Standards Education and Training as a Resource Program

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ABSTRACT

Codes and standards compliance enhancement is emerging as a compelling resource program strategy that provides significant low-cost energy savings. Since 2001, the California Energy Commission (CEC) has adopted numerous changes to California's Building Code (Title 24) and Appliance Efficiency Standards (Title 20), both advancing existing standards and significantly increasing the scope of California's regulations. This widened scope has created a critical need to support stakeholders, to make sure they are aware of code changes and understand their role in compliance. A new Standards Education and Training (SE&T) program responds to this need.

SE&T is aimed at practitioners responsible for interpreting regulations, such as building designers, contractors, manufacturers and distributors, as well as the code officials responsible for enforcement. For Title 24, SE&T strategically focuses on individual measures, rather than attempting to increase compliance as a whole – a problem too complex to tackle at once. SE&T targets a handful of measures representing the majority of potential energy savings. For Title 20, SE&T provides educational outreach to manufacturers and product sellers in California. To our knowledge, this is the first program targeted to improve compliance with appliance standards.

This paper presents an overview of SE&T program theory, linking the activities to increases in the compliance rate and associated energy savings. This program may serve as a model for other energy efficiency advocates as changes in the administration and legislation may result in similar opportunities nationally and for other states that have adopted measures from California's standards.

The Case for Compliance

Improving compliance to California's building and appliance codes plays an important role, both for the industry as part of the cycle of product innovation and for policy makers to ensure energy savings from Codes and Standards programs. In addition, recent CPUC decisions allow energy savings from post-2006 C&S activities to count towards utilities' performance earnings basis, making compliance an important resource program for IOUs.

Industry Setting

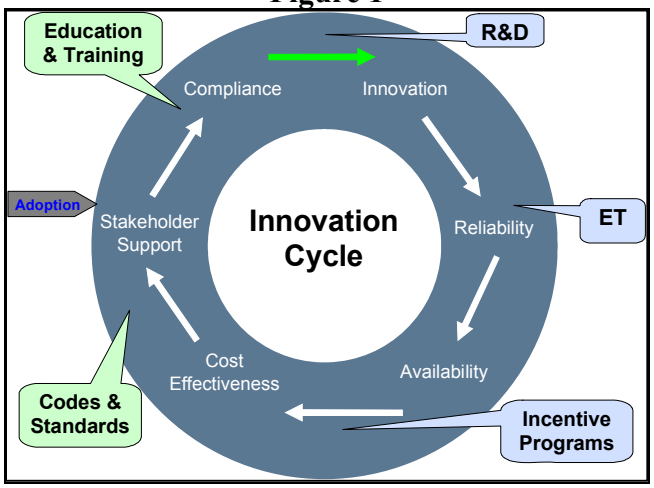
Compliance occupies an important position in the innovation cycle for energy efficiency products and services (Figure 1). This cycle is a closed feedback loop, so a lagging step reduces expediency of innovation for the industry as a whole. One well-known aspect of this cycle is that, once a product or service reaches a significant market share, regulation through codes and standards is an excellent strategy for extending market change achieved through early adopters to

others less inclined to participate in voluntary programs. Regulation, therefore, completes the market transformation process and captures societal benefits.

Less well-known and less understood is the key role of regulation in innovation. Adoption into code is a process of commoditization in which a technology or service that was once a high-margin product becomes the industry standard. Commoditization reduces price which, in turn, stimulates innovation since most companies prefer a competitive strategy that includes, at least in part, high margin, differentiated products.

Inconsistent compliance among industry competitors negatively impacts the adoption process as well as the efficacy of adopted codes. In addition to direct losses, noncompliance reduces industry throughput; for example, a well-intentioned building or service provider may be burdened by additional costs compared to a competitor with no intention to comply with regulations. This uneven "playing field" erodes support by industry practitioners for adopting new standards and wears away voluntary program baselines. Moreover, incentive program managers need to know that their market conversion efforts are being adequately captured through satisfactory compliance with regulation.

