CA | Energy Efficiency Strategic Plan

Zero Net Energy

Action Plan: Commercial Building Sector 2010-2012

Developed by ZNE Stakeholders

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OVERVIEW

This Zero Net Energy (ZNE) Action Plan is designed to help California's commercial buildings sector achieve the goals described in the California Long Term Energy Efficiency Strategic Plan (the "Strategic Plan" or the "Plan").[1]

BACKGROUND

Publicly-noticed workshops were held to revisit the two major goals outlined in the commercial chapter of the Strategic Plan and solicit input and support for the development of this Action Plan. It was through this workshop process that Energy Division began to look for volunteers (later called champions) to step forward and help assist in the implementation leadership of the ZNE Action Plan. This Action Plan reflects the input of Energy Division, Champions, and ZNE workshop participants (Appendix H). Recommendations from workshop participants are located in Appendix A, as well as throughout the document. Following are details on the individual workshops[2] including purpose and outcomes.

1. October 19, 2009 – First workshop, located at the CPUC in San Francisco, focused on Goal 1: New Construction and key strategies for getting to zero in the five key areas of codes, benchmarking, incentives, design community support, and technology transfer/R&D. Key players and chronological sequence of issues were also discussed.
2. December 8, 2009 – Second workshop, located in Irwindale at Southern California Edison's Customer Technology Application Center, focused on Goal 2: Existing Buildings and how to increase the rate of energy efficiency in key market sectors. Topics included: engaging the broader community and roles of the private industry and state agencies.
3. April 7, 2010 – Third workshop, located at the Pacific Energy Center in San Francisco, focused on key strategies echoed at previous workshops, the selection of near term milestones, mapping of key organizations to specific actions, and identification of priority strategies. The Action Plan process was initiated at this stage, as well as approaches on how to bring this document to life.

THE STRATEGIC PLAN

Published in 2008 by the California Public Utilities Commission (CPUC), the Strategic Plan outlines energy goals and efficiency strategies for key market sectors (commercial, residential, etc.) and crosscutting resources (e.g., HVAC).[3] In order to guide long-term changes in the market by reducing barriers to the adoption of energy efficiency measures (to the point where publicly-funded intervention is no longer appropriate)—market transformation—the Plan embraces four specific programmatic goals, known as the Big Bold Energy Efficiency Strategies or "BBEES" (D.07-10-032).[4] Unlike traditional regulatory approaches, the Plan identifies near-term, mid-term and long-term milestones to move the state towards these BBEES. The Big Bold Energy Efficiency Strategies are:

- All new residential construction in California will be zero net energy by 2020
- All new commercial construction in California will be zero net energy by 2030

[1] CPUC, *The California Efficiency Strategic Plan* (Sep 2008): http://www.californiaenergyefficiency.com/docs/EEStrategicPlan.pdf.

[2] http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/EE+Workshops/.

[3] Ibid, Table of Contents.

[4] Ibid, 4.

- Heating, Ventilation and Air Conditioning (HVAC) will be transformed to ensure that its energy performance is optimal for California's climate
- All eligible low-income customers will be given the opportunity to participate in the low income energy efficiency program by 2020.

As part of the Plan's efforts to achieve maximum energy savings via the BBEES, innovations in a range of technologies, services and even philosophies in program design are required. Stretching beyond the scope and participation of the existing ratepayer-supported utility programs, achieving the goals in the Strategic Plan requires involvement of stakeholders outside of investor owned utilities (IOUs). While the Plan is a policy-oriented document that sets forth leadership and vision, the ZNE Action Plan is a way to operationalize the zero net energy goals of the Strategic Plan for the commercial sector. Not only does this document help the broader California community proceed step-by-step towards achieving the Strategic Plan's zero net energy future, but it also provides meaningful engagement for stakeholders. This document focuses on the Strategic Plan's two primary ZNE goals for the commercial sector, new construction (Goal 1) and existing buildings (Goal 2). Goal 3 (commercial lighting) has been incorporated in the 2010 Lighting Chapter (added to the Plan in September 2010). The Lighting Action Plan (available by end of 2010) will provide more detail, strategies and milestones for this crucial crosscutting resource.

