Pilot Program with Two Focused Approaches to Enhance Energy Code Compliance

Conservation Applied Research & Development (CARD) INTERIM REPORT

Prepared for: Minnesota Department of Commerce Division of Energy Resources

Prepared by: Center for Energy and Environment
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Executive Summary

Center for Energy and Environment developed a commercial energy codes support program to establish a local precedent for utility-funded energy code compliance enhancement programs in Minnesota, a state with relatively low utility rates. Two specific innovative pilot program approaches were developed for 1) small building design team support and 2) large building city review support. Program marketing began in October, 2015.

In contrast to other efforts to comprehensively achieve compliance for all energy code line-items and building types, these carefully targeted approaches are designed to cost-effectively achieve significant energy savings while minimizing program costs. To accomplish this, the pilot program first identified the building types and code line-items expected to have the most potential savings, based on both energy impact and the frequency of specific missed code items.

Based on this information, the first program delivery approach supports design teams with four types of small building projects using a key energy code items quick reference sheet and preliminary plan review services. The second program delivery approach provides technical support to code officials through plan review, as well as inspection guidance for large, complex buildings—especially where energy simulations are used. The design of these two targeted program approaches takes into account an appreciation for the challenges designers and reviewers face in understanding the complexity of the energy code.

Recruitment efforts to date have had mixed results. The recruitment of smaller building pilot program participants to receive support starting early in the design process (first approach) has been slower than anticipated. However, the recruitment of large projects where partner city staff receive support starting at permit plan review (second approach) has been very successful. All 11 projects identified for city support are new construction (or addition), along with at least 9 of the 14 projects currently identified for design team support. Although renovations make up the vast majority of building permit applications, we have been less successful at identifying and recruiting these projects than we have for new construction projects. Multifamily and hotel/motel buildings together make up nearly half of the program participants to date. The two categories of office and restaurant & related uses each make up one-sixth of the participating buildings.

Preliminary results suggest that the potential impact of the program is higher than originally anticipated. Reviews of 9 projects at the permit application phase indicate that without program support, one-fourth of the measures targeted by the program may have been approved, although clearly non-compliant, and another 31% of plans did not have enough design detail to determine or assure that the item would be compliant. Together, that puts 56% of the target measures at risk for not being compliant in these particular projects. This successful detection of higher than expected level of compliance issues makes it more likely that a smaller than originally planned sample could show statistically significant differences. Although broad summary information on final compliance status is not yet available, there is clear evidence that a number of building projects included in the pilot program have made numerous design changes that have substantially increased compliance which will lead to energy savings over
the lifetime of these buildings. Quantification of the energy impacts of the program and cost-effectiveness analysis will be addressed in the project’s final report.
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Introduction

This report provides preliminary information and findings on Center for Energy and Environment’s (CEE) commercial energy codes support pilot program that is supported by a grant from the Minnesota Department of Commerce, Division of Energy Resources through the Conservation Applied Research and Development (CARD) program.

In Minnesota, it has been reported there is over 90 percent commercial energy code compliance, which may suggest little potential for energy savings (Hernick, Nelson and Sivigny 2013). However, this 90 percent compliance rate is based a federal protocol that counts the percentage of a select number of specific code line-items that are compliant, rather than the percentage of buildings that are completely in compliance. Moreover, a number of administrative items that may have little impact on energy use are included in the federal protocol’s count. A similar study in New York with 85 percent line-item compliance found total building compliance with every energy design item to be less than half of that (Harper et al. 2012). This suggests that there may be more opportunity for energy savings than a 90 percent compliance rate by itself may imply.

The current project has been undertaken to develop and test two specific innovative program approaches and optimize these for cost-effectiveness in Minnesota commercial buildings. Rather than trying to broadly increase energy code compliance for all commercial building projects and code line-items, this project uses a carefully targeted approach. The project plans to achieve significant improvement in particular parts of the market through support of project development teams and/or city staff at the time they are working on actual projects. The pilot will focus on the specific combinations of building project types and code requirements where the largest energy cost savings are expected. This targeted program approach takes into account the need to maximize program impact while minimizing costs. It also recognizes the challenges of designers and reviewers who often are overwhelmed by the complexity of energy codes.

The pilot program was developed in the first three quarters of 2015. In June, 2015, Minnesota underwent a commercial energy code update, six years after the previous code update. The new code provides projects with the option of following IECC 2012 with Minnesota amendments or ASHRAE 90.1-2010 (unamended). Marketing of the program began in the fourth quarter of 2015. Program delivery began in January, 2016 and will continue into the third quarter of 2017, with an evaluation at the end of 2017. This paper reports on the program development efforts, resulting program design, and initial program implementation results.
Commercial Codes Program Climate in Minnesota

A number of programs aimed at comprehensive energy code compliance for commercial buildings have been piloted or rolled out in the last few years, but CEE concluded that a more focused approach would be most appropriate in Minnesota for a number of reasons (Lee et al. 2013). First of all, the effective average electric utility rates of ~$0.10 per kWh are much lower than in most areas where codes programs are underway. Secondly, previous research has found that Minnesota already has a higher rate of commercial energy code compliance than most states, so a blanket approach is likely to expend resources in areas where compliance is strong, reducing the opportunity to maximize savings (Hernick, Nelson, and Sivigny 2013). It is also noteworthy that the programs in other states typically have elements that would intervene in the relationships between cities and development teams in ways that many cities in Minnesota may not accept (e.g. allowing a project team to hire a third-party plan reviewer and inspector of their choice from amongst “program approved” reviewers). While utility Energy Design Assistance programs have a proven record of success in Minnesota with cost-effective energy savings through early design intervention for large projects, that approach is too expensive to cost-effectively impact small projects. Finally, when asking about the energy code, the project team has consistently heard from a wide variety of designers and code officials that it is much too large and complex. This call for energy code simplification echoes the findings of previous commercial energy code compliance programs (Madison and Baylon 1998). Taking all of the above factors into account led us to propose a pilot Conservation Improvement program (CIP) utility-funded program that strives to reap significant energy impact at low cost, rather than broadly pursue 100 percent compliance with all energy code items across all commercial building types.

Besides questions about optimal program design and cost-effectiveness, utilities in Minnesota have also been hesitant to initiate energy codes support programs because of other uncertainties. In discussions with utility representatives, concerns were expressed about the coordination with other programs and appropriate crediting of savings for such programs. Utility regulators in Minnesota have historically been rigid in defining compliance with the current energy code as the reference point for calculating utility program impact in new construction situations. Policy discussions within the last few years have suggested that increased code compliance programs could be given credit for energy savings, but there has been no precedent set for this in the state.

