# Savings from Codes and Standards Activities: Developing an Evaluation Mechanism in Massachusetts

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## ABSTRACT

Energy efficiency programs across the nation have paved the way for upgrades to statewide codes and standards with the potential to deliver substantial demand and energy savings. However, measuring the savings resulting from these upgrades and attributing them to the efforts of energy efficiency programs remains a challenge. This paper presents the attribution mechanisms being developed for Massachusetts, based on the extensive evaluation protocols used in California. Massachusetts, a smaller state with a shorter timeframe for claiming savings, has required a more streamlined approach.

The Program Administrators (PAs) of the Massachusetts New Homes with ENERGY STAR Program sought a mechanism for claiming credit for a portion of the savings provided by homes built in communities with stretch codes as well as savings from upgrades to the state code and increased compliance with both the stretch code and the state code. Under the Green Communities Act of 2008 (the Act), Massachusetts cities and towns may apply for a "green community" designation; part of this process includes adopting a stretch code requiring new homes to meet a HERS index of 65 to 70 or less. These homes are thus more efficient than those meeting minimum ENERGY STAR standards. Similarly, under the Act, Massachusetts is due to have both the state code and the stretch code updated every three years, with the latest IECC code adopted by the state within 12 months of its release, and any other efficiency measures warranted to be adopted. Activities supporting stretch codes, statewide upgrades, and compliance include supporting an infrastructure of home energy raters, conducting builder and code official trainings, and leading "town hall" discussions in communities considering stretch codes dealing with building and verification requirements.

## Introduction

The Massachusetts PAs have administered programs for ENERGY STAR qualified new homes since 1998. In addition to monetary incentives, these programs have provided support to builders with ENERGY STAR Homes through marketing materials, website listings, training sessions, and the services of Home Energy Rating System (HERS) raters. While these long-term actions may have laid the groundwork for energy savings to be realized through the adoption of more efficient building codes, the issue of attributing credit for some of these savings to the PAs arose in earnest when the Massachusetts Legislature passed the Green Communities Act (the Act) in 2008.

Two provisions of the Act are relevant to codes and standards attribution. First, under the Act, Massachusetts is due to have its state building code updated every three years, with the latest IECC code adopted by the state within 12 months of its release. Thus, the IECC 2009

building code was adopted by the state and all homes for which building permit applications are submitted after June 30, 2010 will be required to meet the new code. The Act also calls for any other efficiency measures that are warranted to be adopted. Therefore, there are opportunities for the PAs to advocate for enhancements to the IECC 2009 that would be applicable to Massachusetts.

Second, the Act further allows Massachusetts cities and towns to apply for a "green community" designation; part of this process includes adopting a stretch code requiring new homes to meet a HERS index of 70 or less, or 65 or less for homes over 3,000 square feet. In theory, all homes built in these communities will be more efficient than those meeting the current minimum ENERGY STAR standards. Cities and towns with the "green community" designation are then able to apply for grants and loans from the state, which may fund local energy efficiency initiatives. At this writing (May 2010), there are nineteen communities that have adopted the stretch code; many more are holding hearings to consider adoption.

In addition to state code upgrades and the adoption of the stretch code by local communities, a third area of potentially sizable energy savings is increased compliance with the codes in effect. Compliance has gained prominence as the American Recovery and Reinvestment Act (ARRA) calls for 90% compliance with the new energy codes within eight years as a condition for state energy program funding.

In summary, it appears there are significant energy savings that may be attributed to codes and standards activities encompassing state code upgrades, stretch code communities, and increased compliance. However, until now, the Massachusetts PAs received no credit or benefit for any activities they may have undertaken to promote code development and enforcement. In fact it could be argued that engaging in such activities penalized the PAs in two ways. First, they promoted movement of the market baseline, against which savings from their incentive-based programs were measured. Second, spending resources on activities for which they could not claim savings reduced the cost effectiveness of the programs. To correct this situation and to give the PAs an incentive for participating in code development and enforcement activities, Massachusetts needed to develop a mechanism for measuring the impact of these activities on energy saved and for attributing these savings to their efforts. Almost all the work previously done in this area involved the process used in California to determine the savings attributable to code and standard upgrades and then attribute a portion of them to the Investor Owned Utilities (IOUs).

