

Regional Efforts to Capture Energy Savings through Enhanced Energy Code Compliance

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ABSTRACT

California has one of the nation's most ambitious building energy codes, and the state, local governments and utilities rely upon it to assess progress toward greenhouse gas reductions and zero net energy goals. However, with each progressive update, it becomes more difficult to comply with and enforce the code. Utilities, professional organizations and the state offer education and support programs designed to improve understanding of, and compliance with, the code. However, there remains a lack of sufficient building-specific data and compliance feedback on the as-built performance of newly constructed buildings with specific energy measures at a local level. With this in mind, the Bay Area Regional Energy Network (BayREN) has been developing and implementing complementary efforts aimed at establishing county-level baselines of energy code compliance rates and performance indicators, in order to be able to monitor compliance improvement.

This paper summarizes the premise, methods, results, and market transformation implications of BayREN's Energy Code compliance improvement program, including:

- a comprehensive nine-county Codes & Standards Survey for public staff and private sector stakeholders in the building permit process, to identify barriers and training needs;
- third-party, on-site Energy Code compliance assessments, including review of plans and field inspections, and comparison of the performance of new buildings to code requirements and submitted designs;
- local trainings and forums on energy code issues, best practices, process improvements, and recommendations for enhancing compliance with energy codes; and
- incorporation of behavioral science principles in order to drive participation and follow-through among local governments.

Introduction

California's Building Energy Efficiency Standards, codified in Title 24 of the California Code of Regulations, are targeted for update every three years, and are among the most stringent in the nation (ACEEE 2013). By comparison, a building constructed under 2013 Title 24 is projected to use 12 percent less energy than a similar structure built to ASHRAE 90.1-2010. (California Energy Commission 2013) Title 24 provides the regulatory framework for the construction of energy efficient buildings across the state. The California Energy Commission has estimated that the 2013 Standards, due to go into effect July 1, 2014, will save \$1.6 billion in energy costs over the next 30 years. (California Energy Commission 2013) Raising the efficiency standards by 25 percent for residential buildings and 30 percent for nonresidential buildings relative to the previous code, the new Standards keep the state on a pathway to its long-term goal

of mandatory zero-net-energy (ZNE) residential buildings by 2020 and ZNE nonresidential buildings by 2030.

While the Standards continue to drive efficiency forward, multiple reports indicate that compliance with such standards significantly limit the real world savings achieved. Compliance rate estimations literally run the spectrum, from estimates of 0-100 percent, depending on the methodology, location, and type of construction considered (Williams 2013). Compliance rate estimates for both residential and commercial construction tend to run between 50 and 90 percent, but vary widely in how these rates are determined. In California, the most recent comprehensive studies place the compliance rate for nonresidential buildings at 63 percent (Heschong Mahone Group 2009) and residential buildings at 25 percent (Khawaja 2007). Higher estimated compliance rates of 83 percent for both residential and nonresidential new construction and 70 percent for alterations were used in the development of the 2013 Building Energy Efficiency Standards in California, based on analysis of the 2005 state standards (KEMA 2010). It is important to note that a follow up assessment of energy efficiency potential indicated “the compliance rates for 2005 Title 24... were relatively high. It is uncertain if post-2005 standards will be able to achieve the same level of compliance, given the code requirements are more stringent” (Navigant 2012).

What these studies illustrate is the wide variety of techniques, assumptions, information, and methods used to estimate compliance with energy codes. The high cost of comprehensively reviewing building plans, energy models, and constructed buildings results in the development of methodologies that calculate compliance in disparate and non-comparable ways. A minimum of nine distinct methods for estimating compliance were identified in state-level compliance assessments (Misuriello 2012), many of which were affected by issues such as participant bias, sampling error, regional differences, and enforcement variations. Beyond this, each study is significantly limited by the likely levels of enforcement that occur under different local governments within the same state, as well as by individual building department staff in a particular city or county.

The Bay Area Regional Energy Network (BayREN) Codes and Standards program is addressing these concerns by providing a deeper level of analysis, which includes impacts at multiple points in the process of plan review and inspection, a large number of building departments, and reflects the added complexity of post-2005 standards. Further, the inclusion of jurisdiction-specific recommendations for compliance enhancement and active participation of the building department staff make for a more rigorous and integrated set of solutions.