Figure 1



Source: PG&E C&S Program

Policy Setting

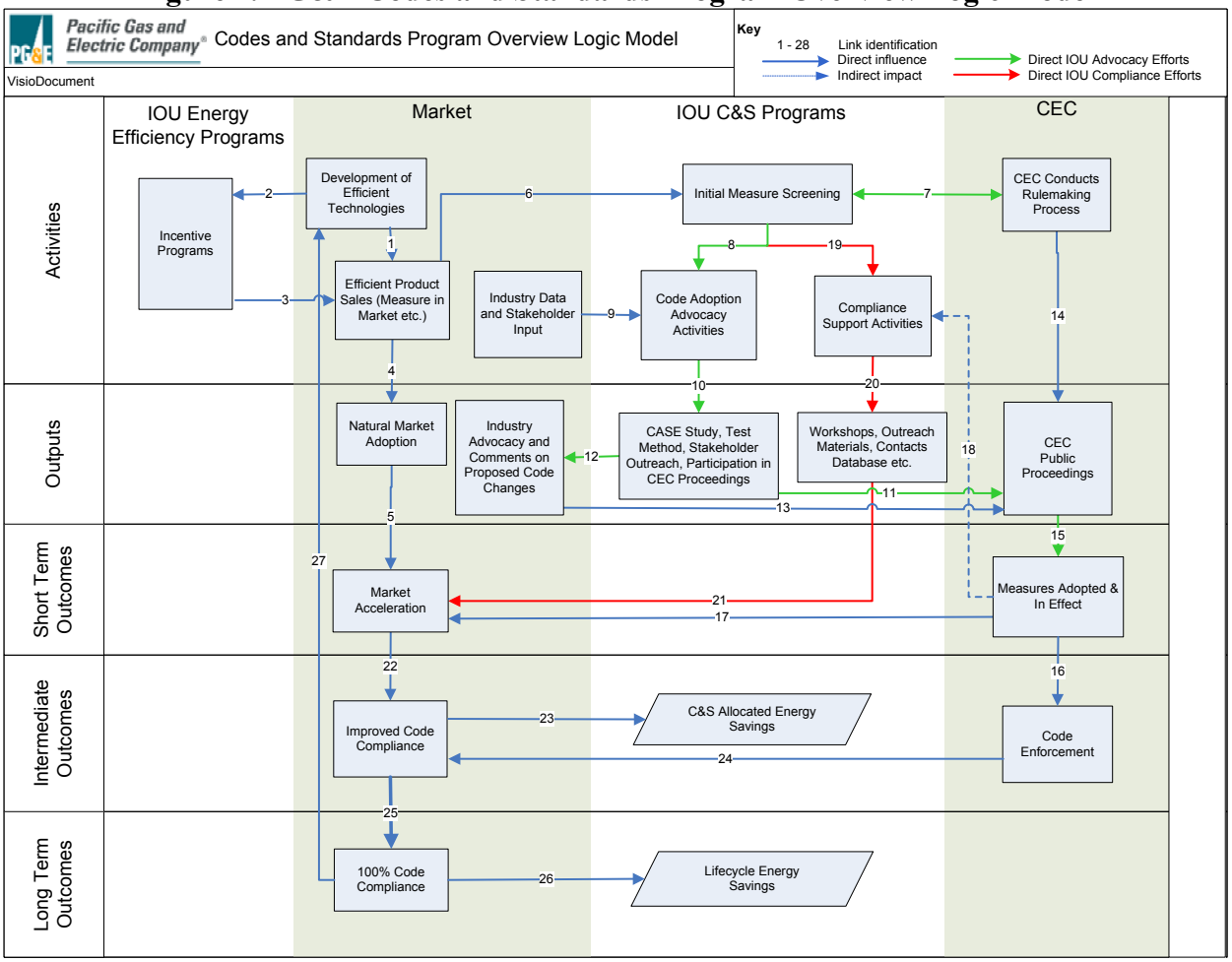
PG&E's Codes and Standards (C&S) Program aims to both assist the CEC in the adoption of new standards and to improve compliance with existing standards through SE&T, as shown in Figure 2. Both advocacy and compliance activities fit within the cycle of market conversion and natural market adoption (shown under the "Market" column in Figure 2 and discussed above), with the code adoption advocacy activities driving the baseline up and SE&T helping to increase sales of efficient products.

The advocacy component of PG&E's C&S program saves energy by influencing code setting institutions to increase the breadth of coverage and stringency of energy efficiency standards. Our principal target is the California Energy Commission (CEC) which conducts periodic rulemakings, usually on a 3-year cycle, to update building and appliance efficiency standards. The program also seeks to influence the US Department of Energy (USDOE, not represented in Figure 2).

The C&S program conducts a number of advocacy activities to improve building and appliance efficiency regulations, including the development of Codes and Standards Enhancement (CASE) studies to promote code ready design practices and technologies, which are presented to standards and code-setting bodies. Following adoption, PG&E's C&S program supports Standards Education and Training (SE&T) to improve compliance with both Title 24

building code and Title 20 appliance efficiency regulations. Though SE&T could easily be a stand-alone educational program, it complements PG&E's Codes and Standards (C&S) advocacy activities, resulting in a comprehensive Codes and Standards Program.

