



Together, Building  
a Better California

# DRAFT

**Energy Efficiency Business Plan**

**Cross-Cutting Segment Chapter:  
Codes and Standards**

**Draft – October 18, 2016**

# Codes and Standards Business Plan - Draft

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## A. Codes and Standards Vision

California's policy goals around energy use are ambitious, and program administrators' (PAs) vision for Codes and Standards (C&S) is that it will play a central role in meeting SB 350 goals, as well as longer-term greenhouse gas (GHG), Zero Net Energy (ZNE), and other broader state policy objectives. To reach the state's ambitious energy efficiency goals, the state needs to increase savings and change the way it uses resources. C&S activities are a cost-effective way to get an ongoing stream of savings. Past C&S efforts have delivered substantial savings,<sup>1</sup> but PAs' vision is to continue to grow these activities to maximize energy savings and support a diverse range of policy objectives.

Codes and Standards 2.0 (C&S 2.0) strategies contribute to California's energy efficiency success by supporting the adoption of robust building codes and appliance standards at the local, state and federal levels, and pursuing improved compliance with adopted standards. As such, C&S' work is directed at code setting bodies such as the California Energy Commission (Energy Commission), Department of Energy (DOE), and American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), or entities that produce data or ratings referenced by codes and standards, as well as those in compliance-related professions.

**The vision for C&S 2.0 efforts is as follows:**

- **C&S 2.0 is an expansion of the old C&S effort. C&S efforts will add new components and emphasize increasing primary research to inform code choices.** Expansions include:
  - Increased emphasis on coordinated long-term planning to reach deeper and have a more deliberate approach to meeting policy goals.
  - Increased primary data collection (and coordination with Emerging Technologies (ET)) aimed at strengthening cost effectiveness and feasibility arguments.
  - Targeted compliance efforts and development of electronic compliance infrastructure.
  - Code readiness activities, and "Code-Directed Industry Transformation (CDIT)," to increase the speed by which we adopt codes and standards.<sup>2</sup>
- **C&S will consider multifaceted objectives** California's statewide goals are diverse in scope, including targets over the next 35 years for energy efficiency, demand reduction, renewable energy, onsite generation, grid connectivity, demand response, energy storage capacity, ZNE buildings, water efficiency, and alternative fuels vehicles. To contribute, C&S must be designed and implemented with these multifaceted objectives in mind. Energy efficiency will continue to be the foundational goal of C&S initiatives, but PAs will also engage in other statewide goals (e.g., water management) that have an indirect, but strong, relationship with energy efficiency.
- **C&S efforts will accelerate the transition of measures into code by being pro-active, targeting interventions earlier in the process to advance energy efficiency faster (i.e., promote code adoption at the earliest feasible date).** The increase in coordination, enhanced primary research efforts, and PG&E's code readiness activities are all examples of how the C&S effort will accelerate the transition into code.

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<sup>1</sup> NRDC's CA Golden Opportunity, p 15: <https://www.nrdc.org/sites/default/files/ca-energy-efficiency-opportunity-report.pdf>

<sup>2</sup> Note: Code readiness is applicable to PG&E local C&S efforts.

- **C&S efforts will be integrated with the other sectors in a multi-sector approach** that applies a systems perspective to the challenge rather than focusing on individual parallel solutions.
- **C&S efforts will advance CDIT<sup>3</sup>**, which includes intentional and specific activities executed to realize the outcomes expressed in D.09-09-047, which defined market transformation as “long-lasting, sustainable changes in the structure or functioning of a market achieved by reducing barriers to the adoption of energy efficiency measures to the point where continuation of the same publicly-funded intervention is no longer appropriate in that specific market.” The 2014 whitepaper by Prah1 and Keating described a preferred approach called “targeted market transformation initiatives” which they defined as “...interventions ... designed to induce sustained increases in the adoption and penetration of energy efficient technologies and practices through structural changes in the market and in behaviors of market actors”.<sup>4</sup> The objective of applying CDIT to accelerate the adoption of new technologies earlier in the product life cycle is applicable for either definition, but especially fits the white paper’s description of initiatives.

### Codes and Standards Goals

C&S and the other cross cutting programs are focused on supporting statewide policy objectives, such as the doubling of energy efficiency by 2030 and efforts to work towards ZNE buildings. Each of the cross cutting programs supports statewide goals in its own way. The vision states that **C&S does this by advocating for stronger building codes and appliance standards at the local, state, and federal levels, as well as supporting the compliance of those more efficient codes and standards.**

C&S’ specific goals are:

- Save energy (in particular **XXX** GWh across the state by 2025) and water, and reduce greenhouse gases through the adoption of new codes and standards at all levels (i.e., local reach codes, state, and federal)
  - This includes providing research that enables and supports state agencies responsible for achieving state policy goals
- Provide services that support and align with state policy objectives by:
  - Coordinating with the public sector the following activities in an effort to inform long-term, planning and collaboration for adoption of future codes and standards
  - Maintaining high compliance margins for whole buildings and appliances; and improving compliance margins for selected, high importance codes and standards
  - Increasing adoption of local reach codes that support the development and adoption of statewide and national code changes
  - Producing high-quality information and data to support CDIT, which aims to transition a measure or system (bundle of measures) into code during the early stages of the diffusion cycle<sup>5</sup>

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<sup>3</sup> CDIT is a feature of the “code readiness” strategy and activities, and applicable to PG&E only.

<sup>4</sup> Prah1, Ralph and Keating, Ken. 2014. *Building a Policy Framework to Support Energy Efficiency Market Transformation in California*. <http://www.energydataweb.com/cpuc/home.aspx> p. 8

<sup>5</sup> PG&E only

## B. C&S Proposal Compared to Prior Program Cycles

Some of the key differences between past C&S efforts and proposed future efforts include: longer-term planning, more targeted compliance activities focusing in on high-impact areas and updating antiquated compliance processes, and the inclusion of code readiness activities<sup>6</sup>. Another core change for C&S 2.0 activities includes increased primary data collection and analysis. C&S plans to conduct primary research and analyses to support code and standards objectives and support state policy goals, guided by the CPUC, Energy Commission, and other state agencies goals, and long term tactical plans.<sup>7</sup> Investment in primary research and data collection efforts accelerates the creation of well-supported code change proposals. C&S will collaborate with code setting entities to identify primary research areas that will be of highest value. Well-substantiated proposals submitted to code setting entities are more likely to proceed with success. The research and primary data collection will fill gaps identified through needs assessments, and will work in coordination with other efforts such as ET efforts. Primary research efforts will be tracked to monitor which research efforts lead to code setting action. This increase in primary research can be seen in several of the intervention strategies.

To meet the goals laid out in the vision, C&S has identified five major intervention strategies (*further detailed in Section G: Approach to Achieving Goals*) for C&S:

### Long-Term Integrated Planning

Long term integrated planning incorporates an integrated dynamic approach to coordinate and align strategic planning within the energy efficiency portfolio. For PG&E, this strategy will also be used to identify “code readiness” priorities<sup>8</sup> for the building and appliance code advocacy programs specifically. Current work in this area ensures the statewide program syncs with the objectives of other internal and external groups, such as incentive program managers and other organizations involved with code development.

- In the very near future, C&S will create a long-term tactical plan to determine strategies that focus on 2030 and 2050 GHG targets as well as dividing appliance advocacy into targeted efforts at the state and national levels.<sup>9</sup>
- In the near midterm future, C&S will increase its involvement in various California Air Resources Board (CARB), Energy Commission, and CPUC proceedings to ensure that C&S activities and opportunities are well understood amongst various stakeholders including transportation, water use reduction and other prioritized areas that have the most promise for success through use of codes and standards activities to support the long-term tactical plan.
- In the long term, the strategy will use the data collected through the program to continue to guide the subprogram to facilitate greenhouse gas reduction and energy efficiency.

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<sup>6</sup> PG&E only

<sup>7</sup> PG&E is broadening the Code Readiness subprogram to include forward-looking research and analysis not included in CASE study development for existing or near-term rulemakings: field surveys that produce population data, tactical field surveys and studies aimed at specific building codes or appliance standards, lab testing, simulation models, tear-down analyses, collection of cost and other web data over time, amenity and human response to physical attributes, equipment operation, etc.

<sup>8</sup> PG&E-specific

<sup>9</sup> Descriptions of these subprograms and proposed activities are included in the Vision section of this document.

## Advocacy to Support Building Codes and Appliance Standards

Advocacy activities develop proposals for building codes and appliance standards. Long-term experience is a significant benefit to this work given the need to anticipate areas of interest by code setting bodies, code complexity, and the necessary information for the rulemakings. For example, a deep understanding of the details in previous code cycles informs the next cycle and reduces the investment in developing new measures.

- In very near term, the statewide Building Code & State Appliance Standard subprograms will be separated from the local National (and possibly International) Standard subprogram. The National Standards program will work on Department of Energy (DOE) appliance standards and test procedure, multiple national (and possibly international, as applicable) agencies or organizations that develop mandatory or voluntary standards, test procedures, labels, and/or protocols that could directly impact California customers and goals.<sup>10</sup>
- In the near term, C&S plans to fund additional research to address current information gaps that limit its capacity to advocate for more efficient and simplified codes and standards.
- In the long term, the program research will be supported by accurate, statistically valid data that will enable well-written standards that enable compliance.

## Code Readiness Activities<sup>11</sup>

This new strategy focuses on introducing promising building systems and appliances to actors within various building industry supply chains<sup>12</sup> to determine whether they are ready for codification. PG&E will expand code readiness in collaboration with other programs in the following ways:

- In 2017 and beyond, C&S will conduct primary research and analyses that supports state policy goals, guided by CPUC, Energy Commission, and other state agency goals, and long term tactical plans.<sup>13</sup>
- In the near term, C&S will invest in a deliberate process by transitioning to codes and standards earlier in the product life cycle,<sup>14</sup> or CDIT. This will allow PG&E to invest in portfolio infrastructure to gradually transition away from traditional incentive programs while continuing to move the market towards more efficient technologies and systems. PG&E will measure

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<sup>10</sup> These includes, but are not limited to, American Society of Heating, Refrigerating, and Air Conditioning Engineers (model building codes, such as ASHRAE 90.1 and 189.1), International Code Council (model building codes, such as the International Energy Conservation Code and the International Green Construction Code), the Environmental Protection Agency (ENERGY STAR labels), the Federal Trade Commission (EnergyGuide labels), Institute of Electrical and Electronics Engineers (e.g., IEEE 802.3 Energy Efficient Ethernet), International Electrotechnical Commission (test procedures), etc.

<sup>11</sup> CPUC approved a new *Code Readiness for PG&E local C&S subprogram for 2016*.

[https://www.pge.com/notes/rates/tariffs/tm2/pdf/GAS\\_3656-G.pdf](https://www.pge.com/notes/rates/tariffs/tm2/pdf/GAS_3656-G.pdf)

<sup>12</sup> Here we will leverage the Compliance Improvement subprogram training platform (e.g., Energy Code Ace).

<sup>13</sup> PG&E is broadening the Code Readiness subprogram to include forward-looking research and analysis not included in CASE study development for existing or near-term rulemakings: field surveys that produce population data, tactical field surveys and studies aimed at specific building codes or appliance standards, lab testing, simulation models, tear-down analyses, collection of cost and other web data over time, amenity and human response to physical attributes, equipment operation, etc.

<sup>14</sup> The *Naturally Occurring Market Adoption (NOMAD)* curves from past C&S impact evaluations provide evidence that this is not only feasible but has been the case for many past codes and standards. For example, many adoption points have occurred at less than 10% market share, resulting in quicker savings and quicker market transformation. Code officials can rely on data from targeted projects (e.g., hundreds instead of thousands) as long as the measure or system is demonstrated as *cost-effective* and *feasible*.

ongoing progress towards CDIT.<sup>15</sup>

- In the midterm, PG&E will conduct primary research and analyses that support the long term tactical plans.<sup>16</sup> Investment in primary research and data collection efforts supports and accelerates the creation of well-supported code change proposals.
- In the long term, the strategy will expand collaboration with voluntary programs to develop specific targeted program offerings based on code readiness projects and future C&S objectives.

### **Technical Assistance to Local Governments to help them Adopt Reach Codes**

This strategy has traditionally included technical support for local governments interested in adopting ordinances that exceed the state building energy codes: Title 24, Part 6. This resulted in the development of cost effectiveness reports that local governments use to adopt ordinances that can be submitted to the Energy Commission for approval, and filed with the Building Standards Commission (BSC). As local governments are increasingly focused on reducing greenhouse gas (GHG) emissions, interest expands beyond the standard performance-based reach codes. The reach codes program will expand to include support for ordinances requiring measures beyond traditional energy efficiency measures including voluntary standards, renewable energy, alternative fuels vehicle infrastructure, energy storage, demand response, and water saving measures.

- In the near term, the strategy will be to educate local elected officials and staff regarding the value of reach codes, and help prepare cost-effectiveness studies that support the CAL Green Voluntary Tier rulemaking process; as well as develop comprehensive ZNE reach codes.
- In the longer-term, the strategy will support the development of tools to support local jurisdictions as they track, quantify and report reach code energy saving and greenhouse gas reductions and align programs with reach measures.

### **Compliance Improvement Activities**

These activities complement advocacy work by ensuring potential savings from codes and standards are realized and persist over time. This strategy targets market actors throughout the entire compliance supply chain, providing technical support, education, outreach, and resources to improve compliance with both building and appliance energy standards.