The current energy code structure and history in Minnesota also has a big impact on this program. Minnesota had an ASHRAE 90.1-2004 based energy code in place for six years before the transition to the current combination of an amended IECC 2012 and unamended ASHRAE 90.1-2010. While the ASHRAE 90.1 standard document is much more expensive by itself than the IECC code book, Minnesota is unique in providing a single code volume that combines the IECC as amended by Minnesota with ASHRAE 90.1 in a single volume that is less expensive than ASHRAE 90.1-2010 by itself. This makes it more affordable and practical for industry professionals to have both documents readily available as a reference.
Program Development

The main technical program development challenge was the selection of key (high impact) energy code line-items and building project types. Engineers reviewed information from a number of sources to develop targeted lists of energy code line items and building types, including:

- A study of energy code compliance in Minnesota (Hernick, Nelson, and Sivigny 2013).
- Interviews with 13 code officials representing 11 cities and 6 states that had adopted codes very similar to Minnesota’s new code, but at an earlier time.
- An examination of specific updates to the codes (Wallace, Deringer, and Hudson 2014).
- Interviews with 17 code officials, architects, engineers and builders in Minnesota.
- Preliminary review of energy impacts of energy code changes.
- Historical data from a construction industry project database service.
- Historical data from partner cities on previous permits.
- Detailed line-item review of state-specific amendments.
- Detailed line-item review to consider likelihood of being missed in various project types.

Through these efforts, the pilot program developed a targeted list of 16 percent of the total energy code line items. Figure 1 presents a summary of the breakdown of the list by building system.

![Figure 1. Results of target line-item measure selection by building system](image-url)
Table 1. Energy code line items targeted by program

<table>
<thead>
<tr>
<th>Envelope Measures</th>
<th>Electrical Measures</th>
<th>Mechanical Systems</th>
<th>Additional Efficiency Package Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Insulation</td>
<td>Window U value</td>
<td>Slab edge insulation</td>
<td></td>
</tr>
<tr>
<td>Above Grade Wall Insulation</td>
<td>Window area/orientation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>HVAC efficiency OR Reduced LPD OR Renewables</td>
</tr>
</tbody>
</table>

One key question the pilot program wrestled with was how to address the multiple path options in the code. While interviews with code officials in other states indicated IECC 2012 was overwhelmingly used by small projects and ASHRAE 90.1-2010 was dominant for large projects, the combination of Minnesota’s history with ASHRAE 90.1 and the publication of a Minnesota specific energy code book that includes both IECC 2012 and ASHRAE 90.1-2010 gave us reason to suspect this pattern might be different in Minnesota. The pilot program initially considered producing separate series of documents for each code path (i.e. IECC vs. ASHRAE 90.1) to make each document simpler. However, the similarities in the requirements of the two paths were consistent enough to make it practical to produce a single document listing the requirements for both options. There is also a simpler renovation version of this document that omits certain items that are only expected to be common in new construction or addition projects (e.g. window area and orientation).

The selection of a second-tier set of guidelines for those project teams wishing to go well beyond the code was another technical challenge to the pilot program. Key considerations were both energy impact and simplicity for design teams to digest and implement. While New Building Institute’s New Construction Guide (NBI 2015) was considered to be an appropriate option, we ultimately chose to use the ASHRAE Advanced Energy Design Guide 50% series for the pilot program (ASHRAE 2011-2012). The most critical factor for this trial use was the simplicity of having multiple people on the project team able to download the documents at no cost and without any special instructions.
Program Description

The overall pilot program goal is to establish a successful model for a utility-funded commercial energy codes support program in Minnesota, and this is done with a very targeted approach to cost-effectively achieve energy savings in a state with relatively low utility rates. Rather than striving to achieve compliance with all energy code line-items for all projects, the goal is to achieve higher compliance for line-items that have a high energy impact and/or are most commonly missed. The method for selecting these line-items was described in detail in the previous section. The pilot program is testing two different strategies to improve compliance, as outlined below. While these approaches could allow for overlap in terms of building projects served, the pilot is avoiding any overlap to better evaluate the impact of each approach.

Program Approach 1: Design Team Support for Specific Small Building Types

The first program approach aims to impact the underserved market of small building design by providing tools and support to project design/development teams from early design through construction. The approach is similar to design assistance programs, with a much narrower scope and program cost per project. The goal, and a key incentive for participating project teams, is to clearly address key energy code items early in the design and development process to avoid much more costly, late-stage changes. The pilot is targeted to specific building types in order to keep the set of project requirements and tools as simple, accessible, and useful as possible. While new construction projects are eligible, it was expected the majority of projects will be renovations of existing buildings. For renovation projects to be eligible, at least two of the three types of buildings systems addressed by the program (i.e. envelope, electrical/lighting, and HVAC) must be included in the scope of work. The key elements of program approach 1 are shown in Table 2 below.

<table>
<thead>
<tr>
<th>Program scope</th>
<th>Small buildings</th>
<th>4 specific building types</th>
<th>New &amp; existing buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 energy code line-items</td>
<td>Whole building tier 2 package</td>
<td>Prescriptive compliance paths</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benefits/support to design and development teams</th>
<th>Energy code cheat sheet</th>
<th>Best practices guide</th>
<th>Plan review prior to permit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incentive to owner</td>
<td>Incentive to design team</td>
<td>Construction phase support</td>
<td></td>
</tr>
</tbody>
</table>

Building owners and project team members participating in the pilot are given modest incentives for successfully incorporating a number of basic efficiency requirements into their project. The incentive amounts are $500 to the building owner/developer and $275 to the design team. Larger incentives of $750 and $475, respectively, also are offered for achieving a second-tier level of compliance with a simplified set of energy design requirements that exceed code (the 50% reduction series of ASHRAE Advanced Energy Design Guides, where applicable [ASHRAE et al. 2011-2012]). The basic energy efficiency requirements represent a targeted list of energy code line-items having lowest compliance and/or largest energy impact for the specific types of buildings targeted— office, retail, restaurant, and multifamily/lodging.
Participants are provided these requirements in the form of a one-page front and back applicability guide document that provides design teams with guidance on the targeted energy code line-items. This “cheat-sheet” document aims to provide a more accessible approach to help designers determine whether a code line-item is required for a particular project and to understand just what is required (while also providing specific code section references). Both the document flow and language contribute to the greater accessibility. For example, the code often has key criteria for when an item is required in a nondescript location buried within a list of exceptions at the end of requirement’s section, while the program document highlights these key notes about when an item is required in a prominent, consistent location. Figure 1 shows an excerpt from the applicability guide document.

<table>
<thead>
<tr>
<th>TECHNOLOGY</th>
<th>TECHNOLOGY DESCRIPTION / EMERGENT IMPACT / CODE REFERENCE</th>
<th>DOCUMENTATION</th>
<th>WHEN APPLICABLE</th>
<th>TENDED BFROENSTY/TYPES</th>
<th>APPLICABILITY SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Equipment that is required to meet air conditioning needs (when possible) instead of running the AC compressor). This reduces compressor</td>
<td>NESC &amp; ASHRAE 6.8.2.4.3</td>
<td>HVAC, when the cooling system’s cooling capacity is greater than 500,000 BTU/hour (157.75 kW) Multifamily: 500,000 BTU/hour (257.80 kW)</td>
<td>Multifamily: Treated air;</td>
<td>Treated air;</td>
</tr>
<tr>
<td>Demand Control</td>
<td>Demand Control (DC)</td>
<td>NESC &amp; ASHRAE 6.8.2.4.3</td>
<td>HVAC, when the cooling system’s cooling capacity is greater than 500,000 BTU/hour (157.75 kW) Multifamily: 500,000 BTU/hour (257.80 kW)</td>
<td>HVAC, when the cooling system’s cooling capacity is greater than 500,000 BTU/hour (157.75 kW) Multifamily: 500,000 BTU/hour (257.80 kW)</td>
<td>HVAC, when the cooling system’s cooling capacity is greater than 500,000 BTU/hour (157.75 kW) Multifamily: 500,000 BTU/hour (257.80 kW)</td>
</tr>
</tbody>
</table>

Figure 2. Excerpt from program guidance document

A second, shared document also provides guidance and serves as the key avenue for providing design teams feedback at the time of design reviews. The first columns of this documentation checklist note basic and best practices for clearly documenting design elements to ensure that the project will achieve compliance with the targeted list of code line-items. Then an interactive set of columns allows design teams to fill out a checklist and add special notes. Finally, there are columns that program staff use to provide feedback when a design review is completed. The form of feedback combines both an at-a-glance visual summary, with detailed measure-specific feedback. An intuitive color code gives project-specific feedback on each measure relative to the program (and code) requirements. For those measures that either do not require more detailed design documentation, program staff provide project specific notes to aid the design team in achieving compliance.

