Statewide Non-Electric Benefits Development in Massachusetts

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ABSTRACT

A statewide consensus has been developed in Massachusetts among electric utilities and non-utility parties for the uniform treatment of Non-Electric Benefits (NEBs) associated with the implementation of Energy Efficient Measures (EEMs). The purpose of this effort was to identify and quantify any ancillary benefits associated with these measures that could enhance their probability of adoption, increase their value, or possibly decrease the incentive requirements needed to foster their adoption. NEBs for both Residential, and Commercial and Industrial (C&I) measures were investigated separately but both efforts took a two-pronged approach. The initial Residential effort concentrated on establishing common algorithms for calculating NEBs currently included in the electric investor-owned utilities benefit/cost calculations for residential non low-income programs. The second approach focused on identifying any additional Residential NEBs that could be quantified and included in the benefit/cost calculations. For C&I, the benefits were initially developed for prescriptive C&I EEMs. Then an effort was launched to identify and quantify NEBs for Custom EEMs.

In all cases, the NEBs selected were to be definable, quantifiable, significant, and likely to be recognized by the user.

This paper presents the current status of the initiative along with a proposed development path for future program years.

Introduction

One of the main objectives of energy efficiency programs for electric utilities is to minimize electrical energy and power usage. Such efficiency improvements decrease the cost of maintaining a residence or operating a business. The key measure of success for these programs is the savings achieved; in energy (kWh) and/or demand (kW) achieved, as well as, the persistence of these savings over time. The savings are usually translated into dollar savings associated with the avoided consumption for the owner, tenant, or building operator. However, it is recognized that other benefits associated with the implementation of these measures exist which aren't covered by these factors. Even if the environmental and monetary benefits at the generation sites are ignored, other aspects may be significant. These other benefits can include reductions in maintenance, water usage, wastewater needs, fossil fuel consumption, arrearages, terminations and reconnections, cooling loads due to the reduced heat inputs, and potentially even insurance premiums. These benefits can account for increases in health, safety, comfort, property values, and even productivity. To recognize such factors in Massachusetts, the electric utilities have developed a uniform set of benefits to be associated with the Energy Efficient Measures (EEMs) implemented.

Formal energy efficiency programs have been implemented in Massachusetts since the early 1980s. Normally, energy efficient measures have a premium cost over the cost of the equipment required by code or installed in current practice. During the program design phase, cost effectiveness screening is conducted to assess how the value of the benefits of the EEMs

compare to the costs associated with adopting and installing the EEMs. Normally, a benefit-to-cost ratio exceeding one is required to justify implementing the program. Dollars are the common unit of measure and Non-Electric Benefits (NEBs) are additional benefits that can be to be considered in the equation. The consumer must be convinced that the EEMs are worthwhile or none will be implemented. Sometimes NEBs can be utilized to encourage consumer adoption of measures, such as with energy efficient clothes washers, where the water/wastewater savings far outweigh the benefit of the electrical savings. As the market transformation progresses, the baseline from which the energy savings are measured moves up while the objective savings decrease over time. This, in turn, pressures the benefit cost ratio downward and the program becomes less attractive. Also, although higher standards are constantly being adopted, there are physical limits to the efficiency increases that can be achieved which also limits the energy savings.

This ever-shrinking energy savings pool provides the motivation for the identification, quantification and recognition of savings, other than electrical, associated with the adoption of electrical energy efficient measures. This paper describes this process and their initial results in Massachusetts. These savings, termed Non Electric Benefits or NEBs are sometimes called Non Energy Benefits in other jurisdictions.

The purpose of this effort was to identify and quantify any ancillary benefits associated with the installation of EEMs that could enhance the probability of their adoption, increase their value, or possibly decrease the incentive requirements needed to foster their adoption. A primary difference between the Residential and Commercial and Industrial (C&I) programs involve the benefits-cost ratios of the programs and the decision criteria used by the consumer or user to decide on whether to adopt the EEMs. A Total Resource Benefits/Cost Ratio (BCR) test is used to determine which energy efficient programs to offer. Typically, the BCRs of C&I programs are significantly greater than one and do not require the addition of NEBs for program justification. Residential programs, however, typically have BCRs much closer to one and can benefit from the inclusion of NEBs. On the other hand, based on Implementation experience and focus group studies, the adoption probability of EE measures by a C&I customer often is enhanced by considering the NEBs in the payback calculation, especially when an aggressive payback period of only 2 to 3 years, or sometimes even less, is required.