- In the near term, this strategy will work to help market actors understand codes and standards, and provide role-based trainings to improve compliance particularly for the areas that have the highest potential impacts.
- In the longer-term, this strategy will support the development of an electronic repository to

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<sup>15</sup> For example, conduct an initial survey in 2016-17, execute strategies for several years, and then conduct regular follow-up surveys (e.g., every 5-10 years) to establish portfolio savings and statewide progress. Metrics will expand to include progress towards state policy goals.

<sup>16</sup> Code Readiness is specific to PG&E. PG&E is broadening the Code Readiness subprogram to include forward-looking research and analysis not included in CASE study development for existing or near-term rulemakings: field surveys that produce population data, tactical field surveys and studies aimed at specific building codes or appliance standards, lab testing, simulation models, tear-down analyses, collection of cost and other web data over time, amenity and human response to physical attributes, equipment operation, etc.

track repeated patterns of non-compliance as well as software tools to ensure accurate monitoring and reporting of compliance.

## Key Learnings from Recent EM&V Reports of California's Codes and Standards Programs

Past evaluations have focused on Building Codes, Appliance Standards and Compliance Improvement, with evaluation recommendations restricted to these subprograms. The following summary of recommendations has been adapted from findings in the *2010-2012 C&S Impact Evaluation*<sup>17</sup>, and the *Codes and Standards Compliance Improvement Program Years 2013-14 Process Evaluation Final Report*<sup>18</sup>.

### Building Codes & Appliances Standards Advocacy

- A major challenge in program evaluation has been the lack of program documentation typical to other energy efficiency programs. A living document that tracks areas for improved evaluation methods and documentation would support ongoing improvement to evaluation practices.
- Building envelopes present IOUs with opportunities for intervention, as they also stood out as a major building component that in the total for all sites was just below 2008 code requirements.
- IOUs should continue their appliances standards work, as appliance standards compliance has been high (typically 80+%).

### Compliance Improvement

- IOUs have made noticeable progress with the development and improvement of the Energy Code Ace (ECA) website, which provides code compliance trainings and resources to building industry professionals.
  - While building professionals identified increasing awareness of the tool opportunities exist for improvement as trainings are slowly evolving to become more specific and targeted to user needs.
  - C&S can continue this progress by identifying code areas that are particularly vulnerable to noncompliance and tailoring trainings to continually highlight and target those areas.
- Although in-person trainings have been well-received, building industry professionals are less likely to attend. IOUs can tap into the remote training market by expanding online ECA training.
- IOUs can use external partnerships to make training materials and links available on other industry sites where professionals are known to seek information and support.
- IOUs have an opportunity to increase code compliance by providing education to counter perceptions that code compliance is unmanageably complex.

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<sup>17</sup> Cadmus, DNV GL. 2014. *Statewide Codes and Standards Program Impact Evaluation Report for Program Years 2010-2012*. [http://calmac.org/publications/CS\\_Evaluation\\_Report\\_FINAL\\_10052014-2.pdf](http://calmac.org/publications/CS_Evaluation_Report_FINAL_10052014-2.pdf)

<sup>18</sup> DNV GL. 2016. *Codes and Standards Compliance Improvement Program Years 2013-14 Process Evaluation Final Report*. [http://calmac.org/publications/ComplianceImprovementImpactEvaluationDraftReport\\_FINAL-OUT.pdf](http://calmac.org/publications/ComplianceImprovementImpactEvaluationDraftReport_FINAL-OUT.pdf)



## C. Sector-Level Budget

Over the 10 year period, C&S is proposing to spend **x** dollars to achieve savings of **x** GWh, **x** MW, and **x** MM Therms. Potential savings by year are shown in Table 2 and budgets by year are shown in Table 1.

(Table 1 TBD)

## D. C&S Annual Net Savings from 2015 Potential Study

TBD

## E. C&S Landscape

C&S affect many stakeholders in the building industry supply chain. Appliance standards impact all customers who purchase regulated products. Considering this, the influence of C&S has an effect on virtually all customers. With respect to advocacy engagement, priority stakeholders include those who can affect the success of standards in the rulemaking process and through implementation. See appendix D for a more fulsome list of key C&S customers and stakeholders.

### a. Trends

C&S sees several key trends affecting statewide C&S initiatives:

- **Increasing CPUC emphasis on Codes and Standards** – During the last several years, the CPUC has communicated the importance of codes and standards.<sup>19,20,21</sup> Additionally, under the Warren-Alquist Act, the Energy Commission expects IOUs to support building standards.<sup>22</sup> These agencies recognize the central role that codes and standards must play in achieving state policy goals, and C&S 2.0 takes significant steps towards meeting these expectations. Given the discussion above on California’s climate policies, this increasing emphasis on C&S is understandable.

**Increasing number of state policy drivers** – California has a growing number of energy- and climate-related policy goals, expressed in Executive Orders, legislative bills, and state agency action plans (see

- below for selected goals).<sup>23</sup> The CPUC has indicated the California’s publicly-funded energy efficiency programs are an integral part of the state’s fight against climate change and greenhouse gas reductions.<sup>24</sup> California’s statewide goals are diverse in scope, including targets over the next 35 years for energy efficiency, demand reduction, renewable energy, onsite generation, grid connectivity, demand response, energy storage capacity, ZNE buildings, water efficiency, and alternative fuels vehicle. To contribute, C&S must be deployed holistically with these multifaceted objectives in mind.<sup>25</sup> The C&S 2.0 framework prioritizes these goals in all planning and implementation.

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<sup>19</sup> CPUC D.12-05-015, pg. 246.

<sup>20</sup> CPUC D.12-05-015, pg. 249.

<sup>21</sup> CPUC. “Regulating Energy Efficiency: A Primer on the CPUC’s Energy Efficiency Programs.” February 2016. [http://www.cpuc.ca.gov/uploadedFiles/CPUC\\_Public\\_Website/Content/News\\_Room/Fact\\_Sheets/English/Regulating%20Energy%20Efficiency%200216.pdf](http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/News_Room/Fact_Sheets/English/Regulating%20Energy%20Efficiency%200216.pdf).

<sup>22</sup> Warren Alquist Act section § 25402.7. Utility support for building standards

<sup>23</sup> For a more comprehensive review of state policy goals see:

- Greenblatt, J. 2015. "Modeling California Policy Impacts on Greenhouse Gas Emissions." Energy Policy 78: 158-72. Accessed December 2016. <http://eetd.lbl.gov/publications/modeling-california-policy-impacts-on>.

California Air Resources Board. “2030 Target Scoping Plan Concept Paper” Appendix A. June 17, 2016.

[https://www.arb.ca.gov/cc/scopingplan/document/2030\\_sp\\_concept\\_paper2016.pdf](https://www.arb.ca.gov/cc/scopingplan/document/2030_sp_concept_paper2016.pdf)

<sup>25</sup> Pat Eilert, Pacific Gas and Electric Company, Eric Rubin, Alex Chase, Energy Solutions, Yanda Zhang, YDZ Energy, “Codes and Standards Climate Strategy,” 2016, ACEEE Summer Study.

	2020	2025	2030	2050
Greenhouse Gases	1990 levels (AB 32)		40% below 1990 levels (SB 32)	80% below 1990 levels (E.O. B-30-15)
Efficiency			2x energy efficiency goals <sup>1</sup>	
Zero Net Energy Buildings	100% of new Res. <sup>2</sup>	100% of new state buildings <sup>2</sup>	100% of new Com., 50% Com. Retrofits <sup>2</sup>	
Renewable Portfolio Standard	33% <sup>3</sup>		50% <sup>1</sup>	
Transportation		1.5 million ZEVs <sup>4</sup>		
Fuels			Displace 30% of petroleum use with alternative fuels <sup>5</sup>	
Water	20% less water per capita in Res. & Com. buildings <sup>6</sup>			
High-GWP Gases	Reduce GHG emissions from HFCs by 10 MMtCO <sub>2</sub> e <sup>7</sup>			
Energy Storage	1.3 GW Storage Procurement <sup>8</sup>			

1. Senate Bill 350
2. CA's Long Term Energy Efficiency Strategic Plan
3. Senate Bill X1-2
4. Governor's ZEV Action Plan
5. Assembly Bill 1007
6. Senate Bill X7-7
7. AB 32 Scoping Plan (CARB)
8. CPUC D.10-03-040

#### Supporting Agencies



Figure 1 Select California Policy Goals

- **Evolving and variable state and federal activities** – State and national regulatory agencies are subject to funding Energy Commission fluctuations, which will impact their efforts towards greater energy efficiency. Over the next ten years, priorities at the state national level may evolve, requiring flexibility and nimbleness in how California executes its C&S strategies. PAs' consistency in C&S support allows California to achieve its state policy objectives despite evolving state and federal funding priorities.
- **Increasing requirements for rigorous data to support Energy Commission rulemakings** – Statewide C&S initiatives support the Energy Commission in their various rulemakings by providing data that building or manufacturing industries demand to support underlying cost or benefits calculations. The Energy Commission relies on statewide C&S activities to provide useful and accurate data. In addition to energy savings, the Energy Commission increasingly considers pricing information and technology readiness, user amenity and how the measure will

be applied in practice in buildings and equipment.<sup>26</sup> Verifiable qualitative analysis is needed to respond to these needs as well.

- **Rising Miscellaneous Electrical Loads (MELs) require evolving processes** – To achieve ZNE in California, special attention must be given to miscellaneous electrical loads (MELs) and plug-in electric vehicles (PEV). Many types of MELs have a relatively shorter product cycle (e.g., cell phones, tablets, smart watches, etc.), so these MELs cannot be effectively managed by the DOE’s existing energy efficiency rulemaking process which can take up to ten years.<sup>27</sup> Furthermore, determining the annual energy consumption, energy usage patterns, and product cycles of these MELs would require sizable resources. We need to explore different paths to transform the market for MELs with a shorter product cycle, in addition to supporting new appliance standards.
- **Increasing focus on existing buildings<sup>28</sup>** – The code for new construction is rapidly approaching ZNE targets for residential buildings, with nonresidential goals following closely behind. As such, existing buildings offer an excellent opportunity for savings. In particular, dramatic increases in the energy efficiency of appliances and system solutions in existing buildings are necessary to achieve Senate Bill (SB) 350 *Clean Energy and Pollution Reduction Act of 2015* goals to double energy efficiency of existing buildings by 2030. However, retrofitting existing buildings have challenges, including a broad variety of project types, design and construction arrangements, and constraints caused by existing conditions. Existing buildings’ efficiency may be improved through code enhancement proposals focused on building alterations and inefficient appliances. In addition, compliance improvement efforts are especially important to ensure the intended savings are fully realized.

## b. Gaps/Barriers

The trends outlined offer insight into the gaps that exist between the needs of the end customer and what is available to fill them. To overcome these barriers, a range of activities—from policy changes to process improvements—are needed.

- **Lack of consistency across state policies and holistic long-term planning to meet those goals** – Disconnects or variances in goal language between multiple well-intending state policies present barriers to integrated implementation. For example, ZNE goals stated in the CLTEESP do not fully align with the GHG reduction goals of AB 32 in terms of metrics, measurement, and milestones. Energy Commission’s building energy standards (Title 24, Part 6) include the scope to accommodate a robust set of integrated requirements for renewable generation, and energy storage/demand response. However, IOU funding for energy efficiency and other distributed energy resources (DER) efforts are authorized in separate proceedings, which can inhibit seamless advocacy efforts across DER.

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<sup>26</sup> For a more in depth discussion, see “Codes and Standards: A Path to Affordable Amenity and Customer Satisfaction.” Jon McHugh, Alex Chase, Gary Fernstrom, Mike McGaraghan, Chad Worth, and Pat Eilert. 2016 ACEEE Summer Study on Energy Efficiency in Buildings Proceedings. August 2016.

<sup>27</sup> The Energy Commission’s process is a faster, 3-4 years but we need to get the process from research to adoption down to a couple years to achieve the best standards.

<sup>28</sup> [http://www.energy.ca.gov/ab758/documents/ab\\_758\\_bill\\_20091011\\_chaptered.pdf](http://www.energy.ca.gov/ab758/documents/ab_758_bill_20091011_chaptered.pdf)

- For Southern California IOUs, additional stringent air quality requirements for reduced NOx and particulate matter in non-attainment areas have been difficult to reconcile, as it conflicts at times with efficiency of stationary sources.
  - C&S believes the greatest impacts will come from looking across policy drivers and broad DER areas, as well as across technologies. As an example, achieving ZNE for new and existing buildings while maintaining transmission and distribution (T&D) grid stability benefits from the flexibility brought about by the integration of various systems in buildings and communities, integration of photovoltaic (PV) and battery storage, and expansion of demand response and alternative fuels and electric vehicle (EV) infrastructures. Moreover, with rapidly approaching ZNE goals and relatively short code cycles, this work must accelerate.<sup>29</sup>
  - C&S' long-term tactical planning efforts will improve coordination across programs, accelerate code readiness activities, and transfer knowledge learned from those activities to targeted industry actors.<sup>30</sup>
- **Data deficits** – C&S has found that most, if not all, rulemakings end in compromise between code setting bodies and industry representatives, and the amount of compromise by DOE or Energy Commission staff depends on the quality of data available to defend a proposed rule. Since code setting bodies such as the Energy Commission and DOE are required to show cost effectiveness and feasibility of proposed standards, successful advocacy efforts are built on defensible, current and rigorous data. However, because many industry representatives consider their data associated with their products to be confidential (cost data, in particular), most useful data is derived from research conducted by either the code setting body or IOUs.
    - Defending a proposed rule requires information that demonstrates the viability of the technology and its role in energy efficient systems, especially as technologies advance to where they are ready to be codified. Beyond this basic viability, though, C&S has found a lack of data that is accurate and useful on the performance of newer technologies as well as a lack of thorough understanding of the impact of widespread adoption on the intended system, both areas that are critical for setting of new codes. This need can be filled by increased population data, technical research, and market analyses that are directly related to a public rulemaking conducted by the Energy Commission or DOE.
  - **State resource constraints** – Developing code change proposals, gathering stakeholder input, designing compliance processes and offering resources to support the implementation of California's codes and standards is a resource-intensive process. Code setting entities, such as the Energy Commission, have relied on stakeholders to contribute code change proposals and to participate in the rulemaking process. Insufficient resources exist for state agencies to conduct all the supporting activities necessary to evolve state standards in pursuit of policy goals. Since 2002, the IOUs have submitted many Codes and Standards Enhancement (CASE) reports and developed a supportive Compliance Improvement subprogram to assist with resource shortfalls.