Figure 3. Excerpt from program guidance document
After project teams are enrolled in the program and receive the guidance documents, the pilot program periodically checks in to discuss design progress and offer assistance in the form of preliminary design review by program staff who are International Code Council (ICC) certified\(^1\) for the energy code. The program requires quick turnaround on requests for design review in order to allow time to redirect design teams while it is relatively simple and inexpensive to make design changes.

Once project design is complete, program staff track the progress of the project through monthly program level check-ins with city code officials and/or the project teams. In some cases, program staff will provide direction to contractors in how to avoid common pitfalls for particular energy code line-items. When construction is complete, program staff perform inspections to confirm compliance with the targeted code line-items before issuing the incentive checks. While the program will likely inspect all participating projects initially, the pilot program will also explore lower cost alternatives such as using building official inspection results and/or randomly inspecting a fraction of participating projects. The energy impact of this program approach will be gauged by a combination of notes on specific design changes made in response to preliminary design reviews and a comparison to a group of control building projects over the same time period.

**Program Approach 2: City Plan Reviewer Support for Large, Complex Buildings**

The second program approach provides the technical assistance of an energy engineer to city staff as they review plans and other detailed submittals. Technical support of city staff during the permit plan review stage will allow for the identification and correction of problems before the time of construction, otherwise, it is generally impractical or cost-prohibitive to make substantial changes. Reviewers with specialized expertise in energy code and building simulation are expected to identify more energy code issues at the design submittal phase. This program approach was expected to have a much higher fraction of new construction or addition projects than the small buildings project, but was also considered likely serve a number of renovation projects. At least two of the three main building systems (envelope, electrical/lighting, and HVAC) must be in the scope of work for renovation project to be eligible. The key elements of program approach 2 are highlighted in Table 1.

City staff have finite amounts of expertise and time available for the review of plans regarding health and safety concerns, resulting in little time for the review of energy specific issues. Projects requiring the review of building energy simulations were also to be a focus of this approach. These simulations allow exemptions from a large number of code line-items by showing a level of performance for the building as a whole, and few code officials have the expertise or time to review these submittals. A specialist develops a checklist of the key design elements that exceed code and make up for exemptions in other areas (allowing inspectors to verify these), and review for accuracy and bias in the simulation analysis. The checklist of items

\(^1\) See http://www.iccsafe.org/education-certification/certification-and-testing/
exceeding code will be invaluable to city staff as they later inspect the project to verify compliance. City staff have also reported that technical assistance with the review of commissioning reports is valuable and is expected to be effective at providing energy savings through the identification of issues that can still be easily addressed at the end of the construction phase of the project. While third-party support of plan review and inspection has been a hallmark of a number of code compliance programs in other states, this pilot program will limit the design review to the key areas with the most significant energy impact and will not attempt to override existing code inspection services (which is relatively expensive and politically sensitive).

Table 3. Features of program approach 2

<table>
<thead>
<tr>
<th>Program scope</th>
<th>Support to city code officials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large buildings</td>
<td>Permit set plan review and report on 22+ items</td>
</tr>
<tr>
<td>Complex mechanical systems</td>
<td>Review of building energy simulations submitted for performance documentation</td>
</tr>
<tr>
<td>New building, additions, and major renovations</td>
<td>Checklist for inspection of performance path items</td>
</tr>
</tbody>
</table>

The program staff report of review findings for city staff is similar, but more detailed than the small project reporting to design teams. A formal, multi-page report starts with a one-page summary of the service, building, design phase, and an at-a-glance summary of review findings. The findings summary is in color-coded format that is similar to the documentation checklist used for small building reviews. Figure 4 below shows a sample of the summary table in this report. After the summary page, any measure with an unresolved issue has at least a paragraph of text noting the current problem and how to address it.

A full-scale program with this approach would be expected to eventually lead to upstream improvements in designs before these reach code officials, helping design teams come to expect a much closer review of energy code items than in the past. For this project, in order to better evaluate the potential energy impact of this program approach code officials are asked not to “warn” design teams that a third-party review with respect to the energy code is taking place. The potential energy impact of this approach will primarily be estimated through analysis of the line-items flagged as non-compliant during reviews.
<table>
<thead>
<tr>
<th>REQUIREMENTS</th>
<th>STATUS</th>
<th>REQUIREMENTS</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Insulation R Value</td>
<td>MECH</td>
<td>Economizer</td>
<td>MECH</td>
</tr>
<tr>
<td>IECC: C402.2.1</td>
<td></td>
<td>IECC: C403.2.5.1</td>
<td></td>
</tr>
<tr>
<td>Above Grade Wall Insulation</td>
<td></td>
<td>Demand Controlled Ventilation</td>
<td></td>
</tr>
<tr>
<td>IECC: C402.2.3</td>
<td></td>
<td>IECC: C403.2.6</td>
<td></td>
</tr>
<tr>
<td>Window U value</td>
<td></td>
<td>Energy Recovery Ventilation</td>
<td></td>
</tr>
<tr>
<td>IECC: Table C402.3, Sec:C402.3.3 &amp; C402.3.4, (C303.1.3)</td>
<td></td>
<td>IECC: C403.2.6</td>
<td></td>
</tr>
<tr>
<td>Window Area &amp; Orientation</td>
<td></td>
<td>Boiler &amp; Chiller System Control</td>
<td></td>
</tr>
<tr>
<td>IECC: C402.3.1</td>
<td></td>
<td>IECC: C403.4.3.4</td>
<td></td>
</tr>
<tr>
<td>Slab Edge Insulation</td>
<td></td>
<td>Variable Flow Pump Control</td>
<td></td>
</tr>
<tr>
<td>IECC: C402.2.6</td>
<td></td>
<td>IECC: C403.4.3.4</td>
<td></td>
</tr>
<tr>
<td>Automatic Lighting Shutoff</td>
<td></td>
<td>Duct Sealing</td>
<td></td>
</tr>
<tr>
<td>IECC: C403.2.2.2 &amp; C405.2.2.1</td>
<td></td>
<td>IECC: C403.2.7</td>
<td></td>
</tr>
<tr>
<td>Daylight Zone Control</td>
<td></td>
<td>Supply Air Temperature Reset</td>
<td></td>
</tr>
<tr>
<td>IECC: C405.2.3.3.1, C405.2.2.3.2 &amp; C202</td>
<td></td>
<td>IECC: C403.4.5.4</td>
<td></td>
</tr>
<tr>
<td>Multilevel Lighting Control</td>
<td></td>
<td>Fan Motor Sizing vs bhp</td>
<td></td>
</tr>
<tr>
<td>IECC: C405.2.1.2</td>
<td></td>
<td>IECC: C403.2.10.2 &amp; C403.2.10.2</td>
<td></td>
</tr>
<tr>
<td>Interior Lighting Power Density</td>
<td></td>
<td>Pool Cover</td>
<td></td>
</tr>
<tr>
<td>IECC: C405.5</td>
<td></td>
<td>IECC: C404.7.3</td>
<td></td>
</tr>
<tr>
<td>Conductor Sizing</td>
<td></td>
<td>HVAC Commissioning</td>
<td></td>
</tr>
<tr>
<td>IECC: C405.8</td>
<td></td>
<td>IECC: C408.2</td>
<td></td>
</tr>
<tr>
<td>Lighting System Functional Testing</td>
<td></td>
<td>Low Leakage Intake and Exhaust Dampers</td>
<td></td>
</tr>
<tr>
<td>IECC: C408.3</td>
<td></td>
<td>IECC: C402.4.5</td>
<td></td>
</tr>
<tr>
<td>Additional Energy Efficiency Package (3 Options)</td>
<td></td>
<td>IECC: C406</td>
<td></td>
</tr>
<tr>
<td>Status Legend:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Code requirement met</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not enough information to determine/ensure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Code requirement not met</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not required for this project</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4. Summary table excerpted from large building review report
Evaluation Activities

