Evaluating Code Compliance Enhancement – A Love Story

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ABSTRACT

As part of the American Recovery and Reinvestment Act of 2009, energy program grants were offered and accepted by states, contingent upon adoption and enforcement of the most recent residential and commercial building codes at the time (IECC 2009 and ASHRAE Standard 90-2007). With this mandate, national model codes have been adopted across the country. Since then, the focus for many agencies has centered on improving compliance with these new codes.

This paper explores the evaluation approach for a utility pilot program by Xcel Energy that offered energy code compliance training, specifically focusing on how the DOE Building Energy Codes Program (BECP) protocol can be used to collect meaningful data that will enable the measurement of the change in compliance rates and associated energy savings, as well as how to attribute those savings to the specific training and education efforts of the utility program.

Each jurisdiction selected for this pilot received a personalized training plan, based on their needs and interest, which was developed simultaneously with the baseline assessment of current compliance strengths, struggles, and goals. This baseline assessment used a modified version of the BECP protocol, recording current practices/efficiency levels in addition to an indication of compliance or non-compliance with the code currently in effect.

We address the inherent need and importance of conducting this evaluation effort simultaneously with the program implementation. Additionally, we discuss the need for compliance studies to both set the baseline, and assess the impact of the program. We discuss the issues encountered, and solutions proposed, from our efforts to translate compliance information into a measure of energy savings. Lastly, we provide recommendations for how other utilities can incorporate energy code programs into their efficiency portfolios.

Introduction

There is a fine line between code compliance and non-compliance. This is the story of how to find that line and paint it thicker so that everyone can see it.

Xcel Energy of Colorado hired Colorado Code Consulting LLC (CCC) to develop and implement personalized energy code training for six (6) jurisdictions that volunteered to participate in the pilot. The Heschong Mahone Group[1] (HMG) was hired to conduct the evaluation of the pilot, focusing on two key questions:

1. Can the education and training efforts to increase compliance with the building energy code produce measurable savings that are attributable to the utility?
2. Can the DOE Building Energy Codes Program (BECP) protocol be used cost-effectively to evaluate the impact of the utility-funded Code Support pilot?

The evaluation portion of this pilot commenced simultaneously with the implementation contractor beginning work on the project and meeting with jurisdictions to establish specific training needs. This allowed the implementer and evaluator to coordinate on the data collection approach before

[1] On January 1, 2013 the Heschong Mahone Group was acquired by TRC, becoming a part of the TRC family of companies.

any training had been administered, planning a thorough and thoughtful approach to collecting the baseline information.

The timing for this type of evaluation is extremely important. The pilot kickoff was in the spring of 2012, which allowed time during the summer to develop the training and evaluation plans, before the trainings commenced late in the fall (after the conclusion of the busiest construction time of the year). Winter is the slow part of the year for construction, and this pilot was designed to take advantage of that available time to administer trainings to building department staff, contractors and Home Energy Raters (HERS raters) during their down time, and to evaluate the impacts of those trainings in the spring when construction picked back up.

The DOE BECP protocol provides compliance checklists that were used by both CCC and HMG in their data collection efforts. CCC and HMG collaborated on the data collection, with CCC collecting baseline information that would be used for developing the training plans, as well as the baseline data for evaluation against the post-training data. The BECP protocol was chosen for evaluation, as it is the current national standard for determining compliance with the International Energy Conservation Code (IECC).

Jurisdictions fell into two categories in terms of their participation: those receiving training that would increase compliance with the codes in their jurisdictions, and those receiving training in other code related areas, including the potential impacts of advancing to a new, more stringent code, or training inspectors to become certified in energy codes. The baseline code and type of support provided in each jurisdiction is presented in Figure 1. The focus of the evaluation and this paper are on the activities and results in Jurisdictions A, B, and C.