Figure 2. PG&E Codes and Standards Program Overview Logic Model

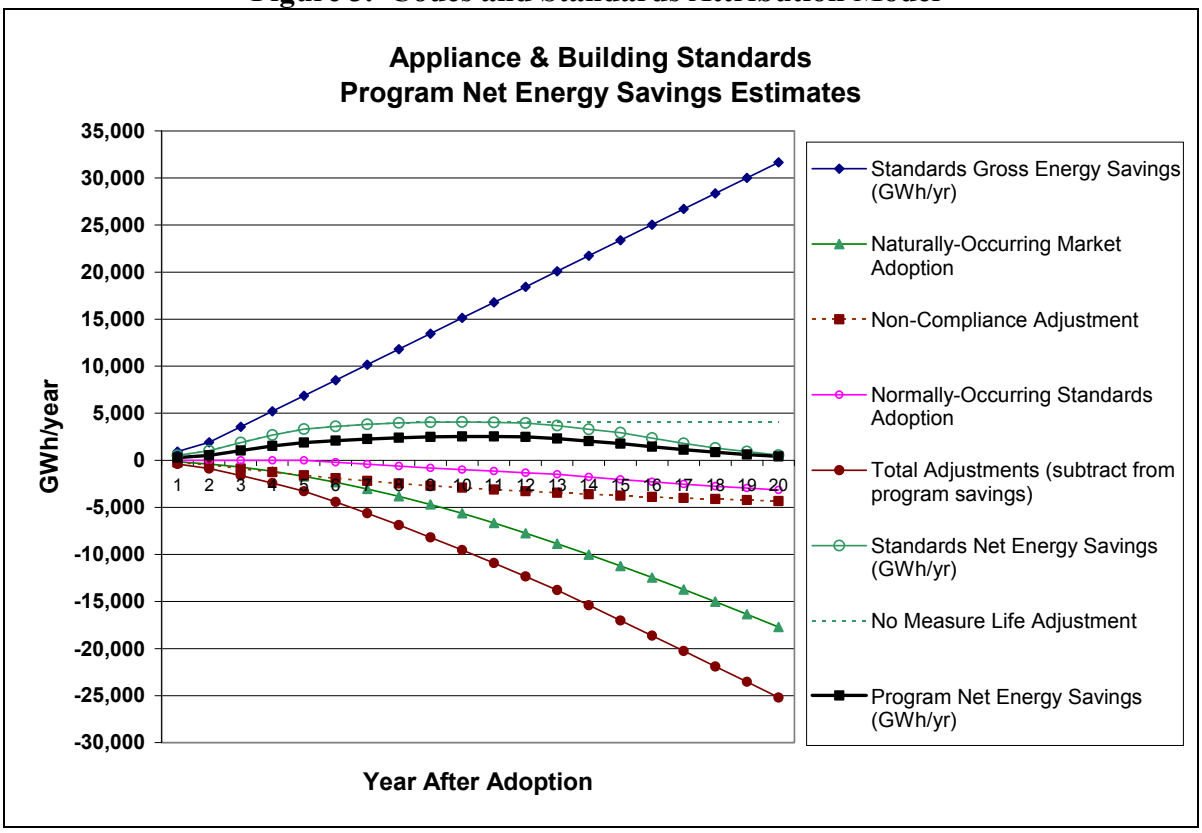


PG&E Codes and Standards Program (November 2007)

California Energy Efficiency Evaluation Protocols (CPUC 2006) include formal procedures for evaluating and estimating energy savings from advocacy, and calculating attribution. Figure 3 shows that net savings are calculated from gross savings by applying various corrections; for example, a significant amount of naturally occurring market adoption (NOMA) is assumed, resulting in large reductions in net energy savings. The correction for normally occurring standards adoption (NOSA) attempts to capture an alternative future in which the CEC, absent the C&S program, would adopt the same measures into code. Hence, NOSA zeros out new savings beyond a future date. The non-compliance adjustment (NCA) reduces gross savings based on non-compliance with existing regulations. As a component of C&S attribution model, a positive change in compliance (a reduction in noncompliance) increases both

the actual energy savings achieved by the code and the C&S savings contribution towards meeting customer energy efficiency portfolio goals. [1]

Figure 3. Codes and Standards Attribution Model[2]



Source: Heschong Mahone Group

One of the key policy framework decisions is CPUC Decision 07-09-043 (CPUC 2007) which established that, "On a forward-looking basis, we directed that savings from C&S advocacy work undertaken in 2006 and beyond would be counted when calculating either net resource benefits ("performance basis") or cost-effectiveness (TRC or PAC tests)." This means that energy savings attributable to investor owned utilities from C&S advocacy are counted equally as savings from incentive programs.

Although evaluation protocols support SE&T as a resource program, CPUC policy remains unclear regarding attribution and earnings from program efforts aimed at improving compliance with building and appliance standards effective in 2005. On one hand, the CPUC clearly recognizes the importance of compliance improvement as evidenced by repeated reference to the need for IOU support in decisions and strategic planning. However, CPUC policy permits IOUs to claim only 50% of net savings from pre-2006 C&S advocacy (2005

[1] Evaluation of NOMA, NOSA, and NMA corrections is evolving. These are relatively new challenges to the field of evaluation, measurement, and verification; moreover, they add the complexity of variation over time. While NOMA and NOSA corrections remain controversial with respect to initial conditions – and to a certain extent, legitimacy – the non-compliance adjustment (NCA) is both explicable and measurable.