In addition to regular program development and delivery activities, the pilot program incorporates evaluation activities. The goal of these activities is to thoroughly evaluate the results and lessons learned from the pilot program to inform future program development and to quantify the energy impacts of each of the two pilot program approaches. The final results of this task will include quantification of the program impact in terms of percentage implementation and energy savings by both building project type and individual code line-items. Secondary results will include the critical evaluation of numerous program elements to determine what changes may be expected to further optimize the program approaches, and what level of cost-effectiveness may be expected for a full-scale program. In addition to the collection of typical program delivery data, the evaluation requires thorough documentation of sales call success rates, the apparent impact of each intervention with the design team, the specific design element deficiencies pointed out through program activities, and the actual final installed characteristics of specific building design elements in each project. This will allow a determination of the potential market penetration and energy impact of a full-scale program. Additional evaluation activities also include surveys of program participants as individual projects are completed, surveys of city staff, and technical review of a “Control” set of building projects that are completed at times that parallel the program participant building projects. All data from the Control buildings is kept confidential and only reported as part of summary analysis that does not identify issues with any particular building or city.

Capture of Key Design Element Data from Plan Review & Inspection of Program & Control Buildings. While program delivery and city staff would typically perform reviews of plans and inspections only to the extent needed to make pass/fail determinations and to provide design change feedback as program implementation occurs, the pilot program evaluation needs additional information in order to make a definitive determination of energy savings. In particular, we need to quantify two items for each of the “key” design elements: 1) the level of efficiency achieved [e.g. window U-value], and 2) the quantity of the design element [e.g. square footage of window area]. This is being done by having program and/or city staff provide design and inspection information to an energy analysis engineer, who systematically reviews the information and enters it into a tracking system. In a similar way, key design element data will be captured for Control group buildings as each building project in this group is completed. As needed, financial incentives will be offered to the building owners to allow program staff access.

Code Official Focus Group to Get Feedback on Issues with the New Code. As the new Commercial Energy Code went into effect in Minnesota in June of 2015, new trends in non-compliance were expected to occur. In order to allow the program to respond to these changes, program staff held a group meeting in April of 2016 with 7 government staff (code officials) representing 6 different jurisdictions. Five of the participants represented jurisdictions in the twin cities metro area while one had statewide responsibilities and one represented a jurisdiction in greater Minnesota. Because projects that are in the design process at the time of the new code adoption are often allowed use the old code, there is a significant time lag between the date of adoption and when officials have had many project go through the plan review and inspection process. Officials involved in the meeting made numerous statements
suggesting that they were just starting to get a good feel for trends at the time of the meeting, nearly a year after the code was introduced. Because of the limited number of projects within each jurisdiction to have been completed under the code at that time, this group discussion format was chosen over plan review and field verification. This approach was judged to be more effective at getting timely feedback from code review staff that had each dealt with a number of projects. Meeting participants were asked about trends for compliance paths chosen, types of code items where non-compliance is an issue, issues at plan review, issues at the time of inspection, project review/approval process issues, and numerous ways that improved compliance might be achieved.

**Survey Data Collection.** Survey data is being collected to gain further insight into the impressions of the program approaches and how they can be improved. Surveys will be administered to small building program participants and to city officials. Small building program design team members will be contacted at the end of a project’s design phase, and building owners will be contacted after project completion. Both will be offered a financial incentive to complete the survey. Participant surveys address issues such as: overall program satisfaction, motivators for program participation, appropriate incentive levels, impact on their project design, and the value of each program tool and service. City staff are being surveyed after receiving individual building review reports to obtain information about their perceptions of the effectiveness of the program approaches, any reductions in staff time for review/redirection, staff time for ongoing cooperation with the program, and compliance trends.

**Data Analysis.** Data from program implementation and the sources noted above will be aggregated to quantify program energy impacts, cost effectiveness and recommendations for full scale program implementation. We will primarily measure the impact of the small buildings program by comparing the rates of actual installation (or quantifiable efficiency level) of the key design elements targeted in the program participants to the rates in the Control group. The smaller number of large buildings in the program and non-homogenous nature of building types would likely make any finding from a control group comparison for large buildings inconclusive. Therefore, the impact on key design element implementation rates for larger buildings will be based on design upgrades made in response to specific program plan reviewer findings that were reported to city staff (and verified as being implemented). For both the small and large building groups, energy impact of individual “key design element” occurrence will be determined by a combination of building energy simulation and other appropriate engineering analysis. We anticipate using a set of standard reference buildings, with modifications as needed to accurately represent the quantities of each building element (e.g. window or wall area) observed in the program participant and control group buildings. The resulting energy impact per occurrence will be combined with the program impacts on implementation rates (or quantifiable efficiency level differences for many measures). We will also investigate trends over time, but the small sample size may only allow for statistically significant conclusions for a subset of measures that are the most commonly “missed”. The program delivery costs are being tracked separately from the extra pilot evaluation costs so that we can then combine this with energy impact results to evaluate the cost-effectiveness as viewed in typical CIP program terms (e.g. utility, participant and societal cost-benefit ratios). Survey data analysis will provide valuable information that will lead to recommendations for appropriate changes prior to full-scale program implementation.
Initial Results

Recruitment of Small Buildings to Receive Design Team Support

The recruitment rate for small building participants (approach 1) has been much slower than expected, and below the pace needed to reach the pilot program participation goal of at least 40 small buildings. Increasing the small building recruitment rate is currently the most pressing challenge for this program. The actual delivery of services for small buildings typically occurs one to four months after recruitment, based on building design timelines. With pilot program delivery scheduled to end in June of 2017, recruitment must be completed in April or May of 2017. Despite multiple escalations of the recruitment efforts and adjustment of tactics, as of December 2016, only 14 projects have made a commitment to receive design team support through the pilot program.