Effects of Noncompliance

While energy codes are designed to ensure a minimum level of performance for newly constructed and renovated buildings, poor enforcement of such standards leads to a loss of potential energy and demand savings, and higher operational costs to building owners and occupants. Using the noncompliance rates assumed by the California Energy Commission, BayREN projects there is the potential for an estimated 32.26 GWh of first year savings in the Bay Area, relative to the 2008 standards. Given the high estimates of compliance used in that approach, the likely potential savings are even higher. As the standards continue to add complexity around energy issues, compliance will grow increasingly difficult for local governments to achieve. Only by finding new ways to document and track ongoing compliance

improvement can state and local governments hope to realize the potential benefits of codes and standards programs.

Negative effects resulting from noncompliance include not only the need for more electricity and natural gas generation, but also worsened indoor air quality, increased greenhouse gas (GHG) emissions, and decreased occupant satisfaction with buildings. Also lost in noncompliance is the economic benefit derived from increased compliance work itself. A recent analysis at the national level concluded that investments in energy code enforcement returned \$6 in energy savings for every dollar spent (Institute for Market Transformation 2010).

In addition to these effects, noncompliance also creates an opportunity for local governments. The growing practice of climate action planning has led to municipalities establishing goals for GHG reductions within their communities, and documenting and improving the compliance rate with energy codes is a creative and potentially effective strategy to meet these reduction targets. By utilizing education, tools, and other compliance improvement strategies, cities and counties can claim the GHG reductions associated with the decreased energy demands. When calculated across the full range of permitted projects, the potential for compliance enhancement as a GHG reduction strategy is a strong motivator for generating interest among local governments.

Barriers to Compliance

There are a variety of well-established factors contributing to the lack of enforcement of energy code provisions. These can be broken down into private sector barriers on the applicant side and those in permitting and enforcement on the local government side. While additional concerns certainly exist, the following list characterizes the bulk of factors reducing compliance.