Jurisdiction	A	B	C	D	E	F
Current residential code:	2009 IECC	2009 IECC	2009 IECC	2009 IECC	2006 IECC	2009 IECC
Type of Support provided:	Train plan reviewers and field inspectors	Train plan reviewers	Train plan reviewers and field inspectors	Train inspectors to become certified in energy codes	Training on 2009 and 2012 IECC to support adoption	Develop code amendments to support adoption of 2012 IECC

Figure 1: Code baseline and support provided per Jurisdiction

Background

Home Rule State

Colorado is a home rule state so no statewide energy code exists. Local enforcement agencies in jurisdictions that have adopted building codes are required to enforce the provisions of the energy code at the local level, but may adopt their own energy requirements without state approval. Inspections are required as a part of the established building inspection process. Therefore each jurisdiction participating in this pilot could have a different energy code being enforced, each with unique submittal requirements.

Each jurisdiction has its own design criteria for sizing residential equipment according to ACCA Manual J[2]. Most building departments have a "submittal guideline" that identifies what needs to be submitted with the plans in order to obtain a permit. Many of these submittal guidelines are either out of date or simply do not address the energy code provisions. Designers and contractors need access to

[2] ACCA Manual J Manual J Residential Load Calculation 8th Edition (MJ8) produces equipment sizing loads for single-family-detached homes, small multi-unit structures, condominiums, town houses and manufactured homes. For more information please refer to the Air Conditioning Contractors of America: https://www.acca.org/store/product.php?pid=172

jurisdiction specific information, however the submittal requirements are not always easily found on the building department's website.

Opportunity

Recently, Colorado passed legislation requiring the 2003 IECC as the minimum energy code for all jurisdictions that adopt and enforce codes, but there is no requirement for every jurisdiction to adopt or enforce energy codes. Some jurisdictions have updated their existing codes to comply with the state requirement, but lack real enforcement of the energy code. This lack of enforcement is generally a product of lacking the time or understanding to enforce the code. The Colorado Department of Local Affairs (DOLA) has recognized this and offered free trainings to jurisdictions around the Denver region. However, there is a wariness of working with the state, as some jurisdictions are worried the state might "snoop" on their codes and enforcement processes. Additionally the local International Code Council (ICC) chapter holds meetings every other month, providing code training to local members. National training is expensive; the local ICC chapter gets one free training day from National per year. When a jurisdiction is getting ready to adopt a new code, the local ICC chapter often hires firms such as CCC to provide trainings. Building Owners and Managers Association International (BOMA) has also recently begun requesting training on the energy code. Despite these efforts, the demand for increased trainings on codes remains unfulfilled. Xcel Energy recognized the opportunity to support local jurisdictions to increase the energy efficiency of their buildings, and commissioned this pilot to determine whether energy code training can result in attributable savings, justifying the use of ratepayer funds.

Most homes being constructed in these pilot jurisdictions (almost 90%) utilize the Performance Path[3] as their approach to complying with the IECC. As a result, HERS raters play a large role in enforcement of the energy code.

Implementer selection

CCC has worked on education and technical code assistance with Colorado jurisdictions for several years. Part of the reason CCC was selected to implement this pilot was their experience and familiarity with building jurisdictions, having provided energy code trainings on behalf of ICC previously. Training plans for the pilot were developed based on feedback/self-assessment from the jurisdictions about the areas of code with which they desired assistance. Through several meetings with building officials, plan reviewers, inspectors, HERS raters, contractors and designers, CCC was able to evaluate standard practices and the level of enforcement taking place in each jurisdiction.

Evaluation Approach

The plan for this pilot was relatively straightforward: compare estimates of the compliance rates before and after Xcel Energy trainings were administered. Training plans were customized to the needs and desires of each jurisdiction. The evaluation approach mirrors that customization, with data analysis focused on specific training topics. The data collection and sampling approach across all jurisdictions was to collect all of the available inspection data using the BECP[4] compliance checklist. Whole building compliance rates could then be applied to the expected energy savings of the local code being enforced, based on existing studies. Additional analysis of the impact of targeted areas of the code that were emphasized during the trainings would also be possible with a subset of the same data.