THE ACTION PLANS

Engaging industry leaders and influencers, as well as relevant agencies, stakeholders and utilities, is critical for successful implementation of the Plan. To make stakeholder participation in strategic planning activities meaningful and focused on achieving milestones, the ZNE Action Plan is designed to identify the key actions required to achieve Plan milestones, secure leaders for the steps to achieve these actions, and track and report on progress against the Plan. This roadmap is comparatively succinct and graphical in nature, in the hopes of facilitating comprehension and action by the broadest cross section of California players as possible. The ZNE Action Plan is based on a literature review, a series of public workshops (related to both new construction and existing buildings), ongoing outreach to key stakeholders (see Appendix G & H) and participation in both state and national commercial building efforts (see Appendix D).

Prioritized Strategies. The ZNE Action Plan is designed to achieve milestones identified in the Strategic Plan. However, with more than 30 milestones in the commercial sector recommended for implementation in 2010-2012 alone, actions must be prioritized. Moreover, given both the dynamic nature of the energy efficiency (EE) marketplace and concurrent efforts in other sectors, the ZNE Action Plan does not seek to launch all strategies identified in the Plan by 2010, nor does it provide a highly detailed plan for the entire near term (2010-2012) implementation. Instead, the ZNE Action Plan focuses on priority strategies needing immediate attention, and an overview of activities to be launched in 2011 and 2012. These priority strategies were defined and vetted through workshops with the broader stakeholder community.

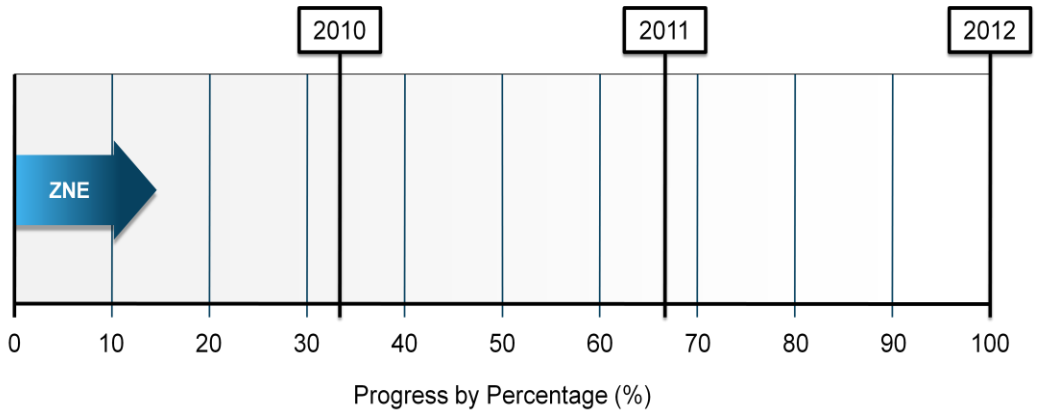
Champions Network. Continued work with the broader stakeholder community is the core focus of this action plan, including manufacturers, contractors, local governments and others. Ongoing coordination is essential to track progress, develop accountability and acknowledge success, as well as generally provide high-level coordination to accelerate progress. The initial approach to the ZNE Action Plan includes identifying champions for each milestone. Via an initial set of workshops (existing buildings, new construction and the joint action plan for both), industry leaders were identified to take on responsibility for the achievement of Strategic Plan goals. Champions include people from relevant state agencies, buildings industry, utilities, and a wide range of trade groups and nonprofit organizations. Many of the champions who have volunteered are already working on some aspect of the action plan in their professional work. In the near-term, the CPUC will serve as a central organizational point for Plan champions, providing both online (www.Enage360.com) and offline facilitation of the champions' network,

as well as tracking progress towards milestones. Regular updates will be provided on actions and progress indicators via www.Engage360.com. Additional champions from the broader marketplace will be essential to truly institutionalize the Plan in the fabric of the state.