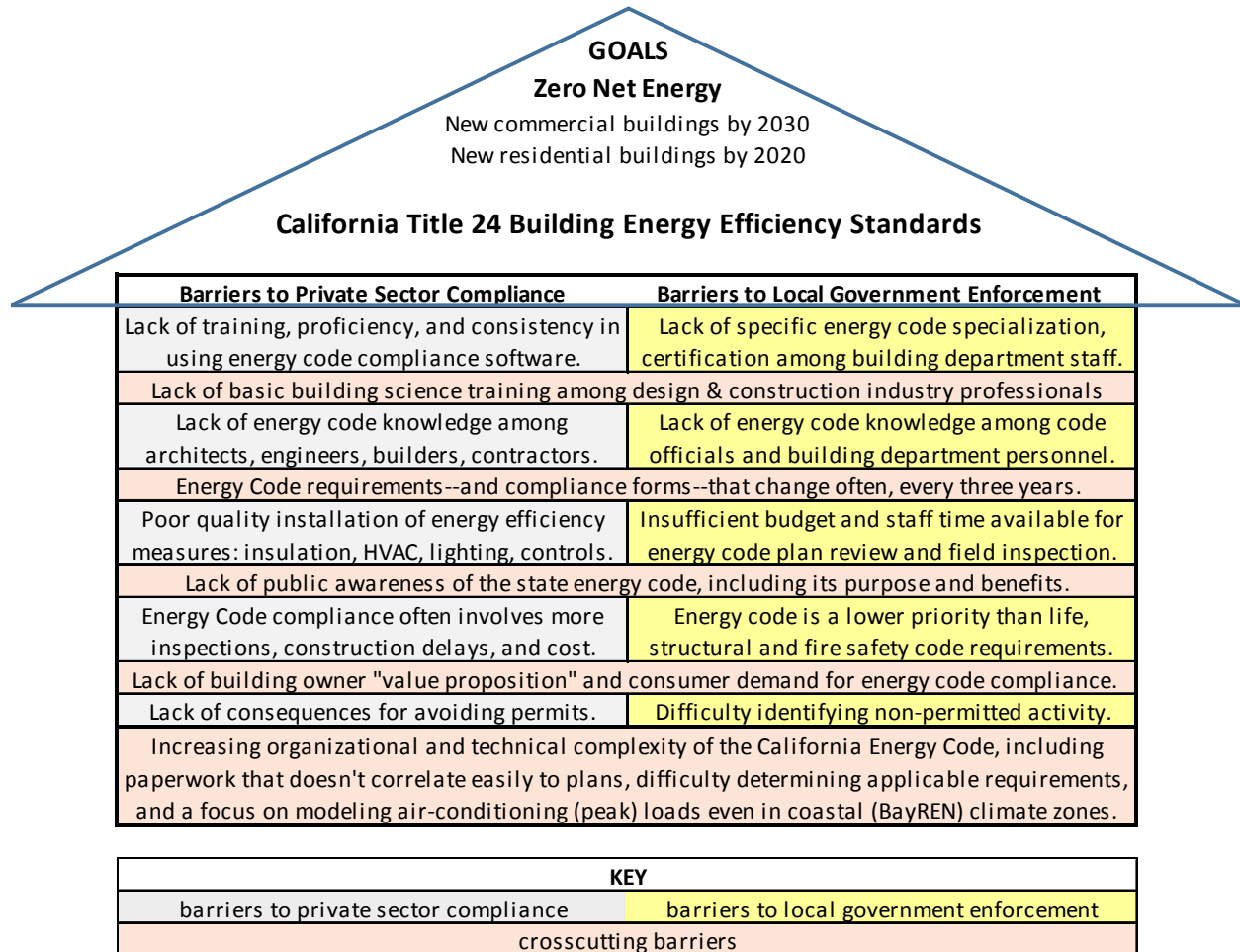


Figure 1. Goals and major barriers to compliance and enforcement of California's building energy code. *Source:* Williams 2013, BayREN 2013, Institute for Market Transformation 2010.

Chief among the barriers to private sector compliance is the lack of a value proposition for compliance in general and energy efficiency performance in particular. Permit avoidance and discrepancies with code provisions do not carry heavy penalties, and there is no feedback mechanism to drive improvement if the end user is unsatisfied with the performance of the building. Most critical among the local government barriers are the lower prioritization of the energy code relative to life and safety code sections, and the time constraints placed on local government staff in permitting and inspecting projects. It is anticipated that the growing complexity of California energy codes, including system controls, automation, and load disaggregation requirements, will also soon lead to difficulty in technical comprehension as well.

The BayREN Regional Approach – Compliance Assessment

The BayREN Codes and Standards (C&S) program was created to provide assistance with energy code compliance assessment and improvement on a regional level, using the expertise and unique role of member local governments to address many of the difficulties already described. As briefly discussed above, compliance rates are difficult to establish for a variety of reasons, including the high cost of assessment, local variations in process, and

inconsistency among the energy models and permitting software systems used by local governments. BayREN's program design addresses these barriers by directly engaging the participation of city and county building departments, leveraging relationships among local government leaders, and integrating the successful aspects of the other compliance assessment and improvement efforts.

The initial task of the C&S program is to evaluate regional rates of energy code compliance for residential and nonresidential buildings. Considering that 2013 was the first year of BayREN's existence, and there are more than 100 building departments within its nine-county region, targeted participation from a range of local governments in each Bay Area county was critical. Six counties are represented by one participating government, while three pilot counties were selected in which to focus additional evaluation efforts: Alameda, Contra Costa and San Francisco. In total, 17 local governments were targeted for participation.

Outreach began through an online survey designed to elicit input regarding energy code compliance barriers, training needs, and building department resources, processes, and priorities. The target audience included chief building officials, plans examiners, building inspectors, and planners as well as private sector architects, builders, and contractors who regularly pull permits. Each target audience received a set of questions pertinent to their role in the compliance process and designed to yield a mixture of quantitative results and qualitative comments. After a month of survey activity, we compiled the results and summarized our findings and recommendations, which informed our subsequent compliance assessment activity (BayREN 2013).

The next step was to recruit and visit 17 building departments, with the goals of:

- Observing their existing permit tracking and energy code enforcement processes,
- Reviewing plans and compliance documentation of up to four permitted projects,
- Visiting active or final building sites to collect as-built data on energy measures,
- Modeling the impact of discrepancies between planned and as-built energy measures, and
- Working with department staff to identify several compliance improvement activities.

Program representatives visited at least one jurisdiction in each county, and several jurisdictions in each pilot county, except the City and County of San Francisco, which conducted a guided self-assessment using identical methodology. Each building department has its own local government, type and volume of building activity, and processes for tracking permits, conducting plan reviews and performing field inspections. These building department visits formed a basis for assessing current levels of energy code compliance and enforcement. By identifying building-specific discrepancies between permitted and installed energy measures, the assessments were able to quantify the impact on compliance. By providing new energy code compliance tools, and committing building departments to periodically report on their progress and feedback (both pro and con), the program initiated a comprehensive local process for compliance improvement.