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<sup>29</sup> For a more in depth discussion, see “Putting it All Together: Leveraging Codes and Standards to Accelerate Integration of Demand-Side Resources.” Heidi Hauenstein, Aimee Beasley, Christopher Uraine, Chad Worth, Stu Tartaglia, and Mary Anderson. 2016 ACEEE Summer Study on Energy Efficiency in Buildings. August 2016.

<sup>30</sup> Working across teams, especially with those that are investing in program strategies that look at systems rather than system components, will result in broadly applicable results.

- **Federal preemption** – DOE has a program to develop federal appliance standards. As the scope of DOE’s appliance program expands, it becomes increasingly important for California’s C&S initiatives to meaningfully participate in the federal rulemaking process due to “federal preemption.”<sup>31</sup> California often desires to have higher minimum standards than the federal standards. For example, after commercial clothes washer standards (first adopted by California in Title 20 in 2003) became federally covered products through EAct 2005, California could no longer update standards beyond federally adopted efficiency criteria for commercial clothes washers. Federal law includes an option for states to petition DOE for a preemption waiver, but no state has successfully done so and it is not considered a practical option. As such, as DOE’s appliance program expands, fewer appliances are available to the Energy Commission to incorporate into Title 20. Thus, efforts must be both focused on the federal level and on completing California adoption of energy efficient standards quickly with the highest levels of efficiency to transform the market as far as possible to set a high bar before the DOE begins its rulemaking process for those appliances. This is a particularly serious issue. The DOE process is much longer than the Energy Commission’s process, stranding cost effective energy savings that could contribute to achieving California’s policy goals.
- **Local governments lack awareness about which reach codes can help them achieve their goals, and lack the resources needed to adopt reach codes** – A “reach code” is a locally mandated code or alternative compliance path that is more aggressive than the current California Building Energy Efficiency Standards, resulting in buildings that achieve higher energy savings. In California, the unique authority given to cities and counties to adopt reach codes allows local jurisdictions to aggressively pursue their local Climate Action Plan goals as well as the CPUC’s goal of achieving ZNE for all new residential construction by 2020 and for all new nonresidential construction by 2030. Reach codes play an important role in ZNE by providing an opportunity to test advanced energy efficiency building practices with designers, building owners, plan examiners, field inspectors, and other development stakeholders. Further, reach code measures work in tandem with utility energy efficiency program incentives designed to accelerate market acceptance and adoption of ZNE building energy practices.

  - Every local government must determine the type of reach code ordinance best suited for meeting its unique GHG reduction goals.<sup>32</sup> However, local governments may lack the awareness, knowledge and resources needed to develop and adopt these codes. Typically, this includes deciding whether to adopt “performance based”<sup>33</sup> CAL Green Energy Efficiency Tiers such as exceeding base code by 15%, mandate “prescriptive”<sup>34</sup>

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<sup>31</sup> Federal preemption is the invalidation of any state law that conflicts with federal law; and for appliance efficiency regulations, the effect of minimum federal standards is to cap state appliance standards. Federal law includes an option for states to petition DOE for a preemption waiver, but no state has successfully done so and PG&E does not consider this a practical option.

<sup>32</sup> Cadmus, DNV-GL. 2014. Reach Code Subprogram 2010-2012 Process and Pilot Impact Evaluations. pp. 2-6

<sup>33</sup> CAL Green (Title 24 Part 11) identifies several voluntary Tiers requiring “performance-based” energy code compliance thresholds that exceed the Title 24 building energy efficiency standards by a certain percentage (e.g., 15%). The performance approach allows considerable flexibility in the way that designers and builders can customize the set of energy measures that are best suited to the project’s needs and characteristics, provided the building energy performance meets or exceeds the minimum requirements.

<sup>34</sup> Prescriptive-based requires installing specific Title 24 building energy measure(s) such as cool roofs, lighting, hot water distribution systems, water efficiency, and/or commercial kitchen applications.

energy efficiency measures such as cool roofs, and/or require “renewable energy”<sup>35</sup> installation such as solar photovoltaic systems. State law<sup>36</sup> requires that “local governmental agencies wishing to enforce locally adopted energy conservation standards” shall submit a study with supporting analysis to the Energy Commission showing how the local government determined energy savings and cost effectiveness and local governments are often limited in their ability to meet this requirement. Through technical assistance, PG&E supports local governments in their efforts to adopt reach codes.

- **Inadequate or absent compliance infrastructure and burdensome compliance processes**—California’s collective investment in a modernized electronic infrastructure to increase the efficiency of the compliance process for Title 24, Part 6 has been slow and, without this modernized infrastructure in place, the perception of the compliance process as a time consuming and paper-heavy endeavor persists.<sup>37</sup> Moving away from the current forms framework and transitioning to a streamlined compliance process, including the potential creation of registries, databases and other electronic infrastructure, will take a significant investment, but C&S believes that improving this infrastructure, and developing easy to use compliance tools and processes, is critical for enabling increased compliance.
  - In addition, compliance software functionality and usability has had new challenges over the past two building code cycles. With the recent rapid increase in complexity, breadth, and stringency of the building codes, the compliance software had challenges keeping pace. This has been in part due to the replacement of the simulation engine from the two-dimensional building modeling DOE 2 program (no longer supported by the DOE) to CBECC-COM, a software engine using a three dimensional user interface that uses and underlying engine based on Energy-Plus. While the EnergyPlus software engine is a more capable tool that can better simulate advanced building technologies, the transition was not entirely smooth and caused delays in the implementation of the standards.
  - Another key concern is the gap in understanding between the compliance software results which are an “asset rating” of a building and the actual operation or performance of a building. This issue has been increasingly problematic as a code compliant ZNE building does not necessarily reflect actual ZNE operation where many consumers and building owners are expecting ZNE code buildings to have a zero energy bill.
  - Achieving the state’s goal of ZNE for all newly constructed commercial buildings by 2030 will require significant advancements to the energy code and buildings will need to employ compliance software tools that offer new functionality to allow design projects to analyze these advanced strategies and demonstrate that projects meet the ZNE goals.

C&S strategies seek to overcome these key barriers, as explained in greater detail in *Section F, Approach to Achieving Goals*, below.

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<sup>35</sup> Mandating installation of renewable energy measures does not necessarily require following California’s Preferred Loading Order: energy efficiency, demand response, renewables, and distributed generation.

<sup>36</sup> Section 10-106 of the California Code of Regulations, Title 24, Part 1, Article 1

<sup>37</sup> Compliance Improvement Advisory Group: <http://www.caciag.com/Issues>

## F. Approach to Achieving C&S Goals

Under C&S efforts, five core intervention strategies exist:<sup>38</sup>


- Long-term Integrated Planning and Collaboration
- Advocacy for Building Codes and Appliance Standards at All Levels
- Technical Assistance for Local Government to Develop and Pass Reach Codes
- Compliance Improvement Activities
- Code Readiness Activities

### Intervention 1— Long-term Integrated Planning and Collaboration

Foundational to C&S’ efforts is long-term planning and collaboration. Many efforts in California are neither coordinated nor integrated at the level needed to address state policy. Long-term integrated planning is needed to develop and implement an integrated dynamic approach to achieving state policy goals and maximize energy savings. Integrated planning envisions what the future building stock and appliance market would be in a world that achieves the State’s energy, water and GHG goals and coordinates a plan that achieves these goals.

The outcome of this effort will be a long-term tactical plan for specific codes and standards activities that support state policy goals. Through this planning, C&S expects to see improved alignment with external stakeholders engaged in codes and standards to improve advocacy. A well-coordinated effort with internal stakeholders would be expected to capture DER synergies and maintain grid reliability.

**Table 1. Long-term Integrated Planning and Collaboration**

Intervention Strategy	Barriers	Example Tactics	Existing, New, or Modified	Short, Mid, or Long-term
 <p><b>Long-term integrated planning and collaboration</b></p>	Lack of consistency across state policies and holistic long-term planning to meet those goals	Deconstruct major policy goals such as, specific code objectives and program activities (e.g., the 2030 ZNE Commercial Building goal: achieve ZNE for warehouses in 2022 T24 code cycle, ZNE low rise office buildings during the 2025 T24 code cycle etc. AB758: billing analysis or building rating required for every entry into MLS database before posted for sale)	N	S
		Develop model to estimate potential	N	S

<sup>38</sup> Advocacy strategies are delivered statewide, per D.16-08-019.



Intervention Strategy	Barriers	Example Tactics	Existing, New, or Modified	Short, Mid, or Long-term
		impacts of each major portfolio element relative to forthcoming code changes and applicable state policy goals.		
		Lead the development of 5-15 year tactical plans, in collaboration with IOU program teams, the CPUC, Energy Commission, HCD, BSC and CARB, which are designed to achieve specific code objectives.	N	S,M
		Explore different paths to transform the market for MELs with a shorter product cycle, in addition to supporting new appliance standards.	N	S,M

**Partners:**<sup>39</sup> Other internal groups outside of the energy efficiency portfolio: distribution, transmission, distributed generation, electric vehicles, demand response, storage, etc.; Agencies and code-setting entities: CPUC, Energy Commission, CARB, DOE, ASHRAE, ICC; Municipal utilities and organizations: SMUD, LADWP, SCPPA, NCPA; External progressive utilities and other entities: NEEA, National Grid, Arizona Public Service, West Coast Collaborative, etc.

## Intervention 2 –Advocacy for Building Codes and Appliance Standards at All Levels<sup>40</sup>

At the core of C&S activities are advocacy efforts. These efforts reach multiple levels of decision making, across both building codes and appliance standards. Specifically, advocacy efforts include strategies to change:

- State Building Codes:** A State Building Codes strategy is needed to influence proceedings conducted by the Energy Commission and other State agencies. Since building codes determine the efficiency of new buildings, additions, and changes to existing buildings that trigger a permit, they directly influence building design and construction as they relate to ZNE goals. The scope of Title 24, Part 6 has expanded over time to control plug loads, outdoor lighting and some industrial process equipment. The relatively new Title 24, Part 11 Green Building Standards covers water efficiency including site irrigation, building materials, and provision for electric vehicle charging.

<sup>39</sup> C&S engages with many different stakeholders and partners. Thus, the “Partners” section within each subprogram table is non-exhaustive.

<sup>40</sup> Advocacy strategies are implemented statewide, per D.16-08-019

- **State Appliance Standards:** The State Appliance Standards strategy is needed to influence rulemakings conducted by the Energy Commission to improve the efficiency of appliance in California. Since appliance standards cover the sale of appliances within the political boundaries of California and impact efficiencies of equipment in both new and existing buildings, they are a powerful policy tool for saving energy and reducing GHG emissions. Appliance standards are enforced by the Energy Commission through the appliances database and occasional monitoring of products sold into the California market. Appliance standards are also referenced by the building standards and enforced by building officials in the 500+ California jurisdictions.
- **National Codes and Standards:** This strategy is needed to influence a broad range of national building codes and appliance standards that impact California regulations. For example, Federal Appliance and Equipment Standards, which are embodied in Title 20, have grown to cover products representing about 90% of home energy use, 60% of commercial building energy use, and 30% of industrial energy use.<sup>41</sup> Hence, federal appliance standards are often the strongest policy tool for reducing energy use in existing buildings and a large part of achieving ZNE in both new and existing buildings. In addition to DOE appliance standards and test procedures, multiple national agencies or organizations exist that develop mandatory or voluntary standards, test procedures, labels, and/or protocols that could directly impact California customers and goals.<sup>42</sup>

Advocacy efforts strive for the adoption of cost effective measures which maximize energy savings and reduce environmental impacts. Advocacy efforts increased energy savings for the state—filling the gap described earlier—in pursuit of ZNE and SB 350 policy goals for residential and nonresidential buildings.


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<sup>41</sup> DOE. (Accessed September 10, 2016).

<http://energy.gov/eere/buildings/appliance-and-equipment-standards-program>. Values are national estimates.

<sup>42</sup> These includes, but are not limited to, American Society of Heating, Refrigerating, and Air Conditioning Engineers (model building codes, such as ASHRAE 90.1 and 189.1), International Code Council (model building codes, such as the International Energy Conservation Code and the International Green Construction Code), the Environmental Protection Agency (ENERGY STAR labels), the Federal Trade Commission (EnergyGuide labels), Institute of Electrical and Electronics Engineers (e.g., IEEE 802.3 Energy Efficient Ethernet), International Electrotechnical Commission (test procedures), etc.