Action Detail. For each strategy discussed in this action plan, activities were ordered in a step-wise approach to achieve milestones. While this document serves to create a broadly distributed and easy-to-understand approach to the ZNE Action Plan, additional project management tools are employed to (a) identify groups already working on key issues related to the ZNE Action Plan, (b) identify likely organizations and individuals who would be able to help deliver a milestone, (c) identify champions who can take responsibility for specific tasks, (d) estimate time to achieve a specific action and (e) record any progress.

Progress Indicators. Progress indicators are based on a simple calculation. For each milestone, there are an established number of actions. Progress is measured as "percentage complete" by dividing the number of actions complete by the total number of actions. While it may be ideal to develop a weighted approach (as achieving some milestones have a significant ripple effect) or develop a formula that equates a score with activities that are ahead, behind or on schedule, this simple method provides for a general gauge for progress against the plan. Processes that are considered "ongoing" (such as updating codes) are listed as one-sixth (17 percent) complete as of July 2010, per a total of 12 quarterly progress reports for what the Strategic Plan calls the near-term (2010-2012) implementation cycle. Progress indicators and not provided for strategies which will be launched in 2011 or 2012.

Overall Progress. In addition to the detail provided in this action plan, a snapshot of general progress against the Plan's goals in key sectors is essential to success. To be considered "on track," overall indicators would need to ensure that milestones for the 2010-2012 cycle are generally one-third complete at the end of 2010, two-thirds complete at the end of 2011 and 100 percent complete at the end of 2012. Assuming steady progress in each year of the 3-year Strategic Plan cycle, near-term milestones (those included in this action plan), should be approximately 17 percent complete by mid-2010. By averaging the progress of all near-term milestones in the commercial sector (37), the action plan appears basically on track as of July 2010, with approximately 13 percent of necessary activities completed:



THE STATE OF THE COMMERCIAL BUILDINGS MARKET

Emerging Trends in Real Estate 2010, a joint project of the Urban Land Institute and PricewaterhouseCoopers, characterizes the commercial buildings market as follows:

> "After more than a year spent in suspended animation lagging already shattered housing markets, the commercial real estate industry hits bottom in 2010, suffering a surge of painful writedowns, defaults and workouts…Transaction markets will begin to thaw and value declines ultimately will average more than 40 percent off mid-2007 pricing peaks. These property market reversals likely will be the worst registered since the Great Depression."[5]

To date, California has more zero net energy buildings (residential and commercial) than any other state in the nation (see Appendix E for details). When reviewing this action plan, it is important to consider the impact of the global recession (2008–2010) on commercial buildings. The market for commercial buildings is in a substantial decline, which will likely continue for several years. This decline will significantly impact development of new projects, as vacancy rates in commercial properties are high and lending is tight. Construction of public buildings has already slowed and will likely continue to lag, as government entities tighten budgets and passage of school bonds may prove difficult. For existing buildings, there will be financial difficulties, but also some opportunities as tenants try to maximize the value of rental dollars and owners look for ways to cut buildings expenses, including the use of energy efficiency. However, with financing and cash both in short supply, the drop in building values may make owners reluctant to invest in their buildings.

Still, with the advent of the Strategic Plan, utility programs have new features that support achieving zero energy commercial buildings. California's state agencies are focused on substantial reduction of building energy use (leading to zero energy buildings) and private efforts (including from the architectural, engineering and green building communities) are targeted to fundamentally change energy-use aspects of the built environment. With this unprecedented multi-party effort focused on zero energy buildings, California is on the path to transform how buildings are designed, constructed and operated.

CRITICAL SUCCESS FACTORS

- **Planning cycles.** California could consider moving beyond quarterly cycles in the private sector, as well as the 3-year policy cycles, in order to create the next generation of buildings that will move towards the Strategic Plan's ZNE vision.
- **Market leadership.** The market includes a wide variety of building owners with divergent perspectives, as well as thousands of manufacturers, services providers and building occupants. Any effort to change the commercial buildings sector must leverage market leaders where change is most possible, while also changing market perceptions. Target markets should be identified as a focus for the next few years. See Appendix C for suggested