## The California Model and Massachusetts

In 2005, California Public Utilities Commission (CPUC) contractors estimated electric energy, demand, and gas savings for 21 appliance standards (Title 20 Appliance Efficiency Standards) and 14 building codes (Title 24 Building Energy Efficiency Standards) adopted in California since 2003, with the 2001 codes and standards used as the baseline. Calculated savings began with making a first-year estimate of "Standards Gross Savings," or the expected savings due to the new building codes and appliance standards to be realized in 2006. For each code or standard, the "Standards Gross Savings" was derived from several published sources and estimated across the entire state, based on annual housing starts, nonresidential new construction, and appliance sales. "Net Savings" were then derived from first-year gross savings by adjusting

for several factors including Naturally Occurring Market Adoption (NOMAD), Normally Occurring Standards Adoption (NOSAD), non-compliance with codes and standards, and measure life. (HMG, 2005a)

"Program Net Savings" were defined as the annual electric energy (or demand or gas) savings in the market that were attributable to the Codes and Standards (C&S) Program and would not have accrued in the absence of the program's efforts. These Program Net Savings were calculated over the time period in which those savings would occur. (California IOUs administered the C&S Program to advocate for code and standard upgrades separately from their programs addressing energy efficiency in different sectors.) To estimate program net savings, there were five factors, such as the preparation of a Code and Standard Evaluation (CASE) analysis and work with various stakeholders in the adoption process, for each code and standard that received a weight and an IOU score, each on a zero-to-one scale. The weight represented the relative importance of each factor to the adoption of each code or standard; the weights for each of the five factors summed to one. The IOU score measured the importance of the IOU C&S programs for each factor. The factor scores and weights were estimated for each of the 2005 building and appliance standards by a group of IOUs, consultants, and California Energy Commission (CEC) experts. The attribution score, which determined the percentage of savings attributed to the C&S Program, was a sum of the products of the weights and scores for each factor.

The overall weighted scores had a wide variation, ranging from 34% to 95% for appliance standards and 32% to 85% for building codes. The overall weighted scores were multiplied by the net savings to derive "Program Net Savings" for each code and standard. The estimated "Program Net Savings" could account for substantial annual savings during the 2006 to 2008 program years, ranging from 9% to 15% of total IOU savings goals (HMG, 2005a).

For the 2006 to 2008 program evaluations, a modified methodology for estimation and attribution of C&S savings was used. The adjustments included a review of the technical documents that form the basis of the gross first year savings, removal of NOSAD, inclusion of a whole building performance analysis, adjustments to NOMAD, compliance rates, construction rates, and attribution to the C&S programs (Cadmus, 2009, 2008; KEMA et al., 2009; Lee et al, 2008).

The calculation of "Program Net Savings" or the attribution to C&S Programs was modified to use three factors rather than the five factors used in 2005. The three factors are as follows:

- Development of compliance determination methods
- Development of technical and cost information
- Addressing stakeholder concerns on the practicality and feasibility of meeting the standard

Data sources included surveys of standards experts, interviews of participants in the development of a particular standard, and review of public documents. All the information collected for each code or standard was summarized in a spreadsheet and presented to a Delphi panel of non-IOU researchers familiar with the adoption of energy efficiency standards. The attribution scores, again the sums of the products of the weights and scores for each factor, had less variation than in 2005 for appliance standards, ranging from 58% to 83%. However, building code attribution scores continued to vary widely, ranging from 26% to 94%.

The work done on estimating energy savings and attributing a portion to the C&S Program in California was an invaluable resource for developing an attribution mechanism for the Massachusetts PAs. However, there were numerous practical considerations to address in transferring the methodology used in California to Massachusetts. First, Massachusetts is a much smaller state; in terms of residential new construction, Massachusetts had only 12% as many new private housing units authorized by building permits as California had in 2006.[1] There would thus be proportionately lower savings for Massachusetts; it was necessary to find a way to also keep evaluation expenses proportionately lower.

The second concern was over timing. The California IOUs put considerable effort into supporting code and standard upgrades before they could claim any credit from C&S Program savings. Investments are made over a period of years, beginning two to three years before the new codes and standards are adopted; there may then be another delay of a year or so until they take effect. The savings thus do not accrue until four or five years after the initial investments, as new buildings are constructed and appliances are purchased under the new codes and standards.[2] The Massachusetts PAs could not, under the present system, simply add C&S expenses to the residential new construction programs in the hopes of receiving credit for an unspecified portion of savings several years in the future. Of particular concern was the impact on the cost-effectiveness tests when program expenses would be added in the current years, without a commensurate increase in benefits, which would appear only in later years' calculations. Another major issue was the timing. Finalization of a process for determining the calculation process and incentive levels required approval by both the Energy Efficiency Advisory Council (EEAC), which oversees the PAs energy-efficiency activities, and the Department of Public Utilities (DPU), which must approve rate matters. If the PAs were forced to wait for a fully approved authorization, program start-up would be delayed by at least another year.

While Massachusetts, at this writing, is still grappling with the details of the mechanisms for calculating net program savings, a compromise has allowed the program to start for residential building code activities. The EEAC and the PAs have accepted the concept that the PAs will receive incentives for efforts made in codes and standards. While the finalization of a calculation method based on the California model proceeds, Massachusetts PAs are now encouraged to start implementing activities that promote code development, compliance, and enforcement; and to document specific efforts so that a future case can be made for their contribution.