NEBs Process and Criteria

The conditions differ under which the Residential and C&I sectors operate. Also, the decision processes used by the customer in choosing whether to adopt energy efficiency measures also differ between the two customer sectors. Therefore, the deliberation about what NEBs are important varies between the two sectors and is considered separately.

Residential Sector

During 2003, the Massachusetts investor owned electric utilities (Fitchburg Gas and Electric, Massachusetts Electric, Nantucket Electric, NSTAR Electric, and Western Massachusetts Electric) undertook a collective effort to review NEB values used for planning purposes. The initial Residential effort concentrated on establishing common algorithms for calculating NEBs currently included in the electric investor-owned utilities benefit/cost calculations for residential non low-income programs. The second approach focused on

identifying any additional Residential NEBs that could be quantified and included in the benefit/cost calculations. The object of the effort was to establish common algorithms for calculating NEB values to be used in the 2004 planning process.

Three types of NEB's were identified as being used by the utilities during this process; operation & maintenance (O&M) benefits, resource benefits, and laundry detergent savings.

This collaborative effort determined that an O&M benefit of $3 could be attributable to the reduced number of incandescent bulb changes resulting from the longer life of the installed efficient measure. The key component necessary to calculate this type of benefit required reaching agreement on expected lifetimes of the various measures. A typical incandescent bulb has a 750 hour life and costs $0.75 while a typical screw-in compact fluorescent (CFL) bulb life can be in excess of 6,000 hours. For direct install programs, where utilities can control the type of CFL bulbs installed, the utilities agreed to install bulbs with a 10,000 hour life and $10 cost. In programs where the utilities could not easily control the type of CFLs installed, they assumed a 6,000 life and $3 cost. (The 6,000 hour lifetime is the minimum average rated lifetime required for CFL bulbs to meet ENERGY STAR CFL specifications.) The lifetimes used by the group for CFL fixtures and torchieres are 20 years and 5 years, respectively. 20 year life for fixtures is based on the expected life of the ballast and the 5 year life for torchieres was used to reflect their portability.

The resource benefits typically relate to the fossil fuel savings due to the installation of space heating and water heating efficiency measures. Since these values are site specific they come directly from the utility vendors responsible for delivering direct install programs to the customer. There can also be additional resource benefits for reductions in water usage and wastewater disposal. The average water savings attributable to the installation of an ENERGY STAR dishwasher is 159 gallons of water and 5,445 gallons for a clothes washer. An additional NEB savings that can be attributed to ENERGY STAR clothes washers is the reduction in the amount of laundry detergent used per wash. The MA utilities assumed an additional NEBs savings of $18 based on using 33%-50% less standard laundry detergent per load.

The other Residential NEB effort undertaken was to identify any additional NEB's that could be quantified for inclusion in the benefit/cost calculations. For non-electric benefits not currently included in the utility benefits/cost calculations, the utility and non-utility party (NUP) representatives participated in a brain storming session to identify what additional non-electric benefits, if any, that could be quantified in the near term for inclusion in the 2004 plans as well as to develop a list of non-electric benefits, if any, that may require additional research. Results of the brainstorming session were grouped into three categories:

- **Category 1** – those that should be straightforward to calculate, and which could have significant impacts on measure valuations.
- **Category 2** – those that maybe possible to calculate, though perhaps difficult, and which might have significant impacts on measure valuations.
- **Category 3** – those that may be possible to calculate, and which may not have a significant impact on measure values.

The specific items identified for consideration included:

- Water Savings
- Property Value Increase

- Fire Hazard Avoidance
- Home Comfort

A search of secondary research was conducted to gather information on the topics. Ultimately, the group came to the conclusion that there was not enough information currently available to support the calculation of NEBs for increased property value, reduction in fire hazards, or increased home comfort. This is consistent with the findings from the separate C&I NEBs group.

The group focused its efforts on developing water and sewer costs to be used for calculating the value of water saved due to installing efficient clothes washers, dishwashers and domestic hot water measures.

The team utilized the "2002 Sewer Rate Survey Massachusetts Communities" and the "2002 Water Rate Survey Massachusetts Communities" published by Tighe & Bond, an engineering and consulting firm, to calculate water and sewer costs by the four investor owned utilities in Massachusetts and statewide. The surveys above summarized information from written survey responses in Tighe & Bond's database of rate information for their existing clients, the 2002 Annual Water & Sewer Retail Rate Survey published by The Massachusetts Water Resources Authority (MWRA) Advisory Board, and telephone surveys. The written survey was mailed to all communities in Massachusetts.