**Table 2. Advocacy for Building Codes and Appliance Standards**

Intervention Strategy	Barriers	Example Tactics	Existing, New, or Modified	Short, Mid, or Long-term
<p><b>Advocacy for Building Codes and Appliance Standards to maximize energy savings</b></p> 	State resource constraints	Lead the creation of detailed CASE proposals for agreed upon topics of interest to the California Energy Commission and other code setting bodies.	E	S,M,L
		Lead a general review of test procedures used to determine performance of appliances for federal and state standards.	N	S
		Expand research and analyses to improve the quality of data included code change proposals. <sup>43</sup>	M	S,M,L
	Data deficits	Provide research and analysis for measures such as water use, building materials, ventilation, and source pollutants.	M	S,M,L
	Federal preemption	Provide market analysis and gather high-quality market data, usage patterns and product performance to inform code change proposals.	M	M
	Proactively engage and foster improved working relationships with a broader range of affected stakeholders and recruit them to directly communicate to the Energy Commission and participate in rulemakings.	N	M	
	Proactively enhance regulations to include DR requirements, grid connectivity, etc. and enable the plug and play grid.	N	M	
	Improve quality of information supplied to the	N	M	

<sup>43</sup> Research may include a variety of activities: field surveys to collect population data; collection of internet data to determine costs, availability, performance, and compliance; tactical surveys on specific technologies, industries, markets, behavior, and satisfaction; lab tests, etc. Research will be conducted in multiple subprograms and there will be some overlap. While most data collection and market analysis aimed at long term code objectives will be conducted out of the code readiness subprogram, codes and standards research on specific measures and building types for open or near-term rulemakings will continue be conducted in other subprogram areas: California Building Codes, California Appliance Standards, and National Regulations. Additionally, support for Reach Codes will continue to include research in various areas.

Intervention Strategy	Barriers	Example Tactics	Existing, New, or Modified	Short, Mid, or Long-term
		Energy Commission for their interactions with federal agencies		
		Actively participate and influence the development and updating of test methods and ratings with industry groups (NEMA, AHRI, etc.), technical committees (ASHRAE, IES, IEEE, etc.) voluntary programs (DLC, CEE, EPA/ENERGY STAR, etc.), and regulatory agencies (DOE, ICC, etc.).	M	S,M

**Sectors: Residential, Commercial, Industrial, Public, ET, Other: DR**

**Partners:** Code-setting entities: California Energy Commission (Energy Commission), Building Standards Commission (BSC), Housing and Community Development (HCD), California Air Resources Board (CARB), State Fire Marshall (SFM); Code enforcement community members (CALBO, CSLB); IOU Energy Efficiency Programs; National Building Code Development Entities: ICC, ASHRAE, IAPMO, NFPA; Standards Setting entities: ASHRAE, ICC IES, ASTM, ENERGYSSTAR, IAPMO; Manufacturing community representatives; Design and construction community members; Municipal utilities: SMUD, LADWP; Compliance software developers; Simulation software developers (e.g. DOE EnergyPlus developers: DOE, NREL, LBNL); Energy efficiency and Demand Response advocates

**Intervention 3— Technical Assistance for Local Government to Develop and Pass Reach Codes**


The Reach Codes strategy is needed to support local jurisdictions which aspire to exceed state building codes. Reach codes are often part of a local government’s climate action plan or other green strategy. IOU support includes development of cost effectiveness studies per Climate Zone, drafting of model ordinance templates for regional consistency, developing compliance support tools (such as a Carbon calculator) and assisting with the reach code application process. These reach codes provide crucial experience for understanding the implementation issues associated with a new code before it is rolled out on a statewide basis when these measures are adopted into Title 24, Part 6 or the mandatory portion of CALGreen.

Recently, local governments have become increasingly focused on reducing greenhouse gas emissions. Many local governments have recently requested technical support from the Reach Code subprogram to provide cost effectiveness studies for non-energy efficiency measures such as photovoltaic systems, alternative fuels and electric vehicle infrastructure, energy storage, demand response, and water saving measures.

Through Reach Codes C&S collaborates with the Energy Commission and Local Government Partnerships (LGPs) to identify and provide technical assistance to local jurisdictions interested in adopting Reach Codes. This includes preparing cost effectiveness studies per climate zone, drafting of model ordinance templates for regional consistency, and assisting with the reach code application process.

The outcomes of this technical assistance will be additional reach codes that are developed and adopted by local governments to help reach higher levels of energy efficiency and GHG reduction, and prepare the building industry for more stringent building codes to advance ZNE.

**Table 3. Technical Assistance for Local Government to Develop and Pass Reach Codes**


Intervention Strategy	Barriers	Example Tactics	Existing, New, or Modified	Short, Mid, or Long-term
<p><b>Technical assistance for local governments to develop and pass reach codes</b></p> 	<p>Local governments lack awareness about which reach codes can help them achieve their goals, and lack the resources needed to adopt reach codes</p>	<p>Lead development of tools in collaboration with local jurisdictions that can track, quantify, and report reach code energy savings and greenhouse gas reduction.</p>	E	M
		<p>Support coordination between Energy Commission, BSC and HCD staff to leverage Title 24 Part 11 CAL Green Voluntary Tiers as a primary source for reach code measures by preparing cost effectiveness studies that support the CAL Green Voluntary Tier rulemaking process.</p>	M	S
		<p>Support local initiatives to improve efficiency in existing residential buildings such as Home Energy Score (HES) upon resale or on a voluntary basis, Green Multiple Listing Service (Green MLS), or mandatory energy disclosure (billing data or HES rating disclosed on MLS).</p>	N	M
		<p>Support collaboration efforts with Energy Commission, regional energy networks, local government partnerships, regional public affairs, and other stakeholders to educate local elected officials and staff regarding the value of Reach Codes, the requirements for adoption of local Reach Codes and best practices, tools and resources available to help local implementation.</p>	M	S
		<p>Develop a comprehensive ZNE reach code that integrates energy efficiency, renewables, alternative fuels and electric vehicle infrastructure, energy storage, demand response, and water saving measures with prescriptive measures for each targeted area.</p>	N	S
		<p>Coordinate with energy efficiency programs such as Savings By Design to align programs with reach code measures.</p>	M	S,M
		<p><b>Sectors:</b> Public, Commercial, Residential  <b>Partners:</b> Code-setting entities: California Energy Commission; IOU Internal Programs: Local Government Partnership Program; State and local governments; Code enforcement community; IOU Statewide C&amp;S Team</p>		

## Intervention 4— Compliance Improvement Activities

Compliance improvement activities help to ensure that potential savings from building codes and appliance standards are realized and persist over time. Activities conducted in support of this strategy target market actors throughout the entire compliance supply chain by providing needs-based tools, training, resources and outreach.

Through compliance improvement activities, critical market actors will better understand their unique role in compliance, and will be equipped with the specific knowledge, skill, and tools that they need to quickly, easily, and effectively perform their compliance job tasks. Ultimately, the outcomes of the compliance improvement activities will be higher compliance rates with building and appliance efficiency standards to help realize the full potential of adopting codes and standards.

**Table 4. Compliance Improvement Activities**

Intervention Strategy	Barriers	Example Tactics	Existing, New, or Modified	Short, Mid, or Long-term
<b>Compliance improvement activities</b> 	Inadequate or absent compliance infrastructure and burdensome compliance processes	Develop and implement role-based training that teaches market actors how to perform their unique compliance job tasks	E	S
		Develop tools and resources that help market actors understand codes and standards, and reduce burdensome processes	M	S
		Develop training using the appropriate modalities per market actor	M	S
		Conduct outreach to increase awareness of the value of compliance with California’s energy standards and publicize the availability of tools, training and resources to support improved compliance	M	S
		Increase clarity and usability of codes by incorporating user-centered design in code development.	M	M
		Develop an electronic repository to track repeated patterns of non-compliance by builders and repeated errors by energy analysts. This data can be used to improve next version of code.	N	M,L
		Electronic repository provides feedback on common errors, which measures are used etc.	N	M,L

Intervention Strategy	Barriers	Example Tactics	Existing, New, or Modified	Short, Mid, or Long-term
		This data can be used to improve next version of code.		
<p><b>Sectors:</b> Residential, Industrial, Commercial, Public, WE&amp;T, ET, Other: DR</p> <p><b>Partners:</b> Code-setting entities: California Energy Commission, HCD, BSC; Other state agencies; Investor Owner Utilities: IOU Statewide C&amp;S Team, Programs, WE&amp;T, DR, Local Government Partnerships; Utilities: POU and water districts; Code enforcement community; Design, construction, energy consultant community members; Manufacturing community representatives; State and local governments; Regional Energy Networks; Research community members; California’s higher education institutions; Energy and sustainability non-profits</p>				

### Intervention 5 – Code Readiness Activities<sup>44</sup>

The Code Readiness strategy is a PG&E-specific intervention strategy. PG&E believes code readiness is needed to support code driven industry transformation, which aims to transition a measure or system (bundle of measures) into code during the early stages of the diffusion cycle, such as the innovator’s stage. These efforts reach back to the earlier stages of a measure than the research conducted under the Advocacy intervention strategy. The measures explored through Code Readiness activities can be disruptive in that they challenge the legacy technologies by having major improvements in efficiency. The success of transitioning a specific measure or system into code is conditional on high quality information that provides compelling evidence of cost-effectiveness and technical feasibility as required by the Warren-Alquist Act. Code readiness includes “high touch” projects using PG&E experts and consultants that have well established reputations in their field for innovative excellence. Detailed code support data are collected (e.g., baseline, measure installation, energy efficiency performance, maintenance, and replacement). In addition, market data is collected such as construction feasibility data, customer satisfaction, impacts on the business models of project owners, designers, builders, and trades sub-contractors.

The Code Readiness activities have three objectives.

- The first objective is to produce high quality information and data (savings are not the initial priority) to support industry transformation. In 2016 this strategy was applied through PG&E’s Code Readiness subprogram in three residential projects and one nonresidential project. PG&E’s plan is to expand this area of work in 2017 and beyond.
- The second objective is to leverage a vast pool of C&S research (technology and market research, cost effectiveness, impacts on manufacturers, etc.) conducted by DOE, IOUs, Northwest Energy Efficiency Alliance (NEEA), and others, adding information garnered from industry representatives during negotiated rulemakings. This research can be used to accelerate

<sup>44</sup> Code Readiness activities are PG&E specific




the development of new measures for incentive programs, in particular, when there is a long delay between final rules and the effective dates of standards.

- The third objective is to improve primary data collection through field surveys, online data harvesting, and laboratory tests to increase the quality and effectiveness of advocacy efforts. Code readiness work will be closely coordinated with ET, with any C&S code readiness elements comprising a new, complementary source of innovation for the portfolio.

The primary outcome of code readiness activities is high-quality data sets for measures and systems needed to support specific codes and standards objectives and documents summarizing C&S research. Through this investment in robust data, PG&E will decrease the cost of future code enhancement proposals.

**Table 5. Code Readiness Activities**

Intervention Strategy	Barriers	Example Tactics	Existing, New, or Modified	Short, Mid, or Long-term
<b>Code readiness activities to gather data for future C&amp;S proposals</b> 	Data deficits	Design and implement promising technology packages and systems to collect accurate, code-relevant data: enforceability, feasibility, and cost effectiveness. Support with various other tactics, including collection of costs and compliance from web data	N	S, M
		Conduct industry analyses to identify critical actors with whom to engage in projects and knowledge transfer	M	S
		Build a searchable and organized database from various sources (code readiness projects, program projects, etc.) to be used in future code enhancement proposals.	N	S,M
		Summarize codes and standards research and other information in a format that can be easily extracted to develop work papers.	N	S,M,L
		Conduct field surveys to collect population data, including detailed on-site audits and metering to determine equipment performance, load shapes, etc. Support with lab testing, tactical surveys, etc.	M	S,M,L
<b>Sectors:</b> ET, Other: IOU Test Labs <b>Partners:</b> Incentive program staff; Equipment Manufacturers; Architects, Engineers, and Building Scientists; Builders and manufacturing partners; Residential and nonresidential building owners; Contractors				

By sector, the top system and measure based code readiness opportunities as of 2016 are detailed in the tables below. Note that these systems and measures may change over time.