[3] An energy code's format can significantly influence design, sometimes more than the actual requirements. A prescriptive code clearly states what applies, but may limit design freedom and foster the view that the building is composed of separate, non-related systems. A performance-based code provides more design freedom and can lead to innovative design but involves more complex energy simulations and tradeoffs between systems. More information is available at: http://www.energycodes.gov/resource-center/ace/compliance/step2

[4] More information is available at: http://www.energycodes.gov/compliance/evaluation/checklists

Methodology

The original plan was to collect data for both commercial and residential projects. It became clear early on in the process that very few commercial projects were available for review, and clearly not enough to allow a sample of similar pre- and post-training buildings and permits. As a result, only residential projects are included in this evaluation.

CCC provided training for residential plan reviewers, building inspectors, builders, designers, and contractors with the goal of receiving better plans with fewer resubmittals. CCC collected data from each jurisdiction including: training plan (who needs what training), training provided as part of this pilot, local contact information, who attended the training sessions, who needed IECC guidebooks, who received training documents, and the list of participants completing the training survey.

The emphasis of the training across jurisdictions was on documentation consistency so that plan reviews are more efficient and complete information is available for field verification. As an example, the training brought together HVAC contractors and HERS raters, and explained the importance of consistency in values used in both the Manual J load calculations and HERS reports, such as conditioned floor area, insulation values and glazing U-factors. The HVAC load calculations, based on ACCA Manual J, could potentially lead to appropriate (reduced) equipment sizing installation if based on specific and correct information.

There are two distinct phases of data collection: the baseline (pre-training) and the post-training phases. Each jurisdiction received training at differing times between October 2012 and March 2013, while the post-training data collection effort spanned February to April 2013; so the timeline for the baseline and post-training phases was different for each jurisdiction. Three distinct stages of code enforcement and compliance were identified as possibly warranting training and education to lead to increased code compliance; 1) submittal process, 2) plan review and 3) field inspections. Not all jurisdictions were trained in each area, but a baseline assessment of the status of each of these areas was prepared for each jurisdiction. Baseline data about the submittal process was collected by CCC, relying on interviews with building department staff in each jurisdiction and publicly available documents related to submittal requirements on their websites. Baseline assessments of the plan review and inspection processes were completed by CCC using a modified version of the BECP 2009 IECC Residential checklist, recording current practices in actual projects, including an indication of compliance or non-compliance with the code currently in effect (the 2009 IECC).

The post-training data collection effort was limited to the three jurisdictions participating in the pilot where the impact of the trainings was expected to produce measurable results[5]. HMG coordinated with HERS raters and building department staff at each jurisdiction to accompany inspectors on field inspections and collect data to fill out the BECP compliance checklist. Field inspection data was supplemented by information provided on plans, compliance documentation and/or Manual J submittals for those projects when available.

Due to the condensed timeframe of this pilot and the inherent time lag between plan submittal, review, construction and inspection, most projects that received field inspections as part of the post-training data collection were based on plans that had been reviewed prior to the plan reviewer training. Therefore, there was not sufficient opportunity to collect field data from a project that had gone through the plan review process after the plan reviewers in that jurisdiction had received training as part of this pilot. One jurisdiction was able to conduct field inspections of projects whose plans had been recently reviewed due to their unique permitting process, which allows permits to be issued prior to the completion of the energy code compliance review.

[5] Only three jurisdictions received training on enforcement and compliance with the 2009 IECC. Other jurisdictions received training regarding adoption of a new code, or training to become certified energy inspectors.

The DOE Building Energy Codes Program has developed standard compliance checklists for conducting building evaluations based on a review of the plans and actual construction in the field. The Score+Store™ tool is available to aid states and local jurisdictions store, measure and report compliance with their building energy codes as part of a compliance evaluation. The tool also automates the reporting process, helping to align data gathered across states and local jurisdictions. After the data were collected, they were input in the Score+Store™[6] online database tool to calculate the compliance rates of the projects sampled.

Piloting the Building Energy Codes Program Compliance Evaluation Protocol

As stated previously, one of the main goals of this pilot was to determine whether the DOE Building Energy Codes Program approach for measuring state energy code compliance could be used to evaluate the impact of a utility-funded code support program.