In both surveys Tighe & Bond provided a "Typical Annual Homeowner's Cost" for each community. They based this on a typical yearly consumption of 90,000 gallons. The average dollar per gallon was calculated then weighted by population to produce utility specific and statewide values.

Table 1

	$/ 1000 Gallons		
	Sewer	**Water**	**Total**
Statewide	**$ 0.039**	**$ 0.030**	**$ 0.069**

Starting in 2004 all the Massachusetts utilities agreed to use the statewide average value, of almost 7 cents per 1000 gallons in Table 1, when calculating the value of water and sewer savings due to the installation of water efficient measures.

Commercial and Industrial Sectors

Prior to considering the definition of NEBs secondary research was done to determine what ground had been covered. Some of the literature reviewed is listed in the Bibliography. Most of this work could be generalized as interviews with programs participants to delineate and put a monetary value range on NEBs spontaneously identified by the user or prompted by the interviewer. It was directed that the NEBs criteria in MA be more formally grounded in their technical derivation.

The implementation of C&I energy efficiency programs in Massachusetts has generated several mechanisms or tracks to facilitate the adoption of efficient equipment, beyond standard practice. In the prescriptive track, specified equipment may be adopted with pre-determined incentives. On the custom track other measures are considered and their savings, specific to the customer's application, are calculated. These calculations are then reviewed, refined if necessary,

and screened for cost-effectiveness in the implementation process. Another possibility is a comprehensive technical study of an entire facility and its energy use on an interactive basis. In any case, a decision must be made the by owner or operator to accept the recommended efficient equipment and any cost not covered by the offered incentives. In many cases, the criterion for acceptance is aggressive; a requirement for a two-year payback is not unusual. In other cases, the estimated paybacks for various projects are ranked and only the most attractive ones adopted. To be adopted the energy efficient measure must be financially attractive, i.e. the benefit cost ratio, including any incentive, must be maximized. This is the source of one of the criteria for NEBs, that the customer recognizes it as having value. If there is no such recognition it would not be included in the decision-making process and the NEB has no effect.

It should also be noted that negative NEBs are also considered. For example, the requirement for comfort heating would be increased if a more efficient lighting measure were adopted due to the decrease in waste heat. Such interactive considerations also increase the credibility of the savings to the decision makers.

As with most estimates, the savings due to energy efficient measures has some associated uncertainly resulting from the assumptions used and the parameters involved in the calculations. A second requirement, therefore, is that the NEB be significant, that is, it must be large enough in the overall savings calculation to make a difference in the possibility of project adoption regardless of the uncertainty factor. A small savings, typically less than 15% of the energy savings, especially considering the uncertainty likely involved, would be ignored by the decision maker.

A third criterion for NEBs is that it be quantifiable, in dollar terms. An oft-cited NEB is productivity increases in production or office environments. However, as numerous other studies have shown, these increases are hard to pin down in dollar terms. They may be accepted as real but not quantifiable, either on a prescriptive or custom basis. As such, they have been ignored in the current NEB formulation in Massachusetts.

Initial C&I NEBs Application in MA

The development of C&I NEBs in Massachusetts in 2003 was directed to be a statewide, collaborative effort among distribution utilities. It was divided among three (3) tasks. They first two were aimed at the prescriptive and custom tracks, respectively. The third was to suggest a possible additional study of NEBs, either passed over in the current consideration, or considered to be promising but requiring further study for creditable definition.

Prescriptive Track

As mentioned previously, the prescriptive track offers fixed incentives associated with the adoption of specific energy efficient equipment. It is applicable to both the C&I New Construction and Retrofit programs. Since detailed knowledge of the specific application is not known, the EEMs associated with the prescriptive measures necessarily assume some model for the usual case. The NEBs, likewise, assume some general common characteristics to calculate other savings. EEMs considered for NEBs include mainly lighting of all types, and lighting controls but also chiller replacements, premium motors, variable speed drives (VSD) and air compressor systems. It was judged by the working group, however, that the NEBs associated

with measures, other than lighting, had insufficient data or were too variable to yield consistent numbers.

An example of some prescriptive savings for lighting is presented is Table 2.