**Figure 2. Top System Code Readiness Opportunities by Sector in 2016**

Cross-cutting	Residential	Commercial
<ul style="list-style-type: none"> <li>• <b>Integrated variable speed devices:</b> pumps, motors, and controls</li> <li>• <b>Integrated variable speed fans</b></li> <li>• <b>High and low frequency demand responsive controls</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Hot Water:</b> Heat Pump Water Heating (CO2   Natural Gas)</li> <li>• <b>Space Heating and Cooling:</b> Combined hydronic heating and cooling (Natural Gas condensing   Air to Water Heat Pump)</li> <li>• <b>Whole House Controls:</b> Wireless addressable appliance, lighting and plug loads</li> <li>• <b>Energy Storage:</b> Thermal   Electric</li> <li>• <b>Integrated envelope:</b> thicker wall sections   deeper window flanges   verified low infiltration</li> <li>• <b>IAQ and Ventilation:</b> reduced ventilation to dilute toxic off-gassing</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Dedicated Outdoor Air System (DOAS):</b> With heat recovery   Generation 2: high efficiency HX, economizer, smart controls, self monitoring, addressable</li> <li>• <b>Radiant ceiling heating and cooling:</b> Flat panel grid   suspended acoustic panels   integrated architectural elements</li> <li>• <b>Building Automation:</b> Addressable controls of lights and plug loads   Performance tracking</li> <li>• <b>Energy Storage &amp; Distribution:</b> Thermal   Electric   Micro Grid</li> <li>• <b>Integrated lighting:</b> high quality source + control   easy to use local controls w/good interfaces</li> </ul>
Agricultural	Industrial	Public
<ul style="list-style-type: none"> <li>• <b>Irrigation system efficiency</b></li> <li>• <b>DR pumping</b></li> <li>• <b>Title 23 system-level measures:</b> similar to model landscape ordinance</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Lab hood sash controls and VAV</b></li> <li>• <b>Compressed air systems:</b> capacity controls   leakage testing</li> <li>• <b>Networked FDD steam traps</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>ZNE Issues Guide for State Buildings</b></li> <li>• <b>TDV Valuation Tool for State Buildings</b></li> <li>• <b>Integrated PV, storage and emergency generation</b></li> </ul>

**Figure 3. Top Measure Code Readiness Opportunities by Sector in 2016**

Cross-cutting	Residential	Commercial
<ul style="list-style-type: none"> <li>• ZNE Guidelines</li> <li>• Variable speed                             <ul style="list-style-type: none"> <li>○ space heating and cooling</li> <li>○ air compressors</li> <li>○ cooling and refrigeration</li> <li>○ boilers</li> </ul> </li> <li>• PV infrastructure with battery storage</li> <li>• Low GWP refrigerants</li> <li>• Water Use Efficiency</li> <li>• Outdoor lighting</li> <li>• Integrated Demand Flexibility</li> <li>• Steam Traps</li> <li>• Drain water heat recovery</li> <li>• Air to air heat recovery</li> </ul>	<ul style="list-style-type: none"> <li>• Advanced envelope opportunities – windows, walls, attic</li> <li>• Heating and Cooling Delivery                             <ul style="list-style-type: none"> <li>○ radiant</li> <li>○ ductless</li> <li>○ ducts in conditioned space</li> </ul> </li> <li>• Combined water and hydronic water and space heating</li> <li>• IAQ and Ventilation Cooling</li> <li>• Integrated Demand Flexibility and TOU Rates</li> <li>• Home automation with high energy efficiency networking equipment</li> <li>• PV with battery storage for peak demand reduction</li> <li>• Indoor lighting – LED &amp; lighting quality</li> <li>• Outdoor lighting and motion controls</li> <li>• Variable speed swimming pool pumps and replacement motors</li> <li>• CO2 and Gas Heat Pump Water Heater</li> <li>• DHW – compact distribution and drain water heat recovery</li> </ul>	<ul style="list-style-type: none"> <li>• Generation 2 DOAS with HR, FDD, EMS</li> <li>• Indoor lighting LPD and controls</li> <li>• IAQ and Cooling Ventilation</li> <li>• Heating and cooling only                             <ul style="list-style-type: none"> <li>○ radiant</li> <li>○ chilled beam</li> <li>○ VRF heat pumps</li> </ul> </li> <li>• Optimize WWR, U-factor, SHGC</li> <li>• Parking lot lighting</li> <li>• Storage (electricity and thermal) to reduce peak demand</li> <li>• CO2 supermarket and commercial refrigeration</li> <li>• Warehouses – multiple measures</li> <li>• Drain Water heat recovery</li> <li>• 2023 efficiency level RTU with suite of system requirements</li> </ul>
Agricultural	Industrial	Public
<ul style="list-style-type: none"> <li>• Irrigation efficiency for emitter types and emitter selection</li> <li>• Irrigation Pump Systems optimized by site conditions, weather, and crop</li> </ul>	<ul style="list-style-type: none"> <li>• Large horse power variable speed motor systems</li> <li>• Refrigeration evaporator fan speed control</li> <li>• FDD networked steam traps</li> <li>• Gas fueled hydronic                             <ul style="list-style-type: none"> <li>○ injection molding</li> <li>○ high vacuum diffusion pumping</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• See sectors above</li> </ul>

Within the Approach Section, C&S describes new and innovative strategies and tactics, some of which will lead to initial efforts at the program level. C&S will describe any unique and innovative aspects of each program, as well as any initial activities contemplated or underway, within program-level implementation plans.

## G. Statewide Administration and Transition Timeline

TBD

## H. Solicitation Strategies

TBD

## I. Metrics and EM&V

C&S and the other cross cutting programs are focused on supporting statewide policy objectives, such as the doubling of energy efficiency by 2030 and efforts to work towards ZNE buildings. Each of the cross cutting programs supports statewide goals in its own way. C&S does this by advocating for stronger building codes and standards at the local, state, and federal levels, as well as supports the compliance of those more efficient codes and standards.

The specific goals of C&S are:

- Save energy (in particular X,XXX GWh across the state by 2025) and water, and reduce greenhouse gases through the adoption of new codes and standards at all levels (i.e., local reach codes, state, and federal)
  - This includes enabling and support state agencies responsible for achieving state policy goals by providing them with research
- Provide services that support and align with state policy objectives by:
  - Producing high-quality information and data to support CDIT, which aims to transition a measure or system (bundle of measures) into code during the early stages of the diffusion cycle<sup>45</sup>
  - Maintaining high compliance margins for whole buildings and appliances; and improving compliance margins for selected, high importance codes and standards
  - Increasing adoption of local reach codes that support the development and adoption of statewide and national code changes

In addition to savings, the primary metric C&S and the other cross-cutting programs at the business plan level is alignment with state policy goals and the portfolio. 'Alignment,' however, is difficult to measure given the changing needs of the state. As such, C&S proposes that on a biennial basis it will present the long-term integrated plan for C&S. Following the long-term integrated plan, we will also present an annual measurement of accomplishments against the goals set forth in each of the annual C&S plans. Thus, similar to the other cross-cutting areas, C&S proposes an annual planning and reporting process as the metric of success.

The C&S plan will include the timeline set forth by California policy to reach milestones on the pathway to ZNE. The Energy Commission makes the final decision as to what criteria constitutes success, and it is C&S' goal to offer in-depth support to Energy Commission staff and Commissioners in this process.

C&S activities will also be measured by the success in improving compliance and supporting the creation of electronic infrastructure systems, such as databases and repositories that collect information that provides evidence of improved uptake of adopted standards. All of these program level objectives (and related measures of success) will be described in the plan.

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<sup>45</sup> CDIT is a feature of the "code readiness" strategy, and applicable to PG&E only.

Table 6. PG&E C&S Metrics

PG&E Goals	Intervention Strategies	Metric	Baseline (or Benchmark)	Metric Source	Short Term Target (1-3 years)	Mid Term Target (4-7 years)	Long Term Target (8-10+ years)
Save XX GWh, XX MW, xx MM therms and XX GHG from C&S efforts (supported by ETP)	All C&S Interventions	Electricity	Average of XX GWh/ year across 2011-2015	Impact studies	XX GWh	XX GWh	XX GWh
		Demand	Average of XX MW / year across 2011-2015		XX MW	XX MW	XX MW
		MM Therms	Average of XX MM Therms/year across 2011-2015		XX MM Therms	XX MM Therms	XX MM Therms
		GHG reduction	XX tons GHG		XX tons GHG	XX tons GHG	XX tons GHG
Support State Policy and Portfolio Goals	Integrated Planning in C&S, ETP and WE&T  All cross-cutting interventions	Alignment and support for State Policy Goals measured by accomplishments against plans	Initial report will be done in early 2017 (on 2016 programs)	Annual reporting by PG&E	Track alignment; Demonstrate leadership in coordination with stakeholders		

## J. EM&V Preparedness and Research Needs

C&S has identified several overarching data gaps in C&S. The research for this sector will be contingent on the needs of the portfolio as a whole and the annual research budget for this sector. However, C&S believes that the following studies should be considered in the EM&V Research Plan.

Studies to support C&S:

- Program attribution study (forthcoming): Program attribution has been difficult to determine. Studying the potential indicators for program attribution will provide greater clarity on attributing program savings to the IOUs.
- Code compliance study: Anecdotal evidence on code compliance is often discussed but actual measurements of code compliance are minimal, especially with HVAC measures and NR lighting retrofits. Studying code compliance on HVAC measures and NR lighting will provide information on areas for the program to improve code proposals in these two key areas.
- Periodic market studies to determine market effects: Potential study provides a market baseline for specific building systems that will be targeted by the program. Tracking the uptake of efficient systems requires additional data collection and analysis. The baseline study should be updated twice, once by the end of year five and the other by the end of year nine.

As described below, 2015 planned IOU-led studies include those to 1) determine code readiness, 2) explore methods for Title 24 improvement, and 3) conduct a process evaluation of IOU C&S Program trainings, classes, and tools.

### a. EM&V within C&S

EM&V activities supporting the C&S Program serve three distinct needs:

1. All of the baseline data collection efforts described next employ C&S, rather than EM&V, dollars since they are integral to program implementation. They are considered part of the program implementation process, rather than the formal EM&V process. Detailed baseline data collection forms the basis for support of federal and State standards development. Standards development, at both the state and federal levels, is grounded in a firm understanding of existing conditions of energy use by appliance, system, and market segment. Without current, appliance/equipment usage information by market segment credible estimates of standard's savings, lifecycle cost, and prospective cost effectiveness it is impossible to present a persuasive case for adoption of a proposed standard. Large, statistically valid samples of customer-specific appliance holdings, building conditions, and consumption patterns are obligatory for establishing the appropriate scope and level of a proposed standard. These efforts demand carefully designed sampling plans, extensive on-site survey efforts, and energy use metering at both the appliance/system and whole building levels. Optimally the sample designs must be sufficiently robust to allow testing of potential efficiency changes to support the standard development process.

The detailed baseline data collection efforts are also critical in the examination and characterization of compliance issues that have arisen with current standards. This is essential so as to not create similar compliance issues as standards are ratcheted upward.

2. Development and tracking of program implementation metrics to gauge sub-program effectiveness is essential to continued improvement of program implementation efforts. Advocacy efforts are the key driver of readily measurable energy savings for the C&S Program. Rigorous recording and detailing of IOU advocacy efforts is essential in order to determine the relative impact of IOU efforts on passage of

new codes and standards. Such information, gathered as part of program implementation efforts, is used in the preparation of Code Change Theory Reports (CCTRs) that form the basis for program attribution determination by CPUC impact consultants.

The use of program implementation metrics is also important in determining the effectiveness of C&S efforts for which direct energy savings information is not readily available. Compliance Improvement efforts, for example, are not easily measured by changes in program savings due to the cost of obtaining detailed compliance data. In particular, building standards compliance data is notoriously costly to obtain. Hence, program efforts are measured by a variety of non-savings implementation metrics that track the effectiveness of compliance improvement/education efforts.

Non-resource implementation metrics are also necessary to track the reach code support efforts that comprise the IOUs' Reach Code subprogram. While reach codes do generate direct savings the IOU efforts are aimed at providing tools for local jurisdictions to implement reach codes. It is up to the jurisdictions to use the tools as part of their enforcement efforts.

Non-resource program implementation metrics will also be needed to track code readiness subprogram efforts. The intent of code readiness efforts is to accelerate the market transformation effects of C&S efforts, rather than directly generating large amounts of near-term savings. Consequently, a set of new program implementation metrics will need to be developed to track code readiness efforts and effectiveness.

### 3. Preparation of materials to aid Commission staff evaluation of CDIT efforts<sup>46</sup>

- a. CCTRs aide net impact determination by Commission staff consultants and establish program activity and code change attribution documentation. CCTRs provide verification of code change logic models and provide insight into the effectiveness of various code advocacy efforts. They play a historical and on-going role in determining savings attributable to IOU program efforts.
- b. Potential study support to help the Commission appropriately allocate future EE budgets
  - i) C&S studies, as funded from EM&V and documented in the EM&V Plan (now Version 6), support program development and provide insight into future opportunities for successful code advocacy.
  - ii) Notable 2010 – 2012 IOU-led studies included 1) a Statewide C&S Program Process Evaluation, which investigated implementation and documentation of Title 20 and 24 advocacy and CASE studies, 2) an Incremental Measure Cost analysis to examine the decline of Title 20 Appliance products costs and update forecasting methods, and 3) a policy thought paper to determine the baselines for building alterations.
  - iii) Notable 2013 – 2014 IOU-led studies have included 1) an assessment of savings overlaps from interactive effects currently unaccounted for in CASE studies, and 2) analyses of 2008 Title 24 nonresidential compliance audits.
  - iv) Planned 2015 IOU-led studies include studies to 1) determine code readiness<sup>47</sup>, 2) explore methods for Title 24 improvement, and 3) conduct a process evaluation of IOU C&S Program trainings, classes, and tools.

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<sup>46</sup> CDIT is PG&E-specific

<sup>47</sup> Code readiness is PG&E-specific

## K. Reference List

TBD: PG&E will complete this section in the final C&S business plan chapter.



## L. Appendices

### Appendix A. Stakeholder Feedback

All Issues Identifier Number (Index)	Relevant Committee or Subcommittee	Topic	Source/Issue <sup>48</sup>	Page Number
0084	X-Cut: C&S	Business Plan Topic	Comment that Program Administrators talk about the challenge presented by Codes & Standards. Suggestion that those in charge of running C&S programs should talk about the how they affect implementation and how they can address those challenges.	TBD

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<sup>48</sup> As indicated in the Issue Tracking Spreadsheet on the CAEECC website, please note that not all issues depicted here are factually correct or current. Additionally, some are paraphrased and others are more verbatim depending on how issue came into tracking process.