## Homes Built in Communities with Stretch Codes

One of the interesting questions confronting the finalization of the mechanism is how to handle activities in stretch code communities. The PAs have played a role in supporting communities that adopt stretch codes; approval of the codes and standards mechanism should give the PAs greater incentive to continue this practice in the future. A secondary problem arises in how PAs are supposed to operate their existing rebate programs in stretch communities.

[1] http://www.census.gov/const/www/C40/annualhistorybystate.pdf The year 2006 is used to avoid comparisons during the recent sharp downturn in building that particularly affected California.

[2] In fact, at the time the estimates of savings attributable to the C&S programs (HMG, 2005a) were first developed, there was no mechanism for the IOUs to claim savings for their C&S programs. The CPUC contracted the HMG report in order to inform its decision on claiming savings from C&S programs.

Arguably, because the stretch code requires all builders to build energy-efficient homes, the rebates are not responsible for the builders' actions and any rebates given in stretch code communities to builders of homes that do not exceed the stretch code requirements should be considered free riders. However, if Massachusetts wants to encourage communities to develop stretch codes, it cannot tell communities that doing so eliminates the awarding of rebates to homes that would qualify for rebates were they built in non-stretch code communities. To solve this situation, the EEAC has allowed the Massachusetts PAs to offer the same program incentives in communities with stretch codes until the end of 2011 or until the state code is updated (subsequent to the update to IECC 2009 in 2010) and claim the savings from program participants using the statewide User Defined Reference Home (UDRH). This is similar to practices in California (Budner, 2009) and on Long Island (VEIC, 2007).

The stretch code solution above raises the question of double counting. Because the existing stretch code communities were developed before the code and standard incentivization process was initiated, the PAs are not eligible to include their development in future savings claims. However, savings from any new stretch code community that the PAs helped to develop would be claimable. Therefore, in the future it will be necessary to net out savings that are already claimed via direct program involvement such as the existing rebate program. Because program elements and code requirements do not perfectly align, there may be cases in which some portion of a home's saving may be claimable under each mechanism. For example, homes in stretch code communities do not need to meet certain requirements of the PAs' rebate program, such as mechanical ventilation. It is also recognized that stretch code communities should not be included in the establishment of the next new construction baseline or the UDRH.

## Promotion of Code Upgrades

Attribution mechanisms for the promotion of statewide code upgrades and compliance efforts, in both cases, use a Delphi panel consisting of five individuals (the same individual may serve on multiple panels) to consider the relative importance of several factors in generating the savings, as well as the PAs' relative contribution to those factors. The panels will thus estimate both factor weights and factor scores. As in California, factor weights measure the relative importance of each factor and need to sum to one for all the factors considered for each category of savings. The factor scores, which range between zero and one, represent the relative contribution of the PAs' efforts in achieving each category of savings, recognizing that other organizations are also involved in advocacy or compliance efforts. The attribution score is the sum of the products of the weights and scores for each factor or:

$$\text{Attribution Score} = \Sigma\ (FWi * FSi)$$

where:

$FW_i$ = factor weight for factor $i$

$FS_i$ = factor score for factor $i$

The savings generated through code upgrades or increased compliance may then be multiplied by the attribution score to obtain the savings allocated to the PAs.

The Delphi process involves having each panel member develop weights and scores after reviewing all applicable materials followed by sharing the weights, scores, and justifications in

an attempt to reach consensus; if the panelists cannot agree, an average is taken, dropping the highest and lowest values. Desirable attributes of the Delphi panel candidates include:

- Independence
- Experience in the residential new construction market
- Long-term familiarity with the Massachusetts New Homes with ENERGY STAR Program

The Delphi panelists will be provided with extensive documentation of the Sponsors' activities affecting savings. For state code upgrades, this documentation may include but not be limited to:

- Lists of training sessions held for builders, subcontractors, and code officials
- Letters of support and testimony provided for code upgrades
- Engineering studies of the expected savings and costs of proposed upgrades
- Input from different stakeholders affected by code upgrades
- Documentation of activities such as town hall-type of discussions supporting communities adopting stretch codes; these communities provide real world data on the effects of code upgrades

The proposed attribution mechanism for upgrades to the state code uses factors similar to those currently used in California since, in both cases, taking the initiative by providing research into technical requirements and costs is necessary. Three proposed factors for attribution of savings from upgrades to the state code are presented below; the bullet points under each factor list examples of activities for which the PAs may get credit.