The San Francisco self-assessment was a unique variation on the overall approach, seeking to build on the staff expertise and knowledge of local building energy code issues. The assessments were provided by staff outside of the Department of Building Inspection, and otherwise followed the same methodology and approach of the other program participants. By allowing San Francisco to conduct these assessments, a greater number of buildings were able to be targeted in the review and thus more data generated. Staff responsible for performing the assessments received training from the program consultants to ensure identical processes and analysis.

There are two key aspects of the program design which raise the potential for sampling bias. Participating jurisdictions were selected on a first-come, first-served basis. Further, projects reviewed under the program were those at or near final construction and occupancy at the time of the site visit. Both of these elements of the program could result in selection bias which affects the overall accuracy relative to region-wide compliance rates. The decision to allow for these elements was based on the voluntary nature of the program and the desire to reach the high targeted number of jurisdictions.

Figure 2 outlines the general process used by local building departments to enforce the California energy code. The role of third party providers in the process serves as both an added check for energy measures as well as a complication in determining who is responsible for verifying measures. The complexity of this system is one of the chief barriers identified by local government staff to energy code compliance (BayREN 2013).

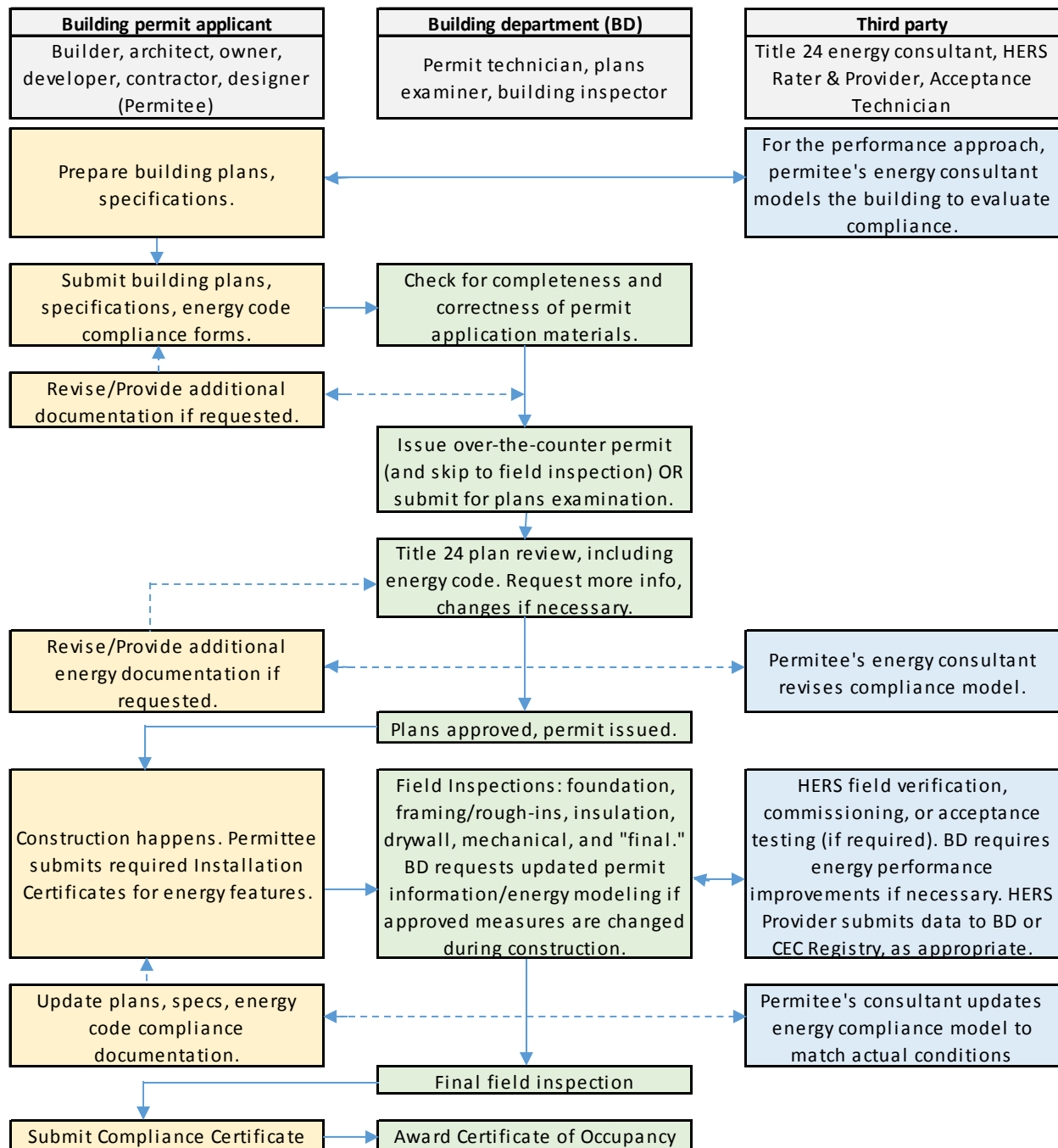


Figure 2. California energy code compliance and local enforcement process.

The BayREN Regional Approach – Compliance Improvement

BayREN's Codes & Standards program complements and leverages the two main additional efforts to improve local compliance with energy codes. The Building Codes Assistance Project (BCAP) is a national nonprofit energy efficiency advocacy organization that offers assistance with development, implementation, and enforcement of energy codes, including compliance evaluation and community outreach. The California statewide Codes & Standards Program is administered by investor-owned utilities (IOUs) for the purpose of proposing updates

to the energy code and improving compliance with California building efficiency standards. While these two initiatives have produced some positive tools and resources for compliance evaluation and enhancement, their approach has focused mostly on improving knowledge of specific codes and forms. The BayREN C&S program builds on this by creating and implementing activities that incorporate not only trainings and tools, but also behavioral elements and local government networks to drive greater compliance.