## Appendix B. C&S Business Plan Checklist

	Cross Cutting Sector	
BP Page Number	Business Plan Guidance	Notes
NA	<b>A. Market Characterization</b>	Per Commission staff suggestion, PG&E has renamed this section "Sector Overview"
8, 38	<b>a. Customer landscape (who they are, what are their needs)</b>	
8-10	b. Trends	
10-13	c. Gaps/Barriers	
33-37	<b>B. Value</b>	In drafting the BP cross cutting chapter, PG&E determined this information would fit best woven throughout the chapter. PG&E has moved this specific section to the appendix
33	a. Discussion of roles for cross-cutting sector	
34-35	b. How does it support portfolio	
35-36	c. How does it benefit customers	
36-37	d. External impacts and benefits (community/economic benefits)	
1	<b>C. Vision</b>	
1-2, 14-25	a. Discussion of opportunities	
14-25	b. Whether items are near-, mid-, long-term strategic initiatives	
26-27	<b>D. Metrics</b>	
27	a. One metric or more as appropriate for each intervention strategy	
14-25	<b>E. Program/PA Coordination: Description of which and how strategies are coordinated regionally among PAs and/or other demand- side options.</b>	TBD - PG&E will complete this section in the next draft iterations
28-29	<b>F. EM&amp;V Considerations: Statement of evaluation needs "preparedness" (i.e., data collection strategies and internal performance analysis)</b>	

## Appendix C.: Codes and Standards Value

### *Roles for Codes & Standards Program within the Cross-Cutting Sector*

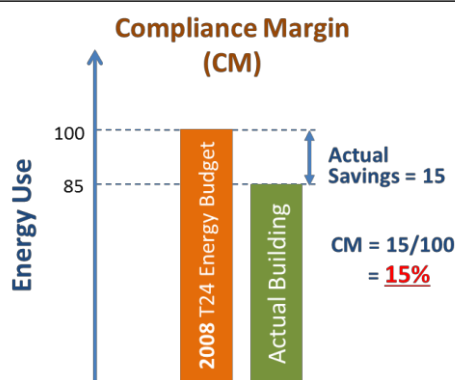
The C&S Program emerged during the late 1990s when California's first attempted to transition away from resource acquisition to market transformation programs. The program objective was to cause permanent reductions in energy use through improvements to Title 24 building codes and Title 20 appliance standards. Circa 2005, advocacy was extended to include federal appliance standards, which are embodied in Title 20 after a DOE final rule.

For measures included in incentive programs, codification of a measure provides an exit strategy to sunset incentive support for technologies that have graduated from emerging to standard practice, completing transformation and liberating funds to be used for new technologies. To ensure the savings from newly adopted codes and standards are realized, the compliance improvement team conducts education and training, and develops tools, to help individuals within compliance supply chain (builders, contractors, manufacturers, etc.) correctly implement state and federal regulations.

Figure 4 shows, based on CPUC evaluations, that compliance margins (percent beyond code) for whole buildings and lighting alterations exceed code baselines, indicating robust compliance with building codes from an energy use perspective.

Figure 4. Compliance Margins from CPUC Evaluations<sup>49</sup>

	Standards	Compliance Adj. Factor (CAF)	Compliance Margin (% above code)
2006 – 08 Evaluation	2005 T24 RNC (whole Building)	120% (Electric) 235% (Gas)	Not available
	2005 T24 NRNC	61.5% (8 – 100%)	
2010 – 12 Evaluation	2008 T24 NRNC	410% (kWh)	13% (kWh)
		328% (kW)	14% (kW)
		118% (Therm)	1% (Therm)
	2008 T24 NR Alteration	304% (Indoor lighting, kWh) 83% (Re-roof)	7% (Indoor lighting, kWh) Unknown for re-roof*



Through reach codes, and planning and coordination activities, the program conducts activities to advance and harmonize codes, standards, and ratings by local governments, ASHRAE and others, such that they support California building codes and appliance standards and other goals. Internal coordination serves to inform programs regarding upcoming changes and gather information to support future code enhancement proposals.

#### How does it support the portfolio

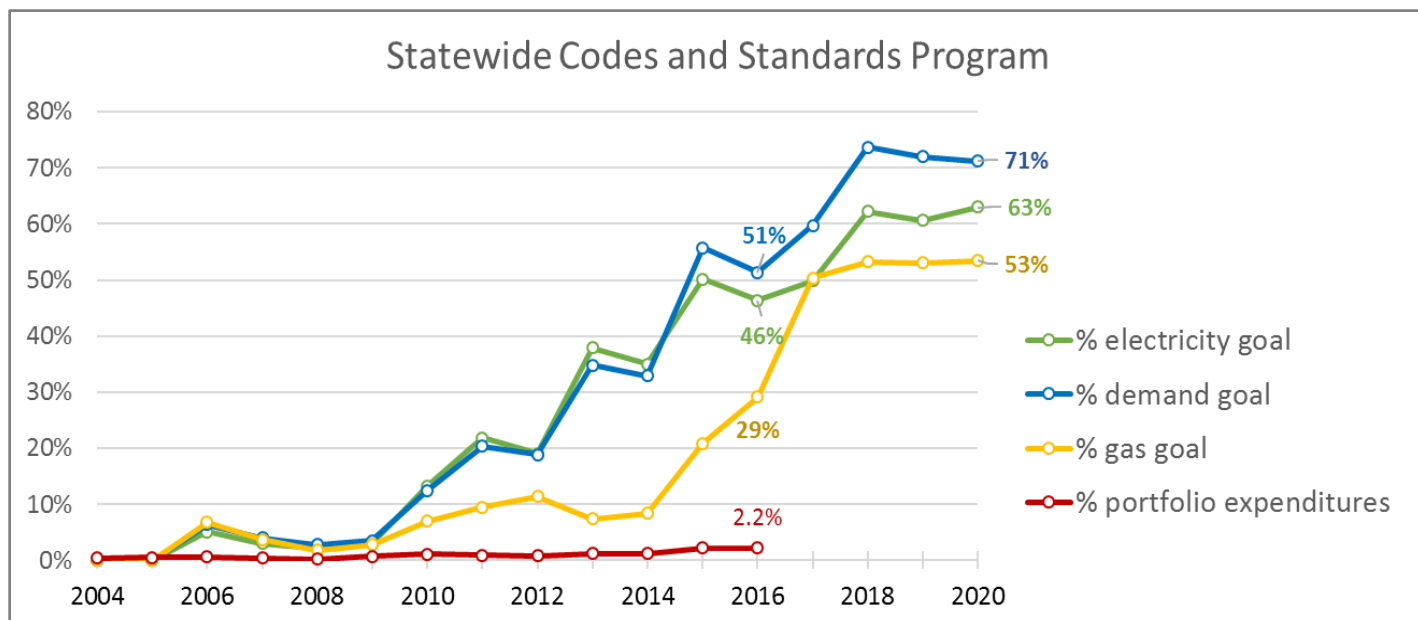
The C&S Program is an extremely cost-effective program since savings continue to accrue for many years following the C&S Program advocacy activities. In 2016, with a statewide budget equal to approximately 2.2 percent of the portfolio total, the C&S Program will generate approximately half of the portfolio electric savings (46 percent electricity, 51 percent demand) and almost one-third (29 percent) of gas savings.

Given delays between research and rulemakings, and between adoption and effective dates, several years may lapse between advocacy efforts realized savings. The savings shown in **Error! Reference source not found.**, below, show that measures adopted because of C&S Program efforts conducted through March 2016 will continue to produce savings equal to more than half of the total portfolio savings through 2020. The activities described in this business plan will produce savings from appliance and building standards

<sup>49</sup> CPUC 2010 (Cadmus). "CA IOU C&S Program Evaluation for Program Years 2006-08." CPUC 2014 (Cadmus). "Statewide C&S Program Impact Evaluation Report PY 2010-12."

scheduled for adoption before 2020, and will set the stage for a stream of savings to be realized in future code cycles.

**Figure 5: Codes and Standards Program Budget and Savings**



Note: the estimated demand, electricity, and gas percentages are calculated by dividing the C&S savings by the total portfolio savings (C&S and incentive programs). The C&S Program savings are based on adopted standards (thru March 2016) for which Statewide IOU team conducted advocacy efforts. The C&S savings are derived from either CPUC Impact Evaluations (for standards that became effective in 2006 thru 2012) or IOU estimates (for standards that become effective in 2013 and beyond). The incentive program savings are estimated based on CPUC evaluation results (for savings from 2004 to 2012), IOU estimates (for savings from 2013-15), and incentive programs goals provided in the CPUC Decision 15-10-028 (2016 and beyond). Per prior CPUC policy, C&S Program savings are *net* and incentive programs savings are *gross*. [Note: The August 2016 CPUC decision D.16-08-019 has now recommended that incentive program goals be measured in *net* goals rather than *gross* goals to address potential free ridership concerns.]

Just as the C&S Program serves a diverse customer landscape, it also plays a cross-cutting role in supporting the other programs and departments within the Energy Efficiency group at PG&E. Accurate data derived from data gathering from code-driven research and market analysis to support the development of effective standards may also be a resource for program developers and implementers serving customers that the standard will eventually impact. This positions the C&S Program to share knowledge through existing relationships.

### Benefits to customers

C&S activities benefits California’s customers by:

- 1) Significantly reducing in energy bills for all customers;<sup>50</sup>

<sup>50</sup> For example, annual bill reductions per home resulting from the Statewide C&S program advocacy is estimated at \$400/y for newly constructed homes and \$100/y for existing homes. See slide 4 of the May 4, 2016 Stage 2 Statewide C&S presentation for the EE Coordinating Council.

[http://media.wix.com/ugd/0c9650\\_7b6b1a4581114c73b658ca50b37ba625.pdf](http://media.wix.com/ugd/0c9650_7b6b1a4581114c73b658ca50b37ba625.pdf)

- 2) Providing a solution for the “split incentive” problem faced by a larger percentage of customers who are tenants. (Many landlords purchase appliances based upon first cost, so the improved standards provide the best chance for improved energy efficiency for tenants.); and
- 3) Supporting building design teams, contractors, customers and government agencies to improve their ability to comply with codes and standards.

C&S activities benefits state agencies by:

- 1) Achieving progress toward CPUC, Energy Commission, and CARB policy goals;
- 2) Coordinating with other entities to support the state’s ambitious energy policy goals; and
- 3) Assisting local governments in developing ordinances that exceed statewide minimum requirements.

### *External Community and Economic Impacts and Benefits*

Codes and standards have far-reaching impacts, throughout California and beyond. California frequently leads the nation in setting stringent codes and standards, and many of the benefits realized in California spillover to other states nationwide, and also internationally.

When a code or standard is adopted, it begins permanently changing the market, and the covered technology (or equipment or activity) typically becomes standard practice. Impacts from these market changes provide significant benefits to both IOU and non-IOU customers throughout the state. This benefit affects those who participate in IOU incentive programs as well as those who do not. The Energy Commission estimates that savings from implementation of the 2016 building standards will reduce annual statewide greenhouse gas emissions by 160,000 metric tons of CO<sub>2</sub>e<sup>51</sup>.

In addition, the economic benefits continue to accrue with each transaction following a code adoption translating to reduced operating costs which directly impact the bottom line for everyone, including:

- Local governments: increase ability to meet local goals through supporting standards implementation;
- Local businesses: increase profits, reduce prices; and
- Homeowners and residents: lower energy costs, increase in discretionary income.

An increase in discretionary income produces increased spending, at least some of which will be spent at locally-owned businesses, compounding the benefits further through the local multiplier effect, which posits that money spent within the community produces a greater local economic benefit as it recirculates and is re-invested in the community.

Updated codes often spur market innovation to increase customer functionality and energy efficiency. One good example of this is residential clothes washers. In 2006 DOE implemented a clothes washer standard that improved the efficiency to push most top loader washers out of the market. This was a pretty progressive move towards energy efficiency at a time when top loading washers still dominated the market. Front loaders were a premium product in the US even if they dominated the market in Europe. As a result of DOE’s regulation manufacturers now produce a low cost front loading washing machine that saves water and energy (while still effectively cleaning clothes). This type of code-driven innovation has encouraged manufacturers to engineer better products while saving energy.

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<sup>51</sup> 2016 Building Energy Efficiency Standards, June 2015. [http://www.energy.ca.gov/2015publications/ENERGY\\_COMMISSION-400-2015-037/ENERGY\\_COMMISSION-400-2015-037-CMF.pdf](http://www.energy.ca.gov/2015publications/ENERGY_COMMISSION-400-2015-037/ENERGY_COMMISSION-400-2015-037-CMF.pdf)

The C&S Program creates jobs through direct employment, indirect employment, and induced employment. The program creates jobs in all three categories with a significant amount created from induced employment which accounts for the expenditure-induced effects in the general economy due to the economic activity and spending of direct and indirect employees. These shared benefits are reinvested in local economies by millions of customers. Wei et al. (2010) estimates that energy efficiency creates 0.17 to 0.59 net job-years per GWH saved.<sup>52</sup> By comparison, they estimate that the coal and natural gas industries create 0.11 net job-years per GWH produced. When utilizing a mid-point for the energy efficiency range (0.38 net job-years per GWH saved), and assuming 80,000 GWH in committed statewide efficiency savings from codes and standards by 2026, the resulting cumulative job creation would be a projected 30,400 jobs.

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<sup>52</sup> “Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US?” Max Wei, Shana Patadia, and Daniel M. Kammen. *Energy Policy* 38 (2010) 919–931.