[2] This model represents a subset of potential savings with respect to compliance improvement; in that, it embodies only code changes in 2005 proceedings. Building and appliance standards as a whole represent a much larger opportunity. Note the vertical scale; in particular, a small change represents significant positive or negative savings.

standards adoption). Moreover, these reduced savings count only towards meeting minimum performance thresholds; hence, savings from pre-2006 advocacy may not contribute to the IOU's performance earnings basis. CPUC policy is clear, however, regarding compliance improvement savings linked to post-2005 C&S advocacy; in that, 100% of savings count towards the performance earnings basis.

CPUC decisions mingle advocacy and compliance improvement, making SE&T benefits difficult to value. For example, more intractable compliance improvement objectives may require several years to achieve, and this level of commitment is difficult to justify without 100% attribution; otherwise, IOUs risk failure in meeting CPUC energy efficiency goals. Confirmation that post-2005 C&S SE&T activities are eligible for 100% savings and earnings credit, irrespective of the standards cycle the measures were adopted, is required to guarantee a level of effort commensurate with the compliance improvement opportunity.[3]

Standards Education and Training (SE&T) Concept

SE&T will leverage existing education and outreach activities and partnerships, and develop new ones, to equip appliance and building industry market actors with the knowledge and tools to comply with existing Title 24 (T-24) building codes and Title 20 (T-20) appliance regulations. This program currently includes three elements, two measure-based elements, one for T-20 and one for T-24, and a comprehensive approach in partnership with local governments, each described below.

SE&T will not attempt to generally raise compliance with building and appliance standards: the sum of all T-24 and T-20 compliance issues is simply too complex and expensive to manage. Instead, SE&T will focus on selected areas of standards that comprise the bulk of the savings. The portfolio of measures must, however, be broad enough to mitigate the risk of partial failure.

Within each area of concentration, comprised of a single measure or a group of similar measures, SE&T will conduct outreach to all market actor groups (manufacturers, designers/builders, suppliers, installers, enforcement, consumers, government agencies, etc.). Extending educational services to all significant groups in a supply chain is essential to significantly increasing the flow of compliant products and services.

Title 24 measure-based SE&T (E-1). PG&E's existing T-24 education and outreach activities include those conducted by the PG&E's Energy Training Center (ETC) in Stockton and the Pacific Energy Center in San Francisco. The ETC, in particular, has supported Codes & Standards training for many years; for example, during 2006 – 2007, the ETC conducted a total of 60 training sessions with 1,235 attendees. A total of 417 building officials, including inspectors, plan checkers and others, attended the sessions.

As impressive as these numbers are, they represent a fraction of market actors engaged in compliance related activities. For example, there are 12,000-14,000 HVAC contractors in California for which we estimate less than 50% have received T-24 training since 2005 residential duct alterations became effective. Additionally, the current sub-prime housing shakeout is likely to effect a large reduction in residential contractors and, hence, the need to educate and train new market entrants in the future.

[3] Stand-alone protocols – one of two sets of CPUC protocols for SE&T – appears to support savings claims for compliance improvement activities aimed at any California building or appliance standard.

The first element of SE&T is to continue existing training efforts, but with greater emphases on educating the entire supply chain and coordinating with others engaged in industry training. SE&T's success hinges in large part on response to outreach. Since SE&T will be implemented as a resource program, vis-à-vis an information program, program personnel will be hired to conduct proactive outreach that increases demand for educational services. Long-term improvement will depend on developing working relationships with industry leaders or working through change agents (individuals or trade groups, for example) who have established relationships with a target industry. This "high touch" approach to outreach leads to coordinated efforts with others – including, for example, California Energy Commission, other IOUs, California Building Industry Association, Contractors State Licensing Board, trade groups, etc. – involved in standards education and training, and is essential to maximizing SE&T impacts.[4]

Local government partnerships are particularly important to the success of SE&T. With increasing concern about climate change, local governments are becoming increasingly interested in a variety of sustainability issues, including local government energy efficiency regulations that reach beyond those of the state. Before going down this path, however, improving compliance with more modest existing state building regulations is a reasonable expectation, especially if IOUs commit to providing robust support.

Title 20 measure-based SE&T (E-2). SE&T increases the scope of existing education and training programs to include T-20 appliance standards. This is a significant change for two reasons. First, to our knowledge systematic education and training for appliance standards has never been attempted. Second, the energy savings potential through compliance improvement is significantly greater than that for Title 24. This is to be expected since Title 24's reach is limited to new construction and major alterations that trigger building permits; whereas Title 20 is based on the sale of appliances anywhere within California. Hence, T-20 impacts all replacement, retrofit and new construction projects that include regulated appliances.