**Factor 1) Provide Technical and Cost Information**

- Support the research and development and/or demonstration of potential technologies or techniques that lead to inclusion in new codes.
- Estimate energy savings and, if applicable, peak demand savings through engineering studies and updated baselines
- Document the incremental cost of the measure over baseline practices
- Document the measure's cost-effectiveness

**Factor 2) Promote Compliance with the Upgrade**

- Provide builder, subcontractor, and code official trainings
- Develop reliable test methods for compliance with upgrades to the code

**Factor 3) Document the Feasibility of Meeting the Upgrade**

- Analyze the general market readiness of builders and the appropriate subcontractors to meet the upgrade

- Document market readiness, such as availability of products to meet the upgrade, market penetration, and homebuyer acceptance
- Document the PAs' contributions to market readiness, such as builder and sub-contractor readiness to comply with the code upgrade due to the PAs' previous training programs
- Document experiences with the upgrade in stretch code communities and the support provided by the PAs in helping communities adopt the stretch code
- Respond to stakeholder concerns about the costs of compliance

## Compliance Enhancement

As was noted previously, under the Green Communities Act, Massachusetts is due to have both the state code and the stretch code updated every three years. With each code update, compliance with the state code and stretch code may be low due to lack of understanding and knowledge on the part of code officials, builders, and sub-contractors. Compliance can be expected to increase gradually over time as the building community becomes more familiar with the code and methods of compliance. Therefore, the PAs may play a vital role in supporting compliance enhancement programs that improve compliance with both the state code and the stretch code at a faster rate than would normally occur and thus yield substantial energy savings. Examples of compliance enhancement programs include training and education programs, enforcement programs, and incentive programs.

Programs to improve code compliance could be developed to target an individual building measure or section of the code (ostensibly for building measures for which there is poor compliance) or programs could target improved compliance with the overall code. Programs for specific building measures could target a wide range of actors, such as builders, sub-contractors, suppliers, retailers and building inspectors. In contrast, programs to improve overall compliance may be directed at building departments.

In order to measure the effects of a compliance enhancement program, pre-program and post-program rates of compliance will need to be measured at the state level for statewide code compliance efforts and, quite likely, at the community level for efforts that target stretch code communities.[3] A possible confounding effect in the measurement of increased compliance is the dramatic drop in the number of housing units permitted in Massachusetts—a 71% decline between 2005 and 2009[4]—along with an increase in the proportion of all homes that are ENERGY STAR-certified. It may be that borderline builders—those barely or not meeting energy code—have dropped out of the market, resulting in a more than natural trend in improved compliance. If these marginally compliant builders return when the housing market picks up, they may have a negative effect on overall compliance rates.

In contrast to the promotion of code upgrades, there has not been a model for attribution of savings due to compliance enhancement activities by the PAs. The proposed attribution mechanism for compliance enhancement programs uses factors based on the type of program deployed by the Sponsors: training and education programs, incentive programs, enforcement programs, or other programs. The Delphi panel will need to weigh the relative importance of the PAs' activities for the savings due to each factor in improving code compliance while also

[3] For compliance enhancement programs that target stretch code compliance, compliance rates measurements will need to include control communities that have not enacted stretch codes.
[4] http://www.census.gov/const/www/C40/table2.html#monthly

considering the weight of unrelated factors—such as the exodus of marginal builders—that may contribute to naturally improving code compliance. The potential factors for attribution of savings from enhanced code compliance are presented below; the bullet points under each factor list examples of activities for which the PAs may get credit.

**Factor 1) Training and Education Programs**

- Training of builders, subcontractors and trade allies
- Training of building departments and code officials
- Educational programs that improve customer or trade ally awareness of the code and need for compliance

**Factor 2) Incentive Programs**

- Supporting an infrastructure of HERS raters who can provide performance testing for different homes
- Providing incentives for homes that comply with the energy code

**Factor 3) Enforcement Programs**

- Taking enforcement actions against non-complying properties

## Conclusions

The Massachusetts PAs plan to expand codes and standards activities in the following three areas over the next three years (Cape Light Compact et al, 2009):

- Identifying desirable changes in the Massachusetts building code and, in consultation with key stakeholders, helping develop technical analysis and providing testimony in support of these changes.
- Supporting individual communities considering adoption of the Stretch Code including development of compliance documents with other stakeholders and trainings for builders, architects, and code officials on the Stretch Code.
- Expanding training for building and design professionals and code officials addressing code compliance, and highlighting measures and practices that go beyond code requirements and/or are promoted by the PAs' program offerings.

These activities represent new ground for the Massachusetts PAs. While an attribution procedure and mechanism has been outlined in this paper, the actual implementation of the concept presents challenges. In California it has become increasingly complex. Massachusetts cannot justify the same expenditure level and will need to balance rigor with potential benefits. The challenge lies in finding the right balance so that the PAs are willing to risk expending effort and dollars in activities that will bring lasting and cost-effective energy savings, and so that regulators can differentiate between real effects and those changes that were not influenced by PA activities without creating an evaluation process that cripples the whole mechanism.

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