## Appendix D. Customer Landscape

C&S affect many stakeholders in the building industry supply chain. Appliance standards impact all customers who purchase regulated products. Considering this, the influence of C&S has an effect on virtually all customers. With respect to advocacy engagement, priority stakeholders include those who can affect the success of standards in the rulemaking process and through implementation. Stakeholders include, but are not limited to:

- a. Local, state and federal government agencies
  - i. Local jurisdictions
  - ii. State agencies
  - iii. Federal agencies
- b. Utility colleagues
  - i. California investor-owned utility (IOU) partner utilities
  - ii. Non-California based IOUs operating in California
  - iii. California-based municipal utilities
  - iv. National utility partners
  - v. Third party implementers
  - vi. Trade professionals
- c. Standards, testing, and ratings organizations
  - i. Professional organizations (ASHRAE, IES etc.)
  - ii. Industry organizations (AHRI, NEMA, AGA, CTI etc.)
  - iii. Voluntary equipment rating programs (ENERGYSTAR, DesignLights Consortium, CEE, WaterSense etc.)
  - iv. Building rating programs (LEED, PassiveHouse, EPA PortfolioManager, Living Building Rating etc.)
  - v. Building testing organizations (HERS, NatHERS, ATTs, Commissioning Organizations)
  - vi. Governmental organizations (DOE, NIST, National Labs, EPA)
- d. Enforcement agencies
  - i. Building inspectors
  - ii. Plans examiners
  - iii. Building official advocacy groups (CALBO)
- e. Regional partnerships & advocacy groups
- f. Construction industry market actors
  - i. Design professionals, contractors, engineering firms, energy consultants, HERS raters, and acceptance test technicians
- g. Construction industry suppliers
  - i. Manufacturers, distributors, and retailers
  - ii. Industry associations
- h. Building owners and operators
  - i. Building owners (BOMA, California Business Properties Association, etc.)
  - ii. Occupants (employee unions, retailers etc.)
- i. Demand response providers
  - i. California utilities
  - ii. Third party implementers
  - iii. DR Equipment providers
- j. Renewable energy providers
  - i. Solar equipment manufacturers
  - ii. Solar installation companies

Renewable energy advocacy groups (CalSEIA, Environmental Groups)

Energy Commission

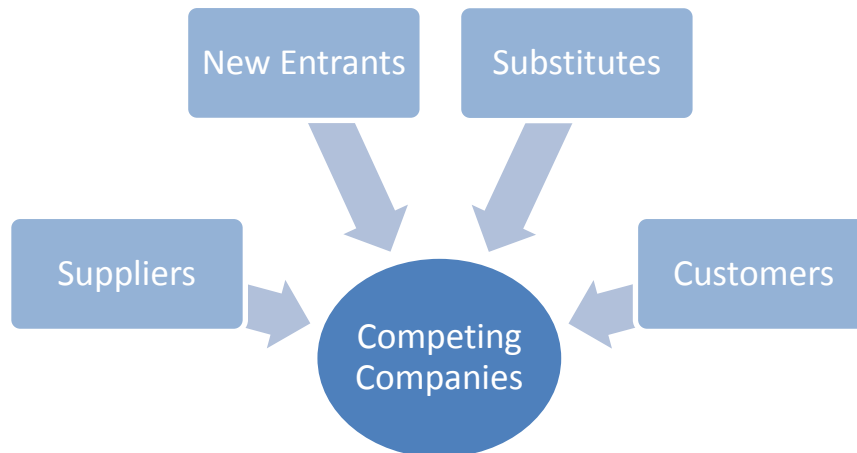


## Appendix E. Overview of PG&E’s Code-Directed Industry Transformation (CDIT)

PG&E plans to implement strategies and tactics to advance CDIT.<sup>53</sup> A market may be defined as a group of potential customers or buyers within a geographic boundary. From this perspective the market for an upstream or midstream incentive program may be customers within California’s political boundaries and be dominated by individuals who purchase from distributors or retailers. The market for a downstream program may be an IOU service territory and be dominated by builders and contractors. Customers (contractors, individuals, etc.) within a geographic boundary choose from a selection of substitute products depending on price and amenity.

One of the problems with implementing “market transformation” through incentive and other programs is that many customers within a market do not respond to incentive programs due to various market barriers. “Markets” are somewhat amorphous in that they comprise dissimilar customer groups for different products, and incentive programs may not be designed to distinguish between various customer groups. Moreover, markets are only one piece of a larger strategic picture, and most individuals have little or no input to industries that provide EE products or services. For these and other reasons, voluntary programs cannot generally achieve market transformation alone, which is why markets are regulated through legislation, codes and standards and executive orders.<sup>54</sup>

Industries are comprised of companies (builders, retailers, etc.) which compete with one another based on price, differentiation, or other means. For example, an industry may be defined by firms that compete to build new grocery stores. Another industry may include companies that manufacture specific types of residential lighting products. As part of competitive strategy, these companies will consider the strengths and weaknesses of competitors, potential new entrants, substitute products, the relative strengths of suppliers and customers, and other issues.



*Based on work by Michael Porter, Harvard University*

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<sup>53</sup> CDIT is a PG&E-specific activity

<sup>54</sup> Within this context, we recommend that policy makers consider the usefulness of Market Transformation as a framework for individual incentive program design.

When applying industry analysis to the business of energy efficiency, a number of the questions emerge:

- How intense is competition between builders, of low-rise office buildings for example?
- If competition is fierce, can we leverage this competition to reduce the number of projects?
- Do suppliers have an advantage relative to builders?

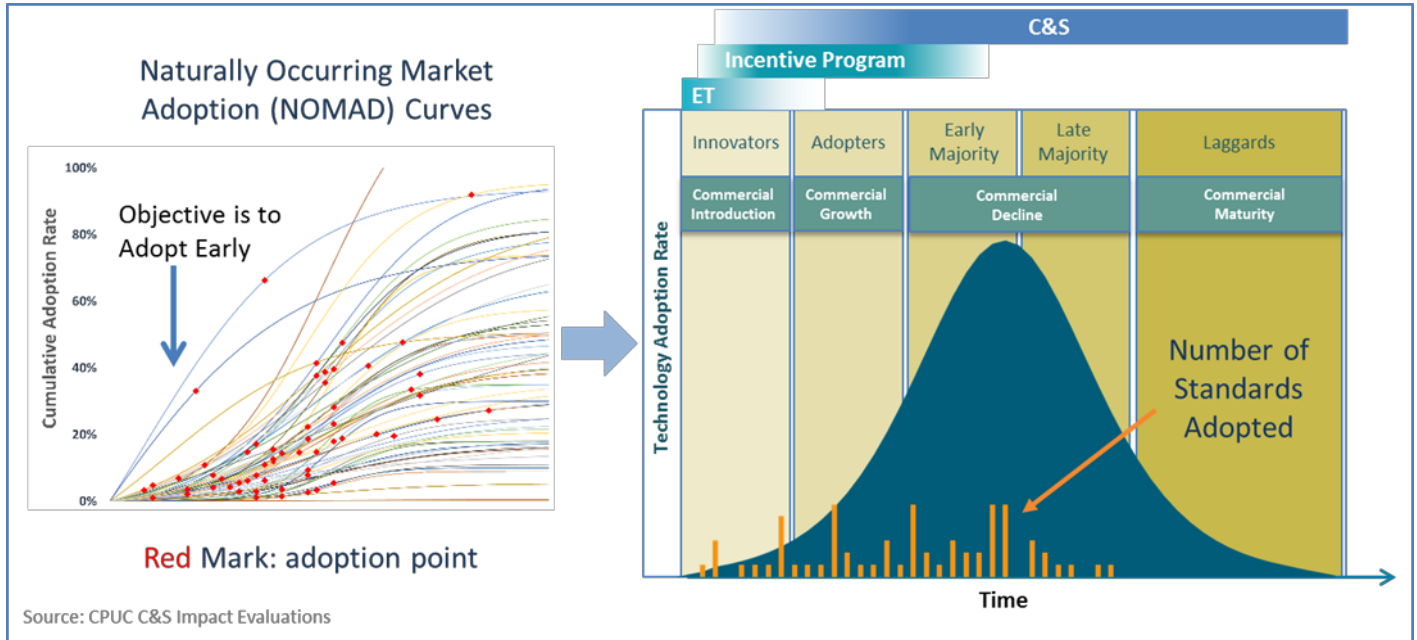
For example, do suppliers of disruptive HVAC systems have a negotiating advantage with respect to builders and, if so, what competitive strategy is driving the supplier? Do buyers/customers have an advantage relative to builders? How many builders compete to build warehouses? Can a small group of relocatable classroom manufacturers be transformed with codes and standards? Are there new builders or suppliers entering a specific industry? If so, are they entering the industry based on cost or differentiation? Partially successful, voluntary, market transformation efforts are likely based on informal industry analyses by experienced individuals who understand an entire industry.

If done thoughtfully, industry analysis can leverage competition to change a group of companies and transform an industry. Industry analysis is a common tool for decision making that can support a new approach to C&S work, Industry Transformation. PG&E will employ analysis to target code readiness projects and research. PG&E anticipates that industry analysis will set us up for better transitions to incentive programs, and eventual Industry Transformation.

CDIT includes intentional and specific activities executed to realize the outcomes expressed in CPUC Decision (D.)09-09-047, which defined market transformation as “long-lasting, sustainable changes in the structure or functioning of a market achieved by reducing barriers to the adoption of energy efficiency measures to the point where continuation of the same publicly-funded intervention is no longer appropriate in that specific market. Market transformation includes promoting one set of efficient technologies until they are adopted into codes and standards (or otherwise adopted by the market), while also moving forward to bring the next generation of even more efficient technologies to the market.”

The objective of applying CDIT is accelerate the adoption of new technologies earlier in the product life cycle. Achieving this goal will save significantly more energy for less money compared to business as usual. As can be seen on the left side of Figure 6, there is little or no correlation between cumulative market adoption rates and the market share at which measures are adopted into code. This occurs because code readiness is determined not by market share, but by life cycle cost effectiveness and technical feasibility as defined by the Warren Alquist Act. CDIT will therefore conduct activities that advance determinants of code readiness; in particular, designer, builder and contractor feasibility studies and documentation of the cost effectiveness of measures over time. The assessment for code readiness and evaluation of technologies as they would function within the larger building system must begin as soon as the technology is market-ready and shows potential.

**Figure 6: Market Adoption Rates**



CDIT begins by breaking broad policy goals into actionable objectives. After selecting a specific objective, planning and coordination develops and manages a long-term tactical plan to achieve specific building code objective, and conducts a parallel assessment of appliances needed to optimize the building codes. Since the energy use from unregulated (by T24) appliances represents approximately 50 percent of electricity energy use in residential buildings,<sup>55</sup> and approximately 30 percent in nonresidential buildings,<sup>56</sup> the parallel effort to improve the efficiency of appliances is as important as building efficiency.

Given the magnitude of energy use for unregulated appliances relative to the whole building, work will be conducted to optimize the performance of appliances and document performance, and be supported by field studies to produce population data. Additionally, the code readiness activities may be conducted to leverage C&S Program research to support development of new measures for programs.

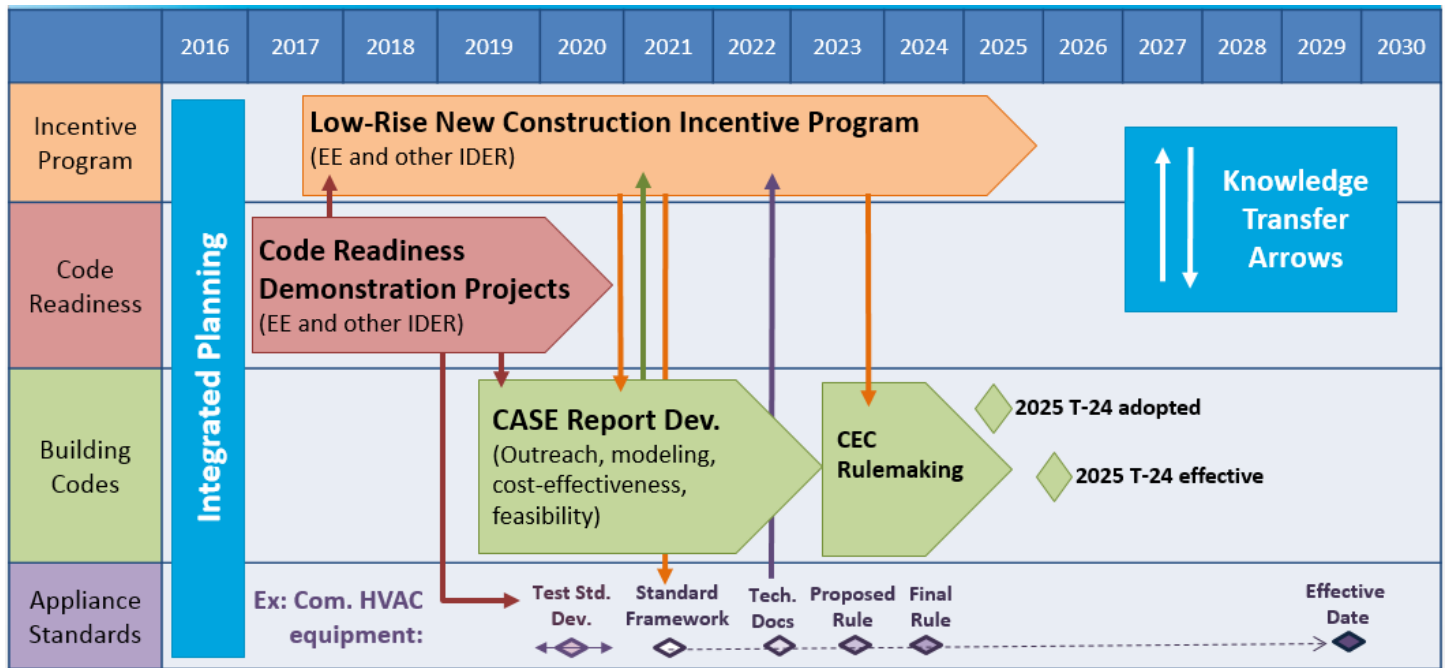
A key part of CDIT is that specific measures and systems will be transferred from code readiness projects into other programs; for example, performance based programs be repurposed to promote specific measures identified through code readiness work (“Incentive Program” lane in Figure 7). This level of specificity (see vertical blue box in Figure 7) between other programs and C&S staff will increase the likelihood of knowledge transfer and will enable continued documentation of feasibility and costs data for specific measures needed to support future code enhancement proposals, and C&S will partner with programs with commercial and residential programs collect these data. Also, PG&E’s collective effort will aim for a small number of projects

<sup>55</sup> 2009 California Residential Appliance Saturation Study (RASS) Executive Summary Prepared for: California Energy Commission Prepared by: KEMA, Inc. OCTOBER 2010. Report No. ENERGY COMMISSION - 200 - 2010 - 004 - ES. [http://www.energy.ca.gov/2010publications/ENERGY\\_COMMISSION-200-2010-004/ENERGY\\_COMMISSION-200-2010-004-ES.PDF](http://www.energy.ca.gov/2010publications/ENERGY_COMMISSION-200-2010-004/ENERGY_COMMISSION-200-2010-004-ES.PDF)

<sup>56</sup> California Commercial End-Use Survey Prepared For: California Energy Commission Prepared By: Itron, Inc. March 2006 CEC-400-2006-005. <http://www.energy.ca.gov/2006publications/CEC-400-2006-005/CEC-400-2006-005.PDF>

with each of several actors selected within target industries,<sup>57</sup> including industry focused training, to rapidly expand feasibility. These high-touch, industry-focused efforts may be conducted within the C&S program or in partnership with other local residential and commercial code readiness programs.

