energy efficient buildings and implement energy efficient systems in large, new construction projects (Puget Sound Energy 2013) . Participants in this program must be planning a building with at least 100,000 square feet. The program pays incentives to projects that are modeled to exceed energy code requirements by at least 10%, with additional, pro-rated incentives provided to buildings that are modeled to exceed the code by up to 30%.

Key Program Attributes for Whole System Programs

The key to successful whole system programs lies in administrators' ability to allocate and execute targeted marketing and technical support coupled with an incentive structure that encourages customers to undertake a broader range of measures within a system --- looking not at just the entrée but also the appetizer and dessert and nuts. The programs reviewed for this study provided insights into the design and implementation features of whole system based programs.

Target Market Segments

Segmentation of the C&I market and developing program offerings tailored to different customer segments as a very fundamental finding and one that applied to almost any energy efficiency program and certainly not just whole system programs, specifically:

- Large versus small commercial customers- Smaller customers often needed more technical support than larger customers especially those customers with experienced energy/facility managers
- Industrial process applications – Manufacturing and process applications typically required custom solutions

In order to drive customers to consider options beyond their immediate needs, whole system programs need to recognize the different motivations for equipment replacement or installation (e.g., a boiler fails on a weekend and needed to be replaced immediately versus an HVAC system was being specified for a new building), the technical expertise and financial considerations of the customer.

To fully identify and quantify the savings associated/derived from a comprehensive whole systems approach in the new construction and major retrofit markets, a detailed engineering analysis of the entire building was often required. The additional program costs incurred with the engineering analysis were typically cost effective for larger facilities where the total potential savings were greater than for smaller buildings. However, the definition of 'large' varied across programs included in this study.

For customers undergoing a smaller scale project such as replacing a single piece of equipment (e.g., chiller or boiler), whole building engineering analyses were not typically performed. Instead, a lower cost engineering analyses of a specific system (e.g., HVAC) was more appropriate in identifying and capturing whole system savings.

Program Incentives

Financial incentives to both owners and the design community helped to deepen their engagement into a whole system program. Successful whole system design programs provided building designers with incentives closely tied to their work and took several forms. First, providing A&E firms with an incentive up-front can helped to offset the cost of performing the engineering analysis and overcome the potential cost risk to the firm. Second, the incentive to A&E firms encouraged the firms to bring other projects into the program. Finally, A&E firms received incentives based upon the projected savings for the building. However, waiting until the building was completed to provide designers with payment disconnects the incentive from their work. Table 3 outlines some key findings in terms of effective incentive mechanisms or structures.

Table 3. Key Findings – Effective Program Incentives

Key Findings – Program Incentives
▪ Incentives for multiple stakeholders in New Construction/Major Retrofit Markets – Building owners and Architect and Engineering (A&E) Design Teams ▪ Additional incentives for achieving specific certifications or exceeding a performance standards such as: – Green Building Certification – LEED Certification – State or industry energy code regulation – e.g., Title 24 in California, ASHRAE 90.1-2004 or ASHRAE 90.1-2007 ▪ Incentives for completing each phase of a project such as: – Initial payment based on building square footage – Completion of engineering savings plan – Implementation of engineering savings plan – Post installation verification and monitoring - conducted 3 and 6 months after completion of project ▪ Tiered incentives with increasing incentives for higher percentage of savings

Type of Eligible Measures and Services

The new construction market provided a unique opportunity for utilities to capture whole system savings. Offering builders, design professionals, energy consultants, and owners incentives sufficient to engage their participation and requiring engineering analysis of the building systems with a focus on optimizing end use systems have been effective strategies to obtaining deeper savings. Table 4 summarizes several of the measures and services offered in effective whole system programs.

Table 4. Key Findings – Eligible Measures and Services

Key Findings – Eligible Measures and Services
▪ Engineering analysis of entire building in new construction
▪ System based studies for major retrofits/major retrofit sectors
▪ Explicit requirements to assess efficiency opportunities with other components of the end use system
▪ Required assessment of other end uses affected by the retrofit end use (e.g. lighting and HVAC)

A comprehensive whole system approach to energy efficiency was accomplished if, to state the obvious, an assessment of all components of a given end use was required. The Xcel Energy Heating Optimization Program was an example. Participants were required to examine all sub-system components to maximize the efficiency of the HVAC system and not simply replace the boiler or chiller. However, we noted that this program did not appear to incorporate the interaction effects with other end uses. To be truly holistic, a whole system program would also look at opportunities to reduce the load on the heating system through envelop and ventilation measures and include system controls such as set points, unoccupied controls, etc. to make the system more human responsive while further reducing energy use.