Table 2. Partial List of Prescriptive NEBs

Prescriptive Measure	Non-electric Benefits Present Value ($/unit)	Non-electric Benefits Levelized Annual ($/unit)	Unit	Analysis Period (years)	Source of non-electric benefits
LED Traffic Lights					
Red Balls, always changing or flashing	$ 419	$34.14	Lamp	15	Avoided Incandescent bulbs and labor.
Red Balls, changing day, off night	$ 242	$19.72	Lamp	15	Avoided Incandescent bulbs and labor.

Note that two reckonings of savings are presented; present value and annual payback While present value may be the more financially rigorous presentation, in commercial practice, payback is the more frequently used criteria in the C&I area. (Both methods require the EEM cost to complete the calculation.) The complete NEB table also includes the assumptions and calculations made to derive the savings but is too long for inclusion here.

Custom Track

If the prescriptive track does not offer the measures desired, a custom track is generally used. Where only specific measures are available in the prescriptive track, the custom track encompasses the rest of the energy efficient possibilities. As such, the number of possible NEBs is also correspondingly large. The working group considered it necessary to narrow the number of NEBs to those with the greatest commonality and the greatest monetary value. Usually third party engineering firms analyze custom track measures. A guideline on the NEBs to be considered in Custom Reviews was developed by the working group.

Table 3 lists the NEBs to be considered by these vendors.

In conjunction with this list of NEBs, the guidelines prepared for these vendors outlined what NEBs aspects may be considered and what is to be excluded. For example, negative heating impacts were to be included.

Table 3. Listing of NEBS Suggested for Appraisal on Custom Projects

	Project Level		Program Level	
NEB	Unit	Cost Basis	Tracked Unit	Cost Basis
Fuel Oil	Gallon	Customer Actual	MMBtu	Statewide
Natural Gas Heating	Therm	Customer Actual	MMBTU	Statewide
Natural Gas - Non-htg.	Therm	Customer Actual	MMBTU	Statewide
Water - Purchased	Gallon	Customer Actual	Gallon	Statewide
Wastewater	Gallon	Customer Actual	Gallon	Statewide
Labor	Annual $	Fully Burdened	Aggregated $	N/A
Material & Scrap	Annual $	Customer Actual	Aggregated $	N/A
Site Environmental	Annual $	Customer Actual	Aggregated $	N/A
Other Economic	Annual $	Customer Actual	Aggregated $	N/A

Possible Future C & I Work

A further review was performed for those EEMs for which NEBs were likely to be significant but which were difficult to quantify. These were listed and offered as a plan for further research in both the Prescriptive and Custom tracks.

For the purposes of this plan, additional NEBs were of interest to the extent that they meet all of the following criteria:

- Can be qualified and/or quantified as being recognized by and significant to the customer implementing the Commercial and Industrial (C&I) energy efficient measures (i.e., would the participant consider the NEB savings in the financial aspects of the projects decision making).
- Can be related to the measure being implemented, e.g., $ of benefit per kWh of measure savings. The dollar benefit may be a range, or, if the range is reasonably tight, an average value.
- Can be at least 15% of the dollar value of the associated EE Measure implemented.
- Can be applicable to other sites using the same EE Measures

At the time of this writing, this further research has not been initiated.

Conclusion

Both Residential and Commercial & Industrial (C&I) Non-Electrical Benefits (NEBs) have been collaboratively identified and defined on a consistent basis across the state by EE Measure. Each of the investor-owned utilities in Massachusetts used these consistent NEB values in their 2004 planning process. These have been defined using fairly rigorous ground rules. Specifically, to be considered they had to be definable, quantifiable, significant and likely to be recognized by the customer. Starting in 2004, the indicator precursors for these NEBs are being tracked as part of the implementation process. Benefit/Cost models have been run to predict the NEBs achieved with the various EE programs. In turn, goals or Metrics have been set on a portfolio level which lead to the shareholder rewards. Beside the annual energy and power savings, substantial portions of these Metrics consist of the NEBs benefits achieved.

It is interesting to contrast the varied uses of the NEBs in the Residential and C&I areas. In the residential application, the NEBs enhance the BCR of the programs, whereas in the C&I area the BCRs typically are adequate but the NEBs reduce the payback period and so enhance probability of adoption of the EEMs.

Summary

In the Massachusetts implementation, Non-Electric Benefits or NEBs have been developed to enhance the advantages of energy efficient measures recognized and foster their adoption. These NEBs are consistent among utilities, and are included in each utility's planning assumptions and Benefit/Cost calculations. In 2004 these NEBs will be tracked and have metrics or goals associated with the attainment of these NEBs.

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