In the field, it is extremely rare that one project will be available for plan review and inspections at all of the right times in order to fill out every line of the checklist. Therefore, related information from similar but different buildings can be combined to create a snapshot of the building practices and energy code compliance in a particular jurisdiction over a specific time period.

In every jurisdiction there are three paths to compliance with the energy code: prescriptive, trade off, and performance. The Score+Store™ data collection checklist is designed to be generic enough to be used with any of these compliance approaches.

The approach to identifying a building sample for evaluating this pilot was more relaxed than the BECP protocol recommendation, and looser than most evaluation requirements. A "catch-as-catch-can" approach to collecting project data was taken to gain as much data as was available within the time limit for the pilot. Our minimum goal was to collect data for at least three single family new construction projects in each jurisdiction. The resulting checklists were input into the BECP Score+Store Tool, which estimates a compliance rate for each checklist input, and then an average compliance rate across all of the data uploaded. The compliance rate is calculated based on points earned for measures that are compliant, divided by the total points possible for all measures observed. These results, while not statistically robust, provide a snapshot of the compliance rate with the energy code.

Benefits of Trainings

HMG compared pre- and post-training results, at both the plan review and field inspection level, to find indications of improved code compliance as a result of the training. We examined how procedures changed as a result of the training, which can produce long term code compliance improvement and energy savings that do not show up in this short term evaluation of compliance rates.

While our quantitative evaluation results are statistically inconclusive as to whether energy code support and training result in direct energy savings, there are nevertheless real and valuable benefits to a code training program. Based on discussions with building department staff and energy code trainers, there is a perceived need for additional education and training on energy code requirements for both the building department staff and the building community, including designers, contractors and HERs raters; to provide them with the resources and the confidence to meet the code. The theory is that in the long term, increased knowledge and understanding of the code by the entire design community, including building department staff, will result in greater attention to building energy code requirements.

There is also a need for on-going and sustained training opportunities with the plan review process. Training and education are needed to increase core knowledge of specific items, such as use of

[6] More information is available at http://www.energycodes.gov/compliance/evaluation

proper climate data and how to review Manual J. Increased understanding of code, ACCA Manuals J, S and D, and energy documents will improve the confidence, speed and efficiency of plan reviewers.

Currently, the industry uses standard rules of thumb for HVAC equipment sizing and oversizing safety factors. These practices are very slow to change, despite the IECC requirement to use ACCA manuals J and S to size and specify HVAC equipment. There is not enough consistent data about design and construction to determine with any confidence that the equipment size 1) is based on the load calculations or 2) would result in reduced equipment sizing even if the load calculations were followed. Understanding and enforcement of the code requirements by the building department staff is the first step in the long process of changing current practice to achieve better designed systems.

There is a general lack of field knowledge of energy code requirements. Field inspections tend to rely on the HERS rater for the energy code elements of the inspection, while some mandatory elements of the code are not checked or used by raters to calculate the HERS score. There is an opportunity to provide additional field training. Improved field knowledge will result in better understanding of energy compliance documentation and the approval process.

Our follow up conversations with trained building department staff suggests that better training of staff will increase confidence, allowing them to request additional information from builders. Once builders know that the building departments are requiring complete energy compliance submittals and they understand those requirements, they will submit complete and consistent documentation. These two inter-related efforts will produce better overall code compliance.

Compliance Rates

An important goal of this evaluation study was to determine whether the training provided to the jurisdictions made any difference in the compliance of specific measures, and whether compliance with the 2009 IECC improved overall. During the course of the data analysis, the evaluators concluded that without substantial information on compliance rates, and the compliance rate improvement, it would not be possible to conclusively determine the overall improved compliance rate nor to estimate potential energy savings. The BECP Score+Store™ tool was used to develop an estimate of the overall compliance rate based on the limited data that we were able to collect during the study period. However, the evaluation is unable to answer several key questions related to HVAC load calculations and equipment sizing due to the lack of documentation associated with those requirements. The majority of the data collected is related to insulation R-values and glazing U-factors. Some of the projects did include ACCA Manual J (Manual J) documentation, which allows for a review of the HVAC load calculations, but that information was often unavailable at the project site. Particularly during the pre-training data collection, field inspections were rarely accompanied by Manual J documentation of the load calculation, precluding the ability to assess whether equipment installed on site matches the plans. This remained an issue during the post-training assessment, but additional effort was expended to acquire Manual J documentation for projects inspected in the field whenever possible.