Similar to E-1, E-2 SE&T will provide education and training services to the entire supply chain. For appliances, this includes manufacturers, distributors, and retailers. Similar to T-24, a high-touch approach to outreach will be the foundation for success, leading to working relationships with industry associations and other groups. New tools, including a new web-based database of compliant appliances, will be further developed to support education and training and provide a reference for ongoing compliance.

The geography of T-20 activities will differ from those of T-24. While the majority of Title 24 activity will take place in California, Title 20 outreach and implementation will require significant travel outside California and the United States. Regional offices of major retailers and distributors are located in other states. Most appliance manufacturers are located in other states as well as other countries.

Local government process (E-3). The third element comprises a holistic approach to improving T-24 compliance based in close cooperation with local governments. E-3 will require a high level of commitment from each local government, so success will depend on the buy-in of local government managers who are willing to change. We anticipate a pilot project beginning in late 2008 with six local government partners and phased implementation.

[4] In addition to greater coordination, greater emphasis will be placed on providing on-site or web-based services to meet client needs. "Circuit riders" will provide technical support to local government staff, as requested.

E-3 will add support for improving local government processes, in addition to E-1 measure based education and training, Process improvement support will include review of existing Title 24 permitting, tracking and inspection processes and practices, including staff interviews. We expect to identify and create tools to simplify enforcement (i.e., electronic forms or code manual help system) including the creation of a permit tracking and management system to streamline permit applications and data recording. E-3 will provide training, resources, and support for staff and local market actors, and support market studies and track compliance status in participating and nearby jurisdictions.

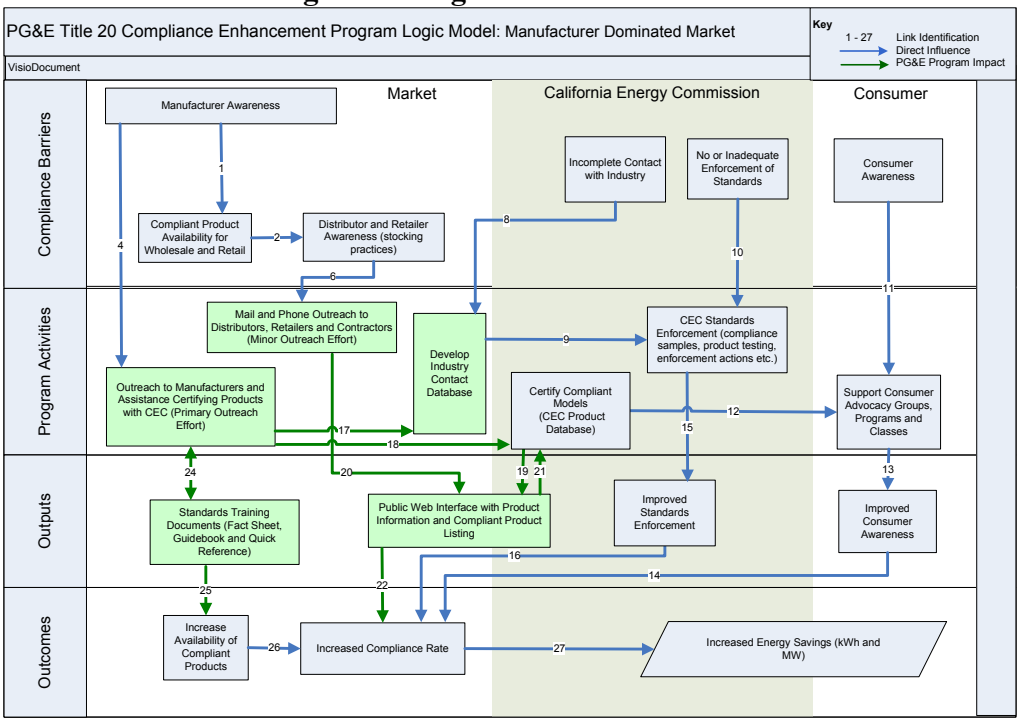
Compliance Improvement Models

The C&S Program has developed two sets of models to describe its approach to SE&T. First, a logic model explains the program theory, showing how program activities address barriers to compliance and achieve energy savings. Second, a program implementation model translates the logic model into specific program activities, associated budget and assumed success rates.

Program Theory and Logic Model

Logic models comprise a formal approach to assessing the viability of program interventions in changing behavior. Logic models are created for each measure and serve to identify barriers, actors, and relationships, sufficient to create a viable compliance improvement theory. Figure 4, a T-20 example, shows barriers associated with industry groups identified in the top row with program activities, followed by outputs and outcomes below.

Figure 4. Logic Model for Title 20



PG&E Codes and Standards Program

Figure 4 is a logic model for compliance improvement targeting an appliance where the manufacturers dominate the sales channel for the product and compliance efforts must focus on outreach to manufacturers. For example, for products with a very small number of manufacturers or well organized trade associations, compliance efforts will target this concentrated group of manufacturers and affect product sales from the top down.