The ConEdison Custom Retrofit Program, was the only program that addressed the interaction effects across end uses, for example the potential interaction effects between lighting equipment and HVAC equipment. Installing high efficiency lighting equipment could alter the heating and cooling loads for a building. For new construction and major retrofit programs this effect would be captured if an engineering analysis of the entire building was conducted. However, utilities and sponsoring agencies need to assess whether or not the costs associated with the additional analysis required to quantify the interactive savings is cost effective for the program.

Program Marketing

A common theme across most programs was that the programs did not meet their participation goals. The studies indicated that the marketing of the programs was limited and relied on C&I account representatives to introduce the programs to customers. Program materials were available through utility websites, but this forced building owners to seek out the programs on their own. Account representatives' other customer responsibilities often over-shadowed the marketing of energy efficiency programs. Leveraging the relationship between account representatives and customers could be an effective means for engaging customers; however, more program-dedicated resources needed to be made available to the representatives. Expanding the channels used to market the program such a utility's web site and presentations at industry conferences or trade shows, could increase program awareness.

For new construction, construction building permit data from public and private information services, such as the McGraw-Hill Dodge Construction Data Base, can be used to target large commercial construction projects before the design stage begins.

The design community is a conduit for capturing customers into whole building programs. Successful whole system design programs build relationships with service area design teams and local building departments. Utilities that develop strong relationships with the A&E firms working in their service territories will not only increase program awareness but can work with the A&E firms to embed the program into their design offerings.

Finally, the program evaluations noted that building owners were skeptical of engaging in a whole system design process because of the additional upfront costs and potential lengthening of the implementation schedule. To address this barrier, successful whole system design programs must clearly demonstrate the lifetime benefits and costs to customers, considering not only lifetime energy savings, but also non-energy benefits such as increased tenant comfort and reduced maintenance costs. Table 5 shows the key findings regarding program marketing.

Table 5. Key Findings – Program Marketing

Key Findings – Program Marketing
▪ Develop a marketing campaign using various communication channels and dedicated utility staff
▪ Develop and leverage relationship between the utility and the design community
▪ Provide building owners with information about both energy and non-energy benefits
▪ Provide education and training for the A&E community and facility operation managers

Benchmarking and Compliance

The majority of the programs reviewed in this study did not typically require post installation verification as part of the program. New Jersey's *Pay for Performance Program*, was an exception. It required rigorous engineering analysis requirements however, the energy performance of the building was not measured after implementation. Instead, participants were required to meet the energy code and reporting requirements that apply to their building in their city or state which may have a lower performance standard than was determined in the engineering design stage. Whole system programs should examine the cost-effectiveness of requiring post-installation monitoring and verification. The key findings related to benchmarking and compliance are shown in Table 6.

Table 6. Key Findings – Benchmarking and Compliance

Key Findings – Benchmarking and Compliance
▪ Require post-installation monitoring and verification
▪ Support benchmarking as part of program design
▪ Support other entities in the promotion of benchmarking legislation

Conclusions and Next Steps

Whole system programs require different incentive structures and marketing strategies and a strong partnership with contractors and the design community (A&E firms). Establishing a strong working partnership with contractors and A&Es is critical to ensuring designs and equipment specifications fully capture the savings opportunities. Incentives serve to motivate program participants and key stakeholders to change their typical equipment purchase process. Tying incentives to milestones throughout a project can balance rewarding owners and builders throughout the implementation cycle helps to motivate parties to complete the project. While the basic components of whole system programs are the same as 'menu-based' programs, the manner in which they are implemented will impact the level of savings captured. It requires motivating parties to sit down at the table and consider all of the options, soup to nuts, and not merely opt to go through the drive through.

This study served as important first step in a research initiative to understand how to obtain deeper savings by capturing all cost effective opportunities in a specific end use system. The programs examined in this study identified the some of the key program attributes and features that need to be considered in designing and implementing whole system programs. Based upon this study, in the spring of 2013 DNV KEMA conducted in-depth interviews with the program administrators and key stakeholders such as implementation contractors to obtain their 'real-world' perspective of the programs' successes and challenges. DNV KEMA tested the feasibility of offering similar whole system programs in Massachusetts by conducting interviews with Massachusetts design firms, contractors and engineering firms who would potentially fulfill similar stakeholder roles. The final findings of this next phase of study will be completed in August 2013.

Acknowledgements

The authors would like to thank the Massachusetts Program Administrators who oversaw this study and Jennifer Chiodo, the Massachusetts Energy Efficiency Advisory Council consultant who championed this research idea. In addition, thanks to Nate Caron for his research and Ryan Barry for his review and suggestions.

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