The originally planned recruiting approach was to contact design teams based on specific projects identified by Dodge Reports as being in a very early phase; this had limited success. The project team then transitioned to market player-based recruitment as the primary approach. The original pilot plan envisaged the majority of recruitment calls being made to design and development team members in the partner cities when they were beginning to design a specific project. The plan assumed that project status information in Dodge Report’s database from McGraw Hill, along with information from city planners, would provide numerous leads for project team members to contact at just the right time for them to commit and then quickly move into program participation. However, over the first few months, it became clear that these sources and contacts are not as comprehensive in scope, and/or are not as reliable in providing current project design and development stage information as was hoped. For these reasons, our calls to design teams based on project database tracking information often failed to secure a commitment for the intended projects. However, these calls did frequently lead to discussions about other specific projects the industry contact would consider for inclusion in the small building design support program if and when those projects reached the appropriate design phase. In addition, the pilot program has reached out to a number of design firms within CEE’s network of contacts, and obtained long-term program interest along with commitments for pilot program participation for specific building projects. While this approach of working on long-term relationships with industry players has been very successful for CEE’s One-Stop Efficiency Shop program, it took years to fully gain traction in the market.

In addition to reaching out to a broader network of designers, the target area for inclusion of small building pilot participants has been expanded beyond the borders of the three partner cities. This change greatly increases the pool of eligible projects, while maintaining a level of consistency in the local commercial building industry players and market practices. The original size limit of 50,000 sf was also relaxed for multifamily and hospitality buildings where the use of simpler, individual unit HVAC systems keeps the building energy code issues relatively simple to address (compared to most larger buildings).
The building types recruited for design team support are shown in Table 4 below. The two largest categories are *multifamily* and *restaurant & related*, with each representing 29% of the participating buildings. When combined with the *hospitality* building category that is very similar, the *multifamily/hospitality* category makes up 37% of the participants. Another significant category is *office*, which makes up about 21% of the participating buildings. Also note that only 4 of the projects are renovations, and that all of these are in the *office* and *restaurant* categories.

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Total #</th>
<th>Renovations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifamily</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Hospitality (Hotel/Motel)</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Restaurant &amp; Related</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Office</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Retail</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
<td><strong>4</strong></td>
</tr>
</tbody>
</table>

**Recruitment of Large/Complex Projects to Support City Review**

The large building pilot program (approach 2) has established close working relationships with three partner cities, which are looking to program staff as a resource beyond what was originally envisioned. Each partner city is a suburb in the Minneapolis-St. Paul metro area. This pilot program has generally found city staff are open to our third-party involvement in plan review and inspection, although this is not always the case. This positive response contrasts with our original assumptions about city staff sensitivity to someone “looking over their shoulder.” The cities the pilot program is partnering with have even asked CEE to perform inspections alongside some of their staff for training purposes, and these relationships with city codes enforcement and planning staff have been invaluable for the first phases of the pilot program.

The most critical result from these city partnerships has been the commitment of seven specific large building projects for review within the first four months of program roll-out, plus four more within specific project requirements since that time. While the actual timing of the permit submittal reviews can occur up to three months after commitment of pilot program services, this pilot program is on track with the goal of reviewing plans for 10 to 15 large buildings. Furthermore, the pilot program has seen no evidence from the partner cities that the requests for project reviews will decrease over time.

Some key summary information about the buildings included in the large building pilot is provided in Figure 4 and Figure 6. All but one of the buildings is new construction and two-thirds were within the *multifamily/hospitality* category. Also note that two smaller buildings were included in this set because of a combination of strong partner city interest and the program’s desire to include building types that had been under-represented to date. The cities had also asked for the inclusion of several other projects that did not fit our criteria for building
size or type, and thus were not included in the pilot, indicating broad acceptance and demand for this approach. It is also noteworthy that the partner city commitments have included repeat requests after receiving their first participating project’s review report. This reinforces the project team’s expectation that cities will see value in the delivery of this program that goes far beyond a one-time training activity.

Table 5. Building types included in city staff supporting reviews

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Number Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifamily</td>
<td>4</td>
</tr>
<tr>
<td>Hospitality (Hotel/Motel)</td>
<td>2</td>
</tr>
<tr>
<td>Office/Warehouse/Manufacturing</td>
<td>1</td>
</tr>
<tr>
<td>Retail</td>
<td>1</td>
</tr>
<tr>
<td>Education</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 6. Building types included in city staff supporting reviews

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Number Reviewed</th>
<th>Average Building Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifamily &amp; Hotel/Motel</td>
<td>6</td>
<td>286,100</td>
</tr>
<tr>
<td>All Others</td>
<td>3</td>
<td>34,250</td>
</tr>
</tbody>
</table>

Beyond providing sites for large building reviews, the pilot program will be leveraging the relationships with partner cities to aid in the identification and recruitment efforts for small building program participants, and to help track projects after the design review so that the pilot program is able to time our field verification visits accordingly. To date, the partner cities have also provided several leads for projects that are early enough in the design process to be served by the small building design team assistance approach (approach 1) providing reason to be hopeful for increased participation. Moreover, the partnerships and code officials’ awareness of our program activities lends more credibility in the eyes of the building project development and design teams.

Plan Reviews & Other Support for Design Teams

While 7 building projects have received design support reviews, the wide variety of design completion level when the reviews occurred makes it of limited value to provide a detailed summary at this time. Figure 6 shows a sample project’s changes in compliance levels as it progresses through various stages. This both illustrates the difficulty in comparing reviews from various design stages, and shows the improvements that were achieved when a project team embraced the program’s support services. In addition to the colored, stacked bars showing the percentage of each of the 4 review findings for each category, the dashed lines show the total percentage of items that are either non-compliant or do not have enough design detail for accurate evaluation. These totals go from 54% at the 50% CD stage, to 42% at the 90% CD phase and finally only 13% for the bid set. The bid/permit stage design value of 13% of items with issues for this project compares quite favorably to 39% for the best of the 9 buildings reviewed at the permit stage when no direct design team support was provided. The final report will provide much more detailed analysis of compliance status across “small” building projects.
based on the latest set of information available for a site. Based on each project’s timing this final data set will include a mix of as-built observations and permit set design information.

**Plan Reviews to Support City Staff at Permit Application**

The summary results presented here are focused on the results from permit application stage of large building plan reviews for 9 buildings going through the large building track. Aside from there being fewer small building track projects having complete reviews, the large building review track gives a much better indication of baseline code compliance without any program impact because no assistance is provided to the design teams and the reviews at this city plan review stage are generally considered be at near final design.