Generic logic models have also been developed for retailer-dominated and contractor-dominated industries. In the retailer-dominated case, compliance efforts must target the stocking practices of these retailers. For example, for consumer electronics, most products are sold either through large "big box" stores or over the internet. In the contractor dominated case, where contractors are largely responsible for the purchase and installation of the product, compliance efforts must focus on outreach to contractors.

Table 1 shows an example of the generic program theory and indicators corresponding to each of the first eight steps in Figure 4; the numbers in the links in the logic model correspond to the table below. Although program theory and indicators are similar for like appliances, each appliance and industry must be evaluated individually.

Table 1. Compliance Improvement Program Theory and Indicators

Link	Program Theory	Potential Indicators
1	As manufacturers become aware of upcoming and current standards, they will make compliant products available and influence distributor and retailer awareness	Compliant models available from manufacturers
2	As retailers become aware of standards, they will stock compliant products in their stores	Compliant models available at retail locations
3	As compliant products are available for sale, contractors will specify compliant products	Compliant models specified for installation
4	To improve manufacturer awareness, C&S program staff will contact manufacturers and assist them with certifying products with the CEC	Stakeholder contact logs Increased number of certified products in the CEC database
5	To improve contractor awareness, C&S program staff will contact contractors and contractor trade associations	Stakeholder contact logs Trade association communications or educational materials
6	To improve retailer awareness, C&S program staff will contact retailers and work with them to stock compliant products	Stakeholder contact logs Increased availability of compliant products
7	Determine appropriate ways to follow-up, potentially including store visits and training programs	Additional outreach efforts
8	Where the CEC does not have the necessary contact with the industry, the IOU contact database can provide important new contacts	Low compliance rates in certain market sectors

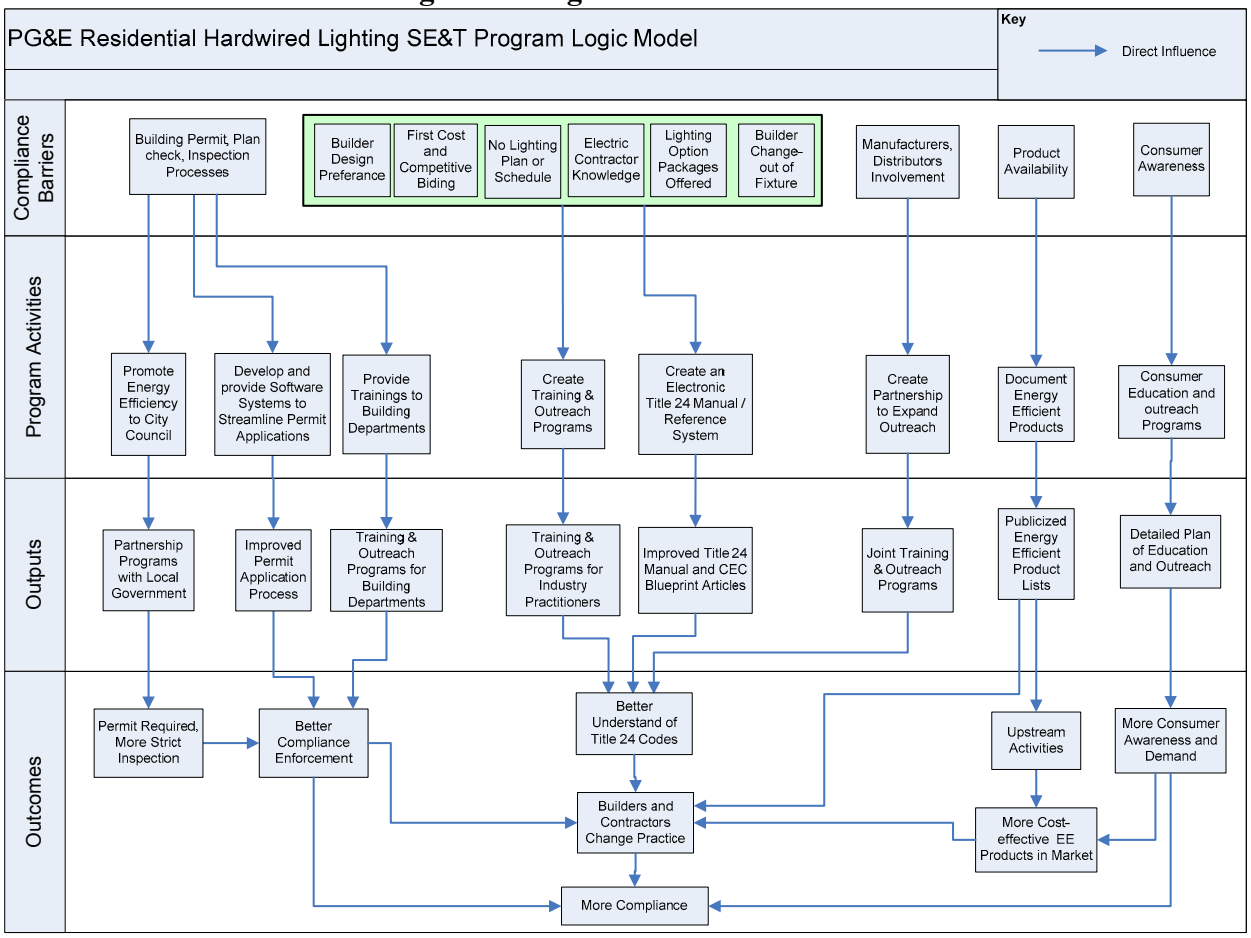
Source: PG&E Codes and Standards Program