Existing workshops and classes are available through the local IOU and professional organizations for both residential and nonresidential building types, often role-based and targeted to specific building types and systems (Lee 2010). BayREN encourages its building departments to send their staff to these role-based classes, and also provides its own trainings to address specific compliance issues. Thus, a plans examiner may attend an IOU course on residential building efficiency standards, and will follow that with a BayREN training on the myriad ways in which plan submittals may not fully reflect those standards. The BayREN trainings address specific needs identified during our stakeholder survey and building department visits, providing locally relevant examples and direction reflecting real world scenarios. BayREN trainings include short in-person or webinar sessions addressing specific case studies or issues, and longer, in-depth workshops centered on strategies for improving compliance and enforcement, respectively, with specific aspects of the energy code, such as nonresidential lighting and mechanical systems.

While the trainings are an important part of the process, the unique aspect of the program is the delivery of targeted Compliance Improvement Metrics (CIMs). Based on the on-site compliance assessments, BayREN provides each participating building department with a list of measures, process improvements, tools, guides, and ideas to drive increased compliance. Each list is customized to the compliance issues and climate zone of the local government, and includes ranking based on the potential energy savings and the ease or difficulty of implementation. This list becomes a priority ranking of the ways in which the department can increase its effective implementation of the energy code. Provided to the Chief Building Official, the various measures on the list can then be selected based on the local knowledge and preferences of the department, and built into the existing systems already in place. In addition to these CIMs, each department is provided tools and guidance on tracking energy code compliance in the future. This ongoing self-assessment allows the department to evaluate the effect of particular changes, and illustrate achievements to their elected leaders and fellow building departments in their County or area.

The education, behavioral elements, and CIMs work together to form a comprehensive and localized approach to enhancing compliance with energy codes. Rather than trying to change or standardize their normal business practices, the Program is designed to help each department find ways to easily integrate specific energy code compliance activities into their normal routine. These activities range from using BayREN-specific over-the-counter permit guides for common residential alterations, such as window replacements and re-roofing, to prioritized checklists for use during plan reviews or field inspections, and hosting brownbag lunches during which a local energy consultant answers questions that staff or permit applicants have about the energy code. By performing deep analysis of jurisdiction-specific buildings and empowering the local leadership with the knowledge and tools to drive compliance, the program provides the participants a much deeper sense of ownership in the process improvements. It is this element that the Program seeks to emphasize as most critical in developing successful compliance improvement strategies.