The compliance rate with the 2009 IECC is based on the measures that were observable at the time the data were collected, which depends on the phase of construction. The values given for each site are based on a point scoring system, and a comparison of the points awarded versus the points possible. The points possible are based on the specific measures observed, weighted by their expected impact (Tier 1, 2, or 3). For example, a Tier 1 measure such as verifying that the HVAC equipment is sized per ACCA Manual S, based on loads per ACCA Manual J, has more weight than a Tier 3 measure such as verifying that building cavities are not used as ducts or plenums, and is therefore awarded more points for compliance. Figure 2 shows the weighted overall compliance rate for each jurisdiction, pre and post-trainings. The number of sites that provided the data that make up that compliance rate is also included in the table. The compliance rates presented in Figure 2 are weighted according to the number of points possible (total measures observed weighted by impact) for each site in the sample.

Jurisdiction	Pre-Training		Post-Training		Change in Compliance Rate
	Number of Sites	Weighted Overall Compliance Rate	Number of Sites	Weighted Overall Compliance Rate	
Jurisdiction A	13	90.5%	13	95.3%	4.8%
Jurisdiction B	13	87.0%	9	92.8%	5.8%
Jurisdiction C	6	96.3%	11	93.7%	-2.6%

Figure 2: Summary of Weighted Overall Compliance Rates Pre- and Post-training

Due to the small sample sizes, confidence in the compliance rates being reported is very low. Additionally, the compliance rates being reported are relatively high, ranging from 87.0% to 96.3%. These compliance rates are calculated based solely on measures that were observed at the time of the evaluation. Measures that were not observable are not considered in the calculation of the overall compliance rate, and therefore do not improve or penalize the compliance score. Consequently, these results should be considered illustrative, and may not necessarily be representative of general practices in each jurisdiction or the state.

Energy Savings

The most accurate methodology to estimate energy savings would involve developing an energy simulation model using the weighted average input values from the pre-training survey and comparing the energy use with a model of the same prototype building using the values from the post-training survey of projects. The savings between these two scenarios could then be scaled up to reflect the level of construction activity. However, the pilot study evaluation did not have the time or the resources to conduct such an in-depth calculation approach.

We used an alternative approach assuming the whole-building compliance rate to be a reasonable proxy for the percent of total energy savings being realized via energy code compliance. For purposes of this calculation, non-compliant measures were assumed to be compliant with the 2006 IECC instead of the 2009 IECC. Figure 3 provides the estimated annual energy savings per single family house in each jurisdiction based on the change in compliance. Values of energy savings associated with the 2009 IECC were obtained from the BECP Colorado Residential IECC report.[7] According to the report, residential buildings built to the 2009 IECC save 9.3 percent of energy costs compared to those built to the 2006 IECC. This equates to savings of approximately 394 kWh and 105 therms per house per year.

Jurisdiction	A	B	C
Compliance delta	4.8%	5.80%	-2.6%
Savings (kWh)	18.9	22.9	(10.3)
Savings (Therms)	5.0	6.1	(2.7)

Figure 3: Estimated Annual Energy Savings per Single Family House per Jurisdiction

[7] http://www.energycodes.gov/sites/default/files/documents/ColoradoResidentialCostEffectiveness.pdf

The results for Jurisdiction C exemplify the challenges of this pilot evaluation. Perhaps more important than the sample size of the pre- and post-training samples, is the focus on which measures were evaluated as part of that sample. The provision of construction drawings and documentation demonstrating energy code compliance is the first requirement on the BECP checklist and provides the basis of information to answer subsequent questions; yet the pre-training sample frequently lacked sufficient documentation or information to conclusively answer this question. However, because the BECP protocol does not penalize projects for having specific information unavailable, the absence of data from the pre-training sample appears to have artificially boosted the compliance rates for Jurisdiction C during that timeframe.