Figure 7: Integrated Planning to Achieve Code-Directed Industry Transformation (Low-Rise Commercial New Construction Example)



Serving as an example of a CDIT strategy in action, in 2016 the DOE adopted the first dedicated purpose pool pump standard in the nation. As pumps are replaced or new ones are purchased, the standard is expected to reduce filtration pumping energy use by 75 percent and demand by 85 percent. The standard will deliver a national reduction in individual pool filtration energy consumption from 2,600 kWh per year to less than 800 kWh per year. This new standard is the result of long-term interventions by utilities using voluntary incentives, industry collaboration, trade education, and advocacy. The standard is a documented, positive outcome of cross-cutting collaboration that includes incentives coupled with education and outreach, which led to manufacturer product development, increased program participation and market share, and finally new standards at both the State and federal level.<sup>58</sup>

<sup>57</sup> This is in contrast to incentive programs which are indifferent to the breadth of coverage among actors within a specific industry.

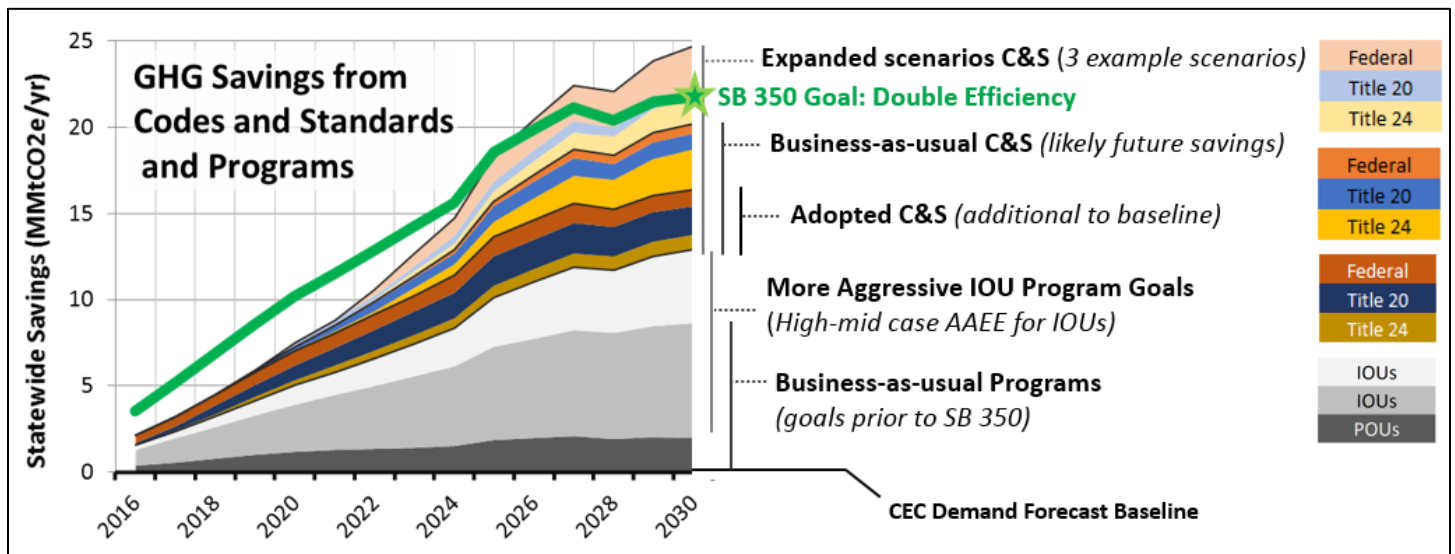
<sup>58</sup> Gary Fernstrom, Alina Zohrabian, Lianne Westberg, Chad Worth, "Standards Driven Market Transformation; 20 Year Multifaceted Intervention Leads to DOE Pool Pump Standard," 2016, ACEEE Summer Study.

## Appendix F. C&S Opportunities

California has difficult tasks ahead between now and 2050. The first is to achieve existing policy goals, including ZNE for new buildings and to double energy efficiency results by 2030 (see **Error! Reference source not found.**). Then, we will need to “widen” existing policy wedges based on successful implementation and establish new policies to fill the gap between business as usual and policy goals (in red below, **Error! Reference source not found.**).

C&S calculates that business-as-usual savings from programs will achieve roughly 40% of the 2030 SB 350 goal. If IOU programs were expanded from business-as-usual to the savings levels estimated in the high-mid case of Additional Achievable Energy Efficiency (AAEE) specified in Navigant’s Potential and Goals Study,<sup>59</sup> programs could achieve 59% of the 2030 SB 350 goal. The additional savings from C&S that have already been adopted but which were not included in the baseline for the SB 350 goal (“Adopted C&S”) will increase total savings to 58% of the 2030 milestone. Adding savings from likely future C&S (measures that have not yet been adopted) results in the total savings from “business-as-usual” Programs and C&S: 93% of the 2030 goal. Given three potential assertive expansions to business-as-usual C&S<sup>60</sup>, we estimate that California could double efficiency by 2030, reaching 113% of the 2030 goal. **Error! Reference source not found.** summarizes the high-level results of savings potential analysis from 2016-2030, in the context of estimated GHG reductions from achieving the SB 350 doubling efficiency goal.

**Figure 8. Deeper Codes and Standards Energy Savings to Double Efficiency by 2030**



General sources and assumptions: C&S savings are discounted by subtracting estimates of non-compliance, (NOMAD), and overlap with Program savings. SB 350 doubling efficiency goal - analysis conducted by NRDC, which followed the

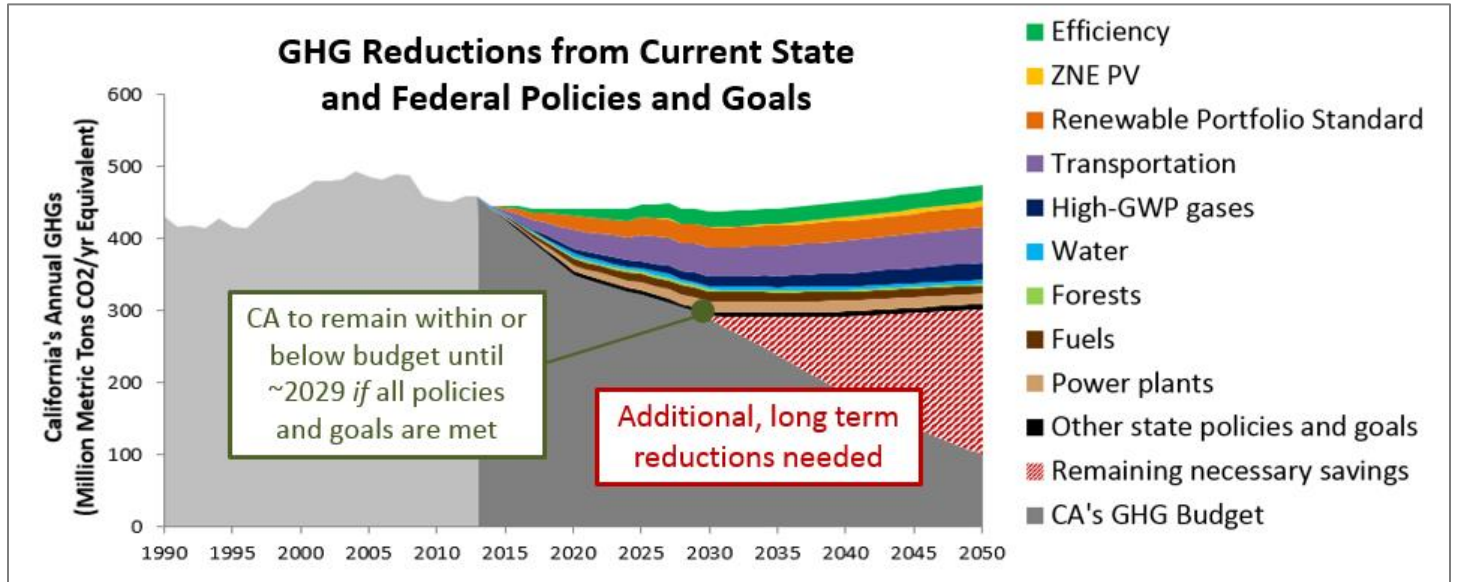
<sup>59</sup> CPUC 2015 (Navigant). “Energy Efficiency Potential and Goals Study for 2015 and Beyond”.

<sup>60</sup> At a high level: 1. **Federal:** Enhanced savings for federally covered product categories (through DOE activity or preemption strategies); 2. **Title 20:** Double the rate of Title 20 measure adoption; and 3. **Title 24:** More aggressive efficiency levels and more retrofits affected. For further discussion, see “Codes and Standards Climate Strategy.” Pat Eilert, Eric Rubin, Alex Chase, and Yanda Zhang. 2016 ACEEE Summer Study. Note that the figure has been slightly updated since the ACEEE Summer Study paper was finalized.

methodology prescribed in the senate bill language. Annual emissions factors – E3’s PATHWAYS model, “Straight Line” scenario. See Eilert et al. *Codes and Standards Climate Strategy* (2016 ACEEE Summer Study) for additional details.

The challenges will continue beyond 2030. **Error! Reference source not found.** below shows California’s historical GHG emissions and forthcoming goals established by AB 32, SB 32, E.O. B-30-15, and E.O. S-3-05 (the top of the gray areas represent GHG goals). If California’s policy goals are achieved, the State’s emissions are expected to decrease at a level that is consistent with GHG reduction goals until about 2029, but additional efforts are needed to reach longer-term goals. C&S can play a role in readying the state for these long-term challenges.

**Figure 9. GHG Reductions from State and Federal Policies and Targets**



Solid colored wedges indicate GHG reductions if current policy goals are met. Even if current policies are successfully executed, we will need additional strategies to achieve the 2030 goal (40 percent below 1990 levels, established by Executive Order B-30-15) and the 2050 goal (80 percent below 1990 levels, established by Executive Order S-3-05). Source: Eilert et al. *Codes and Standards Climate Strategy*. 2016 ACEEE Summer Study on Energy Efficiency in Buildings.

## Appendix G. Abbreviations and Acronyms

ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ACEEE	American Council for an Energy-Efficient Economy
CALBO	California Association of Building Officials
CARB	California Air Resource Board
CBSC	California Building Standards Commission
CCTR	Code Change Theory Report
CDMT	Code-directed Market Transformation
Energy Commission	California Energy Commission
CPUC	California Public Utilities Commission
DER	Distributed Energy Resources
DOE	United States Department of Energy
DR	Demand Response
ED	Energy Division
EE	Energy Efficiency
EM&V	Evaluation Measurement & Verification
EPAct 2005	Energy Policy Act of 2005
EPCA	Energy Policy and Conservation Act
EPIC	Electric Program Investment Charge
ET	Emerging Technologies
GHG	Greenhouse gases
Green MLS	Green Multiple Listing Service
GWP	Global warming potential
HFC	Hydrofluorocarbons
ICC	International Code Council
IDER	Integrated Distributed Energy Resources
IOU	Investor Owned Utility
NEEA	Northwest Energy Efficiency Alliance
NEEP	Northeast Energy Efficiency Partnerships
NOMAD	Naturally Occurring Market Transformation
NRDC	National Resources Defense Council
PA	Program Administrator
RASS	Residential Appliance Saturation Study

RCx	Retro-commissioning
RPS	Renewable Portfolio Standard
REN	Regional Energy Network
SB	Senate Bill
T&D	Transportation & Distribution
TDV	Time Dependent Value
TRC	Total Resource Cost Test
US DOE	United States Department of Energy – US may not be used
US EPA	United States Environmental Protection Agency – US may not be used
US FTC	United States Federal Trade Commission – US may not be used
ZNE	Zero Net Energy
ZEV	Zero Emission Vehicles