The BayREN Regional Approach – Code Advocacy and Support

While compliance enhancement is a primary goal of the overall C&S Program, the BayREN is also focused on assisting local governments in adopting more progressive and ambitious energy policies. To accomplish this, the Program provides support for local governments in the development of advanced energy codes and policies, as well as representation of local government priorities in establishing statewide energy codes. Local governments in the region have been among the most active and progressive in their consideration and adoption of advanced energy policies. Beginning in 2010, California formalized advanced “tiers” for codes which adopted additional energy and green building standards beyond those required in the base code. Tier I represents a 15 percent reduction in overall building energy budget, with Tier II representing a 30 percent reduction. In addition, a number of Bay Area communities have elected to adopt green building ordinances reflecting checklist approaches capturing energy savings and other environmental benefits. Since 2010, 34 cities and counties in the Bay Area have adopted one or more of these ordinances (California Energy Commission 2014). In addition to advanced building codes, cities and counties in this region have adopted Residential Energy Conservation Ordinances (RECO), Commercial Energy Conservation Ordinances (CECO), Benchmarking Ordinances, and a variety of municipally-administered energy efficiency programs for residents, businesses, and government facilities. Climate Action Plans (CAPs) also include a variety of implementation policies linking the GHG emissions reductions from municipal energy programs to overall carbon reduction goals. BayREN assists in analysis, advocacy, and adoption of each of these efforts.

While these advocacy efforts appear independent of the compliance enhancement work, the assistance that BayREN provides in considering and adopting these advanced ordinances and policies is critical to the overall effort. By helping to raise the baseline expectations and requirements in new buildings, these approaches give local governments a vested interest in compliance with energy codes. Additionally, the information obtained in the on-site assessments is used in advocating for improvements to the Title 24 Standards. By ensuring that participation in the program will result in a more effective voice in the development of future codes and standards, BayREN is seeking to better align the implementers of the energy codes with those who craft it.

Code Compliance as a Behavioral Program

Although energy code programs are traditionally thought of as exclusively technical and standards-focused, compliance enhancement is inherently a behavior change initiative. Such programs resolve to raise the perceived importance of energy codes in the plan review and inspection process, and develop tools and information to ease the burden of enforcing the requirements. The challenges of increasing compliance rates are highly influenced by the perceived importance of the codes among the key participants in the system: energy analysts, architects, engineers, contractors, plans examiners, inspectors, and building officials. Their values, motivations, and beliefs about the energy code are as important to its robust implementation as the HVAC, insulation, and lighting requirements. While there is a portion of this effort aimed at assisting local governments with advanced codes and policies, the bulk of the

program elements focus on communication, rebranding, assessment, data management, and other tools to drive increased compliance.

Table 1 provides an explanation of the behavioral elements addressed in the program, along with the ways in which the principles are applied to the program.

Table 1. Behavior change program elements

Element	Description	Program application
Social norms	Influencing actions by conveying actions and beliefs of peers they respect	Using early program participants to recruit new participants; highlighting local similar efforts
Feedback	Influencing action with information about performance relative to issues being emphasized	Providing on-site assessments to give locally focused information on compliance rates and practice
Public commitment	A public commitment leads to greater follow through with action	Participation is publicized with elected officials and surrounding communities
Goal setting	Participant who sets a goal is more likely to take action	Follow up compliance improvement actions are goal based, established by participant
Anchor bias	How issue is framed at outset affects impressions of future information	Compliance rate formalized in early stages; baseline for desired improvements and goals
Foot-in-the-door	Starting with smaller changes will increase potential for later larger changes in behavior	Initial follow up compliance measures are prioritized by ease of implementation
Self-efficacy	Perception that behavior change is both possible and effective	Continuous feedback loop to document effectiveness of actions and follow through
Reciprocity	Tendency to reciprocate when something is offered	Program presented as State money to assess compliance, if participant will take action to improve compliance
Priming	Asking about intentions changes the way people behave around issue	Participants pick from lists of potential actions, and provide direction for how they will act

Element names and descriptions are paraphrased from previous work. *Source:* Ashby 2010

Preliminary Hypotheses and Results

While full results of the on-site assessments will not be available until late 2014, hypotheses based on preliminary information and results are helping to guide ongoing efforts. Since program launch in mid-2013, several recurring themes have been identified relative to the perspectives, involvement, and compliance efforts of local city and county governments. As one of 12 parts of the California Building Code (Title 24 of the California Code of Regulations),

building departments view the energy code as one of the least critical areas necessary in the construction of buildings. This is consistent with previous studies addressing compliance rates, and generally conforms to the belief that building departments prioritize life and safety issues above energy, green building, and other policies not associated with the structural integrity of buildings (Williams 2013). The traditional approaches to increased compliance—educational workshops on standards, direct communication on energy savings, compliance form tracking, etc.—provided support for increasing knowledge of the code but without truly addressing the reasons why professionals weren't prioritizing it in the first place.