Figure 6 summarizes the lower than expected compliance rates for the targeted items. One-quarter of the line-item requirements were clearly not met by the design team, and nearly one-third lacked adequate design detail to ensure compliance (e.g. no maximum window assembly U-value specified). Together, these two types of issues impacted 56% of the line-items reviewed. Nearly one-quarter of the line-items were not applicable for the specific projects, and only one-fifth were both applicable and clearly met by the design documents at the time of permit plan review. Together these amounted to 44% of line-items being acceptable at the time of permit plan review. The very low compliance rate for the targeted items appears to reflect both widespread failure on the part of design teams to adequately address the current energy code design requirements, and success of this program design – it targets the most frequently missed items. Assuming the identified deficiencies are appropriately addressed in design updates and construction, the pilot program is expected to have an even higher impact on building energy use than originally anticipated.
Figure 6. Summary of code line item review findings for large buildings

Figure 7 details how the initial review results varied for the three main categories of requirements. In addition to the colored, stacked bars showing the percentage of each of the four review findings for each category, the dashed lines show the total percentage of items that are either non-compliant or do not enough design detail. These totals are 47%, 80% and 47% for the envelope, electrical/lighting, and mechanical categories, respectively.

We found that the building envelope category has a combination of highest pass rate items and items with frequent issues. The two highest compliance items—roof insulation and window area & orientation—are both in the envelope category. Each of these had only one occurrence of an issue in the 9 buildings. On the other hand, above grade wall insulation and slab edge insulation each had 44% or more frequency of clear non-compliance while window U-value does not have enough design detail 56% of the time (with only 11% clear non-compliance). This echoes CEE’s previous observations of common failures to adequately specify thermal performance values for key envelope elements—especially traditional windows, storefront windows, and rigid insulation.
Figure 7. Variation in targeted item compliance by building system type

Besides having the highest issue percentage, electrical/lighting also has the highest non-compliance rate at 44% (compared to 27% for envelope and 14% for HVAC systems). The majority of clear failures to meet code requirements in this category were for control requirements. In many cases, the lighting control non-compliance items were for a small percentage of the building space. Most of the inadequate design detail occurrences in this category were related to lighting power density and conductor sizing. Even though complete lighting fixture wattage information was lacking for most buildings, the proliferation of LED lighting has led to a clear trend of most buildings have lighting power use densities much better than the level allowed by code. Code officials also commented that electrical contractors and designers tend to be unfamiliar with energy code requirements as they are not used to worrying about anything other than the National Electrical Code. This observation, combined with the preliminary results, suggests a widespread campaign to increase energy code awareness within this specialty area could be beneficial.

While the HVAC category had the lowest percentage of clearly compliant items at 6%, it also had the lowest not compliant rate of 14% and very high 46% rate of items not being required for specific projects. The majority of the items not required for these particular projects were either HVAC-related requirements for systems that did not exist, or were smaller than the threshold for which these requirements apply. Because two-thirds of the reviews were multifamily and hospitality projects that generally have simpler and smaller HVAC systems compared to other commercial buildings, it is likely a larger number of these items will be required among other types of large buildings.

The projects reviewed at the time of permit application are showing mixed trends in regards to energy code compliance path chosen. The most obvious impact of compliance path trends on
program design include whether materials for certain size buildings need to include options for both code paths. While this was not incorporated into the original program design, the results could also inform whether it could be cost-effective for a utility program to encourage building designs to comply with one particular code compliance path. Of the 10 projects committed to be reviewed for a city with a defined compliance path, 5 are following the ASHRAE 90.1-2010 prescriptive path, 3 are following the 2012 IECC prescriptive path, and 2 are using the ASHRAE 90.1-2010 performance path. While the majority of projects followed an ASHRAE path, both the significant fraction of “large” projects using IECC and 8 of 10 “large” projects using a prescriptive path differs from the findings of interviews with code officials and designers prior to program launch. These interviews suggested that only small projects would use IECC and that most large projects that use ASHRAE would use the performance path. For many of the projects, the compliance path had to be determined through verbal inquiry because the construction documents did not indicate which energy code compliance path was being followed. City staff reported that project team representatives often aren’t aware of the need to choose an energy code compliance path when submitting the plans, or which path the project is taking. Even some projects that did note a compliance path on the code summary sheet had some contradictory information provided elsewhere, and one project decided to change from the ASHRAE 90.1-2010 compliance path to 2012 IECC after a major issue with window area and orientation was noted in the program’s initial review. The inconsistent level of knowledge of the 2015 energy code paths suggests that building industry professionals are still adapting to the new code, so that the pilot program’s initial findings related to code compliance path selection trends may still change significantly over time.

**Evaluation**

The evaluation progress results presented here reflect only a small fraction of the quantity and type of results to be presented in the final report. In addition to the formal, planned evaluation activities, it is noteworthy that partner city staff have provided positive, unsolicited comments on the program review reports and have consistently passed along the comments to the design teams—directly or within their own prepared comments. The limited evaluation results available to date are presented below.

Capture of Key Design Element Data from Plan Review & Inspection of Program & Control Buildings. Field inspections to date have been limited to 3 buildings receiving city support. Figure 8 below shows the average compliance status across all measures based on the latest plan review on the left, and the latest inspection on the right. The two modest trends in the overall average results is a decrease in clear non-compliance from 19% to 9% that is offset by a similar increase in items not having enough detail to show compliance. The site to site variation in these trends varied widely, so conclusions about the importance of these trends will not be discussed in detail until much more data is available. The project teams were also generally informed about the permit stage review findings, so these results should also be representative of a combination of both program impact on projects and contractor execution.
Figure 8. Summary of plan review vs inspection findings for 3 buildings

The comparison of plans to inspection findings in the control buildings will give a better indication of the isolated impact of contractor execution of energy code items. Although partner city staff have assisted with the very recent recruitment of 5 building projects, no control plan review or inspection findings are yet available for comparison to each other or program participant buildings.

Code Official Focus Group to Get Feedback on Issues with the New Code. A formal group meeting of 7 code officials from 6 jurisdictions was held to find about early trends of issues with the 2015 Minnesota Energy Code and gain deeper insights into a number of other issues that could impact optimal program design and implementation. The key takeaways from this discussion are listed below.

Key Takeaways from Code Official Focus Group

- Contractors, manufacturers, and code officials all need more training and engagement opportunities around the energy code; all contribute to non-compliance
- Earlier and more frequent meetings with design teams around energy requirements is helpful, but a strain for some cities and it is challenging to get all relevant designers present for a meaningful conversation
- Energy code non-compliant projects are only being slowed in a minority of cases
- Deferred submittals are used as a way to permit a project and keep it on schedule, but there are questions as to the level of compliance of these projects as the submittals often happen too late in the process
• ComCheck is used sometimes as compliance documentation, but the reports do not always match the design and there is more need for education and clarification as to when it is an acceptable documentation tool
• There are concerns about design elements that aren’t being reviewed by designers or code officials, particularly electrical contractors working on lighting and power design
• Code officials and design teams need more tools to help highlight commonly non-compliant issues, and best practices around design documentation
• Cities/Code officials are not well equipped to review projects that meet code via a performance based path. As codes trend in the direction of more performance based standards, there is need for new resources and technical assistance
• Code path selection appears to be leaning towards ASHRAE, with the performance path often being selected for larger projects.
• Non-compliant issues are most often seen in the following areas: air barriers, lighting controls, continuous above-grade wall insulation in wood-framed construction, ultra low-leakage dampers, and vestibules.