While quantification of the savings from the improvements in code compliance are possible, we are reluctant to attribute these savings to the pilot. The explicit link between the improvements in compliance and the training provided is not possible based on the limited data collected. We reach this conclusion primarily because, as stated above, the training pilot actually needed to provide training on fundamental review and consistency of documentation, which is a pre-cursor to actual improved compliance and verification. Continued training of these and other jurisdictions will allow for improved compliance and proper documentation that will allow for better compliance verification. Additionally, the condensed timeframe of the pilot did not allow for sufficient time to evaluate projects that were constructed based on plans that had been reviewed after the plan reviewers received training. Furthermore, competing trainings provided by the State or entities other than Xcel Energy were not fully vetted during the evaluation, which would affect the attribution of savings.

Conclusions

Can the education and training efforts to increase compliance with the building energy code produce measurable savings that are attributable to the utility?

Can the DOE BECP protocol be used cost-effectively to evaluate the impact of the utility-funded Code Support pilot?

These two questions are inextricably linked, and it is not obvious from the limited data collected that the DOE BECP protocol is the appropriate/best tool to determine increased compliance or energy savings from training. This seemingly inconclusive result is due in part to the need for detailed and consistent compliance documentation, including HVAC load calculations and equipment sizing documentation. In order for the BECP protocol to be effective, since it does not penalize projects for not having the documentation available, all necessary documentation must be available and reviewed consistently throughout the process.

The data do provide some anecdotal evidence that this pilot is moving in the right direction. Based on the results and feedback of the jurisdictions evaluated, we conclude that the training program provides increased consistency within and across the jurisdictions. We believe that training and technical support to the jurisdictions does help them better understand the code requirements and therefore make them better able to enforce the code, as well as to assess the implications of increasing the code stringency by adopting a newer energy code. Greater comfort with the energy code reduces the perceived burden of enforcement, which should lead to increased emphasis by the enforcement community. More common, consistent enforcement should increase the rate at which builders, contractors, etc. comply with the energy code requirements, saving energy. However, this remains a hypothesis that this pilot study was not able to prove or disprove.

Part of the question that remains is whether indirect improvements in the code enforcement process, such as reducing time required for approval of submittals, can be linked to energy savings. The argument could be made that streamlining the plan review and inspection process for a building jurisdiction would provide additional time for the plan reviewers and inspectors to review and enforce energy code provisions, normally low on their priority list. The lack of priority is often related to lack of

familiarity with the energy code provisions, or how to check for compliance, compared to other building code provisions.

The BECP protocol as it currently exists seems to be insufficient to fully encompass the impact these trainings have on the process of reviewing and enforcing energy code provisions. Using the BECP checklist provides a snapshot of common construction practices, but does not tell the story of how we arrived at the end result. It would be valuable to know whether the builder submitted plans that met all of the code requirements on the first try, or whether three rejections by the plan reviewer were necessary to ensure compliance. This type of information is not explicitly recorded as part of the BECP protocol, but could add value with only slightly more effort. A single line for filling out the number of submittals required to achieve compliance with a comment box below could provide one method of collecting this data. The BECP protocol recommends marking measures as not compliant if the first submittal is not compliant. However, this does not address the fundamental purpose of this evaluation, which is to determine the energy efficiency of buildings being constructed.

The BECP checklist would also benefit from clearly differentiating mandatory requirements from prescriptive requirements, which can be traded off using the tradeoff or performance compliance paths. With some additional refinement, the checklist could conceivably become a valuable tool for building inspectors to use in the field. If the checklist were used by inspectors or HERS raters during inspections, this would lead to a proliferation of data that provides evidence of progress (or lack thereof) with respect to compliance with the energy code in each jurisdiction. Before and after data for buildings constructed by the same contractor team in the same subdivision can provide a solid basis for comparing the effects of the trainings.