As a result, this program seeks to address the “why” as well as the “what” as its priority. By focusing on the reasons why building department staff, energy professionals, and design engineers don't emphasize energy codes, we aim to drive higher interest in and change perceptions around both the code and its implementation. One of the initial outreach efforts was the establishment of a Regional Forum, held every two months, to address energy issues among local governments. Although the Forum topics have varied from advanced energy codes to climate action planning to building benchmarking, we have used these events to highlight how compliance with energy codes affects all of these efforts. The diverse audiences for these Forums have included elected leaders, senior staff in a variety of departments, technical and policy experts, community advocates, building owners and representatives, and consultants. By framing compliance around these issues, the program has generated interest and involvement far beyond just the building department, and tied a variety of non-traditional stakeholders to the outcomes of the process within specific jurisdictions.

Another early identified need of the program is the incorporation of local priorities and concerns into a regional program. The on-site compliance assessments involved following plans examiners and building inspectors, and making recommendations for improvements relative to energy issues. As expected, many staff did not embrace the effort fully from the start. Responding to these concerns, the program team added elements to make the process less intrusive and more beneficial to the participating staff. The first and most critical addition was confidentiality. The results of assessments in a city or county were reported only to the Chief Building Official, and distribution or sharing was determined from that office only. By anonymizing the results, individual cities and counties could be assured that their processes would not be demonized, and no negative outcomes would be assigned to them. Further, although the jurisdictional assessments were anonymous, any identified best practices were personalized and shared with others. This has created a competition among participants to have elements of their processes and work selected as best among the program communities. Finally, each assessment visit was personalized to the priorities and desires of the local staff. Building types, dates of visits, follow up compliance improvement metrics, and other elements were decided jointly with building departments to give them a sense of ownership of the process and its outcomes.

The flexibility of the compliance improvement options is also proving to be of significant value. At project initiation, the team developed a list of strategies to address the anticipated major compliance concerns, and ranked each according to its ease of implementation and potential to save energy. This list has served as the starting point for identifying specific ranked CIMs for participants, and can be used independently to illustrate the wide array of options for improving compliance. By aligning recommended changes with specific findings from the on-site assessments, cities and counties can see the direct link to changes in constructed buildings. By having building departments select their own CIMs off this list, the departments have a more

vested interest in the adoption and implementation of the measures. We believe this range of options and local responsiveness will better drive compliance improvement at the local government level, and strengthen the commitment to continuous improvement over time.

Program Outcomes

By the end of 2014, the C&S Program will produce a report documenting the regional energy code compliance rate, along with a comprehensive set of compliance improvement metrics for cities and counties to consider in strengthening their plan review and inspection processes. This report will be delivered to all local governments in the region. More than 50 local trainings are scheduled for delivery in the second half of 2014 to provide role-specific compliance improvement strategies to public and private sector professionals, building on the results of the compliance assessments and surveys. Feedback from building departments will be aggregated and submitted to the California Energy Commission to help guide refinement and development of the next generation of the state energy code, and increase the role of area local governments in energy policy at the state level. Finally, the Program will document the number of stakeholders reached through Forums, trainings, and other outreach efforts.

Conclusions

The BayREN C&S Program is an ambitious effort of the 109 local governments of the San Francisco Bay Area to document and increase the rate of compliance with building energy codes and capture energy and demand savings in newly constructed and renovated buildings. The program design, while limited by some of the traditional factors that make it difficult to document compliance rates, provides an innovative and comprehensive approach to truly understanding the factors and potential solutions to low compliance rates. By fully integrating local governments officials into both the analysis and the development of compliance improvement metrics, and by taking advantage of the approaches pioneered in behavioral science, the program seeks to develop a deeper and more nuanced understanding of the process for examining plans and carrying out inspections; to identify realistic and implementable tools to drive up compliance; and create develop a replicable model for energy code compliance enhancement for other cities and counties across California and the United States.

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