A detailed report of notes from the meeting can be found in Appendix A. The final report will include a more in-depth discussion of recommendations for how the key takeaways and detailed results should inform future program refinement in combination with consideration of other evaluation results.

Survey Data Collection. Although all partner cities have had the on-line survey sent to them, only one has completed it to date. While the responses were overwhelming positive, it would be premature to present details of a single survey as an indicative preliminary program result. Surveys of project design teams have not begun as we are awaiting project completion. Note that a number of these surveys will eventually be conducted prior to project completion because the time lag between design review and construction would otherwise preclude these projects from being surveyed within the timeline of this pilot program evaluation.

Data Analysis. While key data is being tracked on program measure line-items, cost per review, cost per inspection, etc., the combination of this data with energy savings and program cost data has not yet commenced. Preliminary information on projected per-site energy savings for a limited number of line-items is presented in Table 7 below. The energy savings is based on DOE reference buildings used for energy code impact analysis and an assumption that non-compliant items will be designed based on the previous energy code. Note that the savings for each measure (as a percent of total building energy use) vary significantly between building types. This is due to a combination of varying absolute energy impact (e.g. daylight zone control doesn’t apply to many spaces) and varying base energy use intensities for the different building types (e.g. the very high process energy use in restaurants causes comparable absolute energy savings from insulation to be a much smaller percentage of the total energy use). Energy analysis for the remaining measures targeted by the program will be developed (except for those that show insignificant potential for improvement in compliance based on participating and control project reviews) and this analysis will include fuel-specific results. The combination of these energy savings per occurrence with participant and control design information by measure, building type, and project counts will provide a complete picture of program potential and actual energy impact.
Table 7. Preliminary energy impact for select measures by building type

<table>
<thead>
<tr>
<th>ENERGY IMPACT (% of site)</th>
<th>Multifamily</th>
<th>Office</th>
<th>Restaurant</th>
<th>Retail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Insulation</td>
<td>0.7%</td>
<td>1.3%</td>
<td>0.0%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Above Grade Wall Insulation</td>
<td>1.4%</td>
<td>1.4%</td>
<td>0.0%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Daylighting Zone Controls</td>
<td>0.1%</td>
<td>2.3%</td>
<td>0.3%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Lighting Power Density</td>
<td>0.8%</td>
<td>1.0%</td>
<td>1.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Economizer</td>
<td>-</td>
<td>1.0%</td>
<td>0.2%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Demand Control Ventilation</td>
<td>-</td>
<td>5.4%</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Preliminary results suggest several specific areas for fine-tuning of the measure list. First of all, the lighting power density review is both unlikely to find non-compliance and is very time-intensive. This item makes it likely that we will recommend excluding this energy code line-item from future inclusion in a program of this type. We are also finding that a large number of mechanical system requirements are not required for the vast majority of participating buildings, and will be considered for elimination from the recommended set of items. Finally, a number of mechanical system requirements have required a very high level of effort to verify in the design documents and/or the actual building (e.g. ultra low leakage dampers). In some cases a lower level of effort could be used to get less conclusive indications of the likelihood of compliance than the typical need to request submittals and/or contact manufacturer’s representatives to get complete information. The analysis will explore both the potential impact on program energy savings and program cost-effectiveness before making final recommendations for future program design.
Conclusions

While it is too early in the pilot to draw objective conclusions about program energy savings and/or cost-effectiveness, initial results suggest promise for the two pilot approaches to achieve energy savings through increased commercial energy code compliance. Both approaches target a limited set of energy code line items and building types in order to maximize the cost-effectiveness and energy impact with a reasonable level of conservation program funding. Primary factors for the selection of specific energy code line-items were energy impact and expected levels of non-compliance, while secondary factors were prevalence within the building types addressed by the first pilot program approach and practicality of being able to address cost-effectively in a production level program. The first program approach primarily provides technical support to design teams while they work on the design of a specific project that fits within one of four small building categories targeted by the pilot program. This support is in the form of an energy code “cheat sheet” with 25 items and review of preliminary designs prior to their completion. Project teams are given a modest financial incentive to clearly show compliance with these 25 items The second program approach provides third party review assistance to city code officials while they review larger, more complex projects.

Pilot program delivery is past the halfway point with mixed results for program participant recruitment. Neither city partnerships nor the use of a building project tracking data service have consistently provided leads for specific small building projects at the appropriate time for early design support of design teams. Therefore, recruitment efforts for small building projects to receive design team support have expanded to general outreach to designers without having identified a particular target building project first. Even with these expanded efforts recruitment for “small building” projects has been behind schedule. On the other hand, the pilot program found that close partnerships with cities has led to a rate of sign up above expectations for third-party review support to city staff at the time of permit application.

Review results from the second “large building” group (that did not receive design team support) have been showing much higher rates of non-compliance and inadequate design information than expected. This is encouraging in terms of the potential for energy savings from a code compliance enhancement program. Although there is only data from a limited number of buildings at this time, there are also encouraging findings about the ability of the program to significantly improve compliance. Also, the higher than expected non-compliance rates make it much more likely that a statistically significant difference in compliance rate can be observed in a smaller sample than the originally planned 40 small building participants. Preliminary results also suggest that specific reductions to the list of measures addressed by the program can reduce costs and simplify the program without having a significant impact on the energy savings achieved. The final report will include much more detailed analysis of the potential energy savings identified, the energy savings achieved, the program costs, and the cost-effectiveness of each program approach.
References

ASHRAE. AIA, IES, USGBC, and USDOE. 2011 and 2012. Advanced Energy Design Guide 50% Savings Series. Atlanta, GA. ASHRAE.


Appendix A

Commercial Energy Codes Implementation Discussion Session

April 27, 2016 | Center for Energy and Environment

OBJECTIVES

The purpose of this discussion is to gage the extent to which the market is successfully implementing (designing & constructing) the new commercial energy code. We expect this conversation to share valuable knowledge about market acceptance that:

a.) helps us determine the ongoing need for access to technical assistance

b.) highlights challenges across jurisdictions to help elevate awareness and future tools for success.

The conversation asked participants to talk about what the issues are, drill in to the why they exist, and think through how they know these issues exist (what are the indicators).

PARTICIPANTS

- City of St. Louis Park – Dave Skallet
- City of Blaine – Tim Manz
- City of Minneapolis – Dan Callahan
- State of Minnesota, Dept. of Labor & Industry – Don Sivigny*
- City of Minnetonka – Kevin McDermott
- City of Minnetonka – Lenny Rutledge
- City of Moorhead – Jack Nyberg*

*Denotes those that participated remotely.