Barriers to code compliance. The primary barriers to code compliance following the adoption of new or revised standards are a lack of industry awareness and understanding about the code requirements and what actions they must take in order to be in compliance. Immediately after adoption one may expect non-compliance to decrease as market actor awareness increases; however, achieving sufficient understanding to fully comply may require more time. For example, noncompliance with CA appliance standards for consumer electronics standby losses is estimated between 40 and 60 percent. Since California imports most its consumer electronics from Asia one may reasonably assume a lack of awareness and understanding to be the cause.

For some industry segments, many stakeholders and trade associations are actively involved in the Title 20 rulemaking, while other industry segments do not participate at all. Especially where manufacturers are unaware of the standards development, there may be a lack of compliant products available in the market. Competition and profit motivation will cause a subset of manufacturers, distributors, and retailers to accept the risk of ignoring regulations.

Figure 5, a T-24 example, is based on the same construct as that for T-20. At first glance the T-24 problem appears extremely complex; indeed, possibly too complex too solve. However, there are multiple paths to improved compliance and one may expect an additive effect from educational services offered to the entire supply chain.

Figure 5. Logic Model for Title 24



Source: PG&E Codes and Standards Program

The root causes for Title 24 noncompliance are similar to those of Title 20, however, with some important differences. Buildings are complex relative to energy use and T-24 standards have necessarily evolved to deal with the complexity. One program theory emphasizes education and training for engineering and design communities while, in parallel, developing tools for the less technically-oriented parts of the supply chain. Some building components such as ducts and nonresidential windows are manufactured on site, in contrast to appliances and other components which are produced in a controlled environment. Local government entities, the "quality control" for T-24, operate independently and have extremely limited resources. Given the costs associated with permits and testing, and minimal enforcement, it's no surprise that non-

compliance with duct sealing standards for residential alterations is estimated to exceed 70%. Without aggressive intervention, energy efficiency practitioners must assume that compliance for many buildings will fall short of 100 percent and remain low.

Program activities and outputs. Program activities are tailored to match the market channel for each measure and are expected to produce specific outputs which affect various outcomes. To address these barriers, the SE&T program focuses on educating industry stakeholders. For the Title 20 Appliance Standards example, SE&T first focuses on outreach to manufacturers to help them certify their products to the CEC and create a complete database of available products. The SE&T Program works with the Multi-State Appliance Standards Collaborative on developing an easy-to-use online directory of products which comply with standards across several states. Following manufacturer outreach, SE&T includes outreach to distributors, retailers and contractors, depending on the market channel of the appliance, to inform them of the new standard and help them comply with the requirements.

Implementation Model[5]

In the SE&T implementation model, compliance improvement is an output in contrast to an assumption. This change in mindset is necessary to create the foundation for a resource program and to develop a systematic methodology that we can improve over time. For each target group, outreach, education and training, and new or improved tools are identified through logic model assessment. Inputs for outreach efforts, class sizes and costs are estimated based on assumptions for responses to outreach and behavior change success from education and training. Additional assumptions include the target actor's level of influence; in part, this is based on number of market actors we expect to train relative to the population.

Another key idea is a tracking database which complements the implementation model. In addition to storing contact information, the database will track outreach and response rates, training attendance, pre and post-test results, and other information. This data will inform periodic updates of the implementation model. As we gain experience and establish relationships with industry, we also expect structural changes to the implementation model; for example, we will probably add columns or other groups that we discover to have significant impacts on compliance.

SE&T Costs and Expected Results

SE&T will first target 11 appliance standards and five building standards beginning in 2008. For T-20, SE&T for these 11 standards will run through 2011; for T-24 SE&T will continue through 2013. Figures 6 though 9 show the estimated compliance improvement possible with the expenditures shown in Figure 8 and are based on available data for current compliance and assumptions regarding future impacts on market actors. Figure 6 shows T-20 measures selected for SE&T. These measures were adopted in either 2004 or 2006 with initial rates of compliance estimated to be in the range of 40 – 80 percent (Quantec, 2007). Figure 7 shows selected T-24 measures and their compliance rates. Compliance rates of zero correspond to standards adopted without prior commercialization efforts. For example, standards for single

[5] The implementation model is a spreadsheet with market actor groups and tactics in columns, and numbers of interventions and costs in rows.

zone commercial duct systems were adopted based on analogous residential standards. Figure 8 shows the forecasted budget and resulting compliance rate improvement for SE&T. T-24 includes larger expenditures and expenditures over a longer period of time compared to T-20, reflecting the need for greater resource requirements to solve the more complex T-24 problem. Savings weighted compliance rates are expected to increase 13 – 14 percent by the close of 2011.