Sample size also becomes more important if this evaluation approach is going to be used to generate statistically significant results. One way to obtain sufficient sample sizes while remaining cost-effective could be to have third-party program evaluators spot-check self-assessments with plan review and inspections for purposes of quality control rather than collecting all of the primary data as part of the evaluation. This approach would work best if the checklists were commonly used by inspectors or HERS raters during inspections. This would provide for a proliferation of data available for evaluation, with minimal added burden. While relying on self-assessments for evaluation would reduce the cost of data collection, it may raise questions about the objectivity and reliability of the data, complicating the evaluation of the program impacts.

Lessons Learned

In addition to the measureable results of this pilot study, we learned some valuable lessons that could help improve future studies of this sort. Below are some highlights that can help inform program evaluations that will rely on interactions with local building departments.

It's who you know

Learn the personalities. This evaluation effort ended up being centered on *individuals*. Each plan reviewer, building code inspector, HERS rater, HVAC contractor and builder is unique in his/her attitudes about the importance of the energy code and what parts of it require their attention. It is imperative that the implementer and evaluator reassure the participants in the pilot so that they are comfortable with the additional attention they are going to receive as part of this effort.

In this case, with a utility program working with building departments, there is a different dynamic than the typical utility rebate program. The utility is not providing any funds directly to a program participant, in this case, the building department. The incentive as a financial commitment is commonly how utilities leverage participation in the evaluation of programs. However, after providing trainings to the building departments, no incentive remains for building departments to cooperate with the evaluation of the program. The evaluators met with some resistance at times trying to collect data via site visits and plan reviews after trainings had been administered. Additionally, there is often a level of

wariness associated with being evaluated, since they are legally obligated to enforce the code. Allowing buildings to pass inspection without actually complying with the requirements would raise serious liability issues that could be embarrassing, costly or even dangerous. For these reasons and others, getting cooperation from building departments requires buy-in from not only the chief building official, or sustainability coordinator, but from each code official with which the program interacts.

Colorado Code Consulting, LLC (CCC) has worked on education and technical code assistance with the jurisdictions in Colorado for several years. The lead implementer for CCC has extensive experience as a building inspector in Colorado and working with building departments on the energy code. Being known and respected by the building community was essential for CCC to engage building jurisdiction and individual inspectors to gain their trust and involvement. Despite this, only half of the jurisdictions participated in ways that were helpful to the goals of the evaluation pilot. Only 3 out of 6 jurisdictions chose to receive training on enforcement of their existing code (2009 IECC), which would enable measurement of the pilot impact in terms of energy savings. Other assistance provided included developing amendments for adopting new code, or training building staff to become certified energy inspectors. These other forms of assistance were not conducive to evaluating energy impacts during the pilot timeframe.

Plan ahead but remain flexible

It is essential to have a solid plan, confirmed with the participants, when conducting the evaluation, particularly for collecting field data. It is also imperative to have a backup plan, because planning assumptions do not always hold. Inspection schedules change day to day, and can be postponed or added at a moment's notice.

There are many reasons why construction activity does not follow the planned schedule, including weather conditions, product delivery delays, labor turn-over and shortages, any of which can delay the construction process, and these impacts often snowball. Therefore timing of inspections is hard to schedule with certainty, making delays and callbacks common. Having an evaluation firm that is local to the region being evaluated can greatly enhance the data collection process. Evaluators with "boots on the ground" are able to join an inspector or HERS rater at a project site with one day or one hour's notice. This can greatly increase the quantity and quality of projects sampled at minimal additional cost.

Digital building department infrastructure

Several jurisdictions that participated in this pilot also had implemented a digital infrastructure for processing plans and permits. This significantly eased the burden of sharing plans for additional review by the evaluators.

No jurisdiction is an island

The building department itself is an independent entity that is allowed to set its own priorities and sometimes its own rules. This is particularly true in home-rule states. The chief building official sets the tone for how permitting, plan review and field inspections are conducted. There is little consistency among various building departments and if a building official leaves, the new person may have different priorities and processes. How each building official within a single department carries out the chief building official's wishes can vary based on their level of expertise or comfort with the topic area. Building department staff need to work within the expectations of their bosses, but often are given plenty of autonomy. A building department may have separate plan review staff and field inspection staff, with sometimes inconsistent communication and cooperation among them. For smaller jurisdictions, one employee could cover both of these roles.