DISCUSSION SEGMENTS & MAJOR TAKEAWAYS

The discussion session was divided into three segments, with some spare time to hear from the partner cities about the value of participating in the Commercial Energy Codes Support Program. Some notable takeaways include:

- Contractors, manufacturers, and code officials all need more training and engagement opportunities around the energy code; all contribute to non-compliance
- Earlier and more frequent meetings with design teams around energy requirements is helpful, but a strain for some cities & it is challenging to get all relevant designers present for a meaningful conversation
- Energy code non-compliant projects are most often not being slowed from development
- Deferred submittals are used as a way to permit a project and keep it on schedule, but there is question as to how compliant these projects are as the submittals often happen too late in the process
• ComCheck is used sometimes as compliance documentation, but it is not always accurate and there is more need for education and clarification as to when it is an acceptable documentation tool
• Concern about design elements that don’t need to be reviewed by designers or code officials, particularly electrical contractors working on lighting and power design
• Code officials and design teams need more tools to help highlight commonly non-compliant requirements, common issues, and best practices around design documentations (i.e. drawings & specs)
• Cities/Code officials not well equipped to review projects that meet code via a performance based path. As codes trend in the direction of more performance based standards, there is need for new resources and technical assistance

Based on the discussion session, the table below summarizes the types of compliance resources that can improve energy code compliance in Minnesota cities. In response to the questions asked, participating cities identified specific either tools that would be helpful or highlighted compliance problem leverage points. Together, these opportunities for improvement feel into three types of compliance resources: Tools & Training, Assistance, or Improved Processes.

<table>
<thead>
<tr>
<th>POINTS OF ENTRY</th>
<th>COMPLIANCE RESOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance Path</td>
<td>Tools &amp; Training</td>
</tr>
<tr>
<td>Review</td>
<td>Assistance</td>
</tr>
<tr>
<td>Inspection</td>
<td>Improved Processes</td>
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</tbody>
</table>

DISCUSSION NOTES

1 | Market Trends & Compliance Paths

1. What general trends are you seeing in the market place (greatest volumes of commercial construction; project team composition, etc.)?
Multiple cities see projects moving in the direction of a performance path because of particularly challenging requirements (e.g. auto shutoff lighting, timed controls, continuous insulation, and window-to-wall ratios).

To some extent earlier meetings between designers and code officials are moving projects towards a performance path because of the challenging prescriptive requirements listed above.

Tenant improvement work is challenging to hold accountable; have to push to get lighting specs on these projects (are working to do this)

Getting project teams to pick a path is a barrier in and of itself (and knowing that multiple aspects of the design all need to follow the same path) Getting the necessary team members involved in this decision is challenging or not done well in the industry.

Contractors and designers see ASHRAE standard as more familiar.

A big challenge lies with enforcing the electrical and lighting requirements. This work is often done by a master electrician and isn’t seen in the form of drawings or complete specifications until the work is being done on-site. Thus, inspection is the first and only time to enforce this work, which is likely too late.

Could we incorporate energy conservation into the NEC? Generally, could the energy code be adopted into other respective codes?

Need more electrical contractor training around the energy code.

Many requirements are waved at the time of permitting and become contingent on deferred submittals. This allows the project to move ahead without delay, while
frequently delaying approval so late that there is little opportunity to enforce some code requirements.

- There is interest and need for commercial checklists that can be applied to prescriptive projects. (This could be a version of what CEE has created for the Commercial Energy Codes Support Program pilot.)
- ComCheck is being used with some frequently (less than 50%).
- There is some lack of clarity about which compliance paths ComCheck is a viable piece of documentation (prescriptive versus performance and mandatory requirements versus non-mandatory requirements.
- When ComCheck documentation is submitted, the information may not align with what is on the plans.

2. **Why do you think you see this lack of compliance?**
   - Lack of code understanding by contractors as well as manufacturers (reps).
   - Design engineers and architects need more education.
   - Code officials don’t understand the energy code sufficiently, particularly considering the emphasis on health and life safety focused codes.

2 | Reviews

3. **How many projects have you now reviewed for the new energy code?**
   - There is a project lag because of grandfathering and rush to get projects in under old code. Most projects under the new energy code have submitted for building permits just recently (late Jan./early Feb or since).

4. **Which requirements/sections tend to have the most non-compliance at the time of review (envelope, mechanical, lighting, domestic hot water, additional EE packages)?**
   - Air barriers
   - Lighting controls – getting the details documented and installed
   - Continuous insulation in stick construction walls; seeing examples of projects where more insulation is installed in the walls to compensate for the roof knowing that they aren’t meeting the roof requirement
   - Dampers on roof-top units aren’t meeting the leakage requirement & manufacturers aren’t stocking locally making for extended lead times which requires more planning ahead
   - Too much reliance on passive ventilation in R-2 multifamily buildings; more often need to move in the direction of mechanical ventilation to meet <5 ACH requirement
   - Vestibules – when requirement applies

*The challenges come from all sections of the energy code*

5. **How often is ComCheck Submitted as (partial or complete) compliance documentation?**
• All cities agree that they see it used on <50% of projects; some cities only see it for a small fraction of projects.
• Need to cross-reference ComCheck documentation with the plans (often times not consistent)
• Unsure if ComCheck is a helpful compliance tool; most cities in the discussion haven’t seen enough ComCheck documentation to have a conclusion

6. What pre-design meetings do Cities currently require?

<table>
<thead>
<tr>
<th>Current Variety of Practices Shared:</th>
</tr>
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<tr>
<td>Minority of project teams come in for pre-design meetings</td>
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</table>

7. Are you seeing an increase in the number of pre-submittal plan reviews?
   • Project teams are not requesting earlier meetings
   • Some cities are recommending earlier meetings and more frequent meetings with code officials before drawings are submitted for building & other permits

3 | Inspections
8. How many projects have you now inspected under the new energy code?

None of the participating cities have projects that are meeting the new energy code that have completed construction and inspections.

9. Which requirements/sections tend to have the most non-compliance at the time of review (envelope, mechanical, lighting, domestic hot water, additional EE packages)?
   • HVAC balancing & system capacity design is correct and installed properly
   • Continuous insulation in above grade walls
   • Ventilation system installation is correct or not installed at all
   • Controls for unoccupied rooms are not installed

*Non-compliance falls across all code sections, including domestic hot water.

*This question was answered specifically by building inspectors speaking from field experience since the new energy code was put in place.

10. Are projects being delayed because of non-compliance with the energy code?
• Based on the DLI 2012/2013 Code Compliance Study, energy code non-compliant projects were not being delayed or halted.
• In Minneapolis there are some examples of projects being delayed when energy models are involved (extra time needed by the design team to get the design to meet the requirements)
  o If projects move in the direction of energy modeling, cities don’t necessarily have people to review the models
• No other cities had examples of project delays, even if projects weren’t compliant

**Partner City Feedback & Comments: Commercial Energy Codes Support Pilot Program**

• Pilot program summary of challenging requirements is a very helpful “cheat sheet”
• Detailed comments have been a real eye opener as to what is not compliant; helpful for upcoming inspections
• Helping cities better understand where they are seeing non-compliance and to think through tools they need as solutions (e.g. Pre-construction meetings with construction teams; focused energy code training plumber and electrical contractor trainings)
• Helpful to have checklists and detailed documentation at the time of review so that it can be used during inspection

**Other Discussion**

• At the national code-making level the trend is to move towards more performance-based requirements
• Some code officials expressed interest in more prescriptive based codes because the performance-based codes are too hard to enforce
• Hard to delay projects because it is not a health or life-safety based code, but this doesn’t mean the projects are compliant
• May non-compliance issues come from not needing to permit the electrical and lighting work at the time of the plan review; the design and installation are done late and with little to no oversight until after they are installed