Figure 6. Expected Changes in T-20 Compliance

Measures	Initial Compliance Rate* (2007)	Compliance Rate Target (2011)
General Service Incandescent Lamps, Tier 1	73%	84%
General Service Incandescent Lamps, Tier 2	70%	82%
Residential Pool Pumps, High Efficiency Motors, Tier 1	85%	91%
Residential Pool Pumps, 2-speed Motors, Tier 2	70%	82%
Pulse Start Metal Halide HID Luminaires, Tier 1	63%	78%
Pulse Start Metal Halide HID Luminaires, Tier 2	70%	82%
Consumer Electronics - Audio Players	70%	82%
Consumer Electronics - TVs	59%	76%
Consumer Electronics - DVDs	43%	66%
Unit Heaters and Duct Furnaces	56%	74%
External Power Supplies, Tier 1 & Tier 2	70%	82%

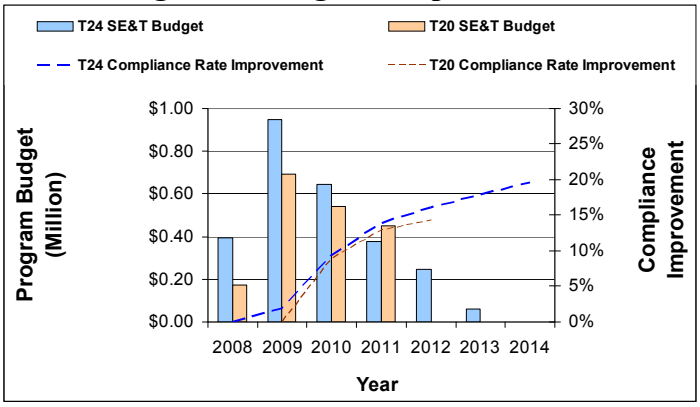
Sources: (Quantec 2007) and PG&E C&S Program

Figure 7. Expected Changes in T-24 Compliance

Measures	Initial Compliance Rate* (2007)	Compliance Rate Target (2011)
Residential Hardwired Lighting	72%	81%
Residential Duct Improvement	27%	50%
Lighting Controls Under Skylights	56%	70%
Ducts, Existing Commercial Buildings	0%	31%
Ducts, New Commercial Buildings	0%	31%

Sources: (Quantec, 2007) and PG&E C&S Program

Figure 8. Program Expenditures



Based on current resource estimates and conservative assumptions we expect savings from SE&T to cost approximately 1.5 cents per kWh. This is about one-half the average cost for PG&E's current portfolio: 3 cents per kWh. Figure 9 shows the cumulative savings through 2011 greater than 51 GWh, and expected contributions from T-20 and T-24 SE&T efforts. As shown, T-20 savings are significantly greater than those from T-24.

Figure 9. SE&T Metrics

Product-Focused Metric	Target	Target Date
Energy Efficiency ▪ Cumulative first-year energy savings through 2011 ▪ Estimated PAC	**51.4 GWh** **9.5 MW** **0.49 MTh** **4.98**	**2011**
Title 20 Annual Energy Savings ▪ Cumulative first-year energy savings through 2011	**43.0 GWh** **7.0 MW** **0.11 MTh**	**2011**
Title 24 Annual Energy Savings ▪ Cumulative first-year energy savings through 2011	**8.4 GWh** **2.5 MW** **0.38 MTh**	**2011**

Source: PG&E C&S Program

Conclusion

At the time of this writing SE&T implementation is just beginning and we expect the effort to mature over the next couple years. Phase 1 of SE&T covers a modest subset of all T-20 and T24 standards, so the opportunity is much greater than ~50 GWh. Inasmuch as SE&T efforts are sustainable – and we think they will be, especially for T-20 – savings will continue into the future. As new standards from the 2008 code cycle become effective, beginning in 2009, SE&T will grow to include them. On a statewide basis, energy savings from improved compliance with all existing building and appliance standards are estimated to be 100's of GWh/year, with the majority of potential savings stemming from appliances.

Standards Education and Training is no substitute for code enforcement, nor is it as effective. Without enforcement by the California Energy Commission, complete compliance in California with all building and appliance standards will never be achieved. In addition, enforcement and education are most effective if conducted in parallel. A little enforcement goes a long way towards motivating industry practitioners to learn more about how to comply with regulations. Still, until proper enforcement occurs, SE&T can provide industry stakeholders with valuable resources and tools to improve compliance and a strong model for a compliance improvement program that can be copied in other states.

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