To try to adapt to increasing workloads and decreasing funding, many building departments rely on HERS raters for site inspections of Quality Insulation Installation (QII), duct testing and other energy compliance requirements. In many cases, building departments rely on raters to perform final inspections for projects following the performance path for compliance, which requires a HERS inspection anyway. As independent consultants, raters are also independent and unique with varying

priorities and backgrounds. As a result building departments have little control over what the raters do inspect or their timeline.

However, there are common builders, raters, contractors and developers across multiple jurisdictions, and they don't want to change their approach depending on the jurisdiction in which the building is located. Consistency helps provide a form of quality control and builders will try to create their own consistency where it doesn't exist. Building department staff can also move among multiple jurisdictions as part of normal staff turnover. This is one example of how a statewide code can provide advantages to those trying to enforce or comply with the code. In the absence of statewide uniformity, multiple jurisdictions in a common region can benefit from aligning their requirements to reduce this confusion. Amendments common to neighboring jurisdictions may make sense based on climate. Even if the requirements differ among jurisdictions, clearly identifying submittal requirements and consistently requiring the same type of documentation can simplify the task of working in multiple jurisdictions.

Opportunities for Utilities

We conclude with some observations on the opportunities for utilities to work with building departments on energy code compliance, and the possibilities of reliably measuring the resulting savings.

The BECP protocol and associated tools have the potential to provide valuable information about energy code compliance. Additional refinements and increased use of the tools can increase the feasibility of conducting energy code compliance studies. This in turn has the potential to reduce the cost associated with evaluation of code support programs, bolstering the ability of utilities to provide these resources that are so clearly needed and desired by the building community.

The development of energy savings potential should be possible following the complete analysis of the data collected. Of course, every jurisdiction, region and state is going to have unique characteristics that effect this calculation. Pilot studies like this help inform the specific needs of methodology to accurately estimate these savings.

Based on our evaluation efforts, we have the following observations and recommendations for a continued and expanded code support program.

New Construction programs are justified on efficiency improvements over baselines, and changes to code impact this baseline. Advancements in codes can impact the ability of traditional utility incentive programs to encourage advanced design. However, this tension can be reduced through integrated program activities involving both new construction and code support. With any adoption of more stringent codes, outreach efforts are needed to support implementation. By developing a new program theory and implementation approach, both kinds of programs can be more effective, and the full measure of savings can be captured by the utility.

The type of outreach that accompanies a traditional new construction program is fundamentally similar to the portion of a code support program targeting the design community. Additional training for the building department staff differentiates the scope of the code support program, but evaluation of energy savings would rely on the compliance rates in the field. Field inspection of energy code compliance is already required for participation in new construction incentive programs, and expanding that evaluation effort to include measures covered by the code training would be a cost-effective method of collecting the data necessary to support claiming energy savings for the code support initiative.

This approach is being investigated by utilities in other states. HMG is currently working with statewide utility groups in California and Massachusetts to pursue this program structure. By coordinating early with regulators, utilities can establish a pre-program agreement that will allow them to claim the energy savings from code compliance improvement.

Coordination of new initiatives with existing programs will also identify opportunities to leverage existing, established resources (e.g., special funds, education strategies, and marketing assets such as existing websites). Specifically, strategic coordination with active professional groups (such as the regional energy efficiency organization[8]), state agencies (such as the Colorado Energy Office), and local code officials will improve best practices training of the building design community to meet and exceed minimum energy code requirements.

The case for attribution of energy savings to the utility can be bolstered if the utility-funded code support program is the only provider of code-related trainings in their territory. This may require working out an agreement with the state and other potential training supporters, or at least making sure to differentiate the program offerings as trialed by this pilot and described in this paper. Tailoring the training to meet the needs of the individual jurisdictions and providing tools to help with compliance/enforcement would help attract participation and make it easier to track attribution of savings to the program.

[8] More information about regional groups is available at: http://energycodesocean.org/regional-energy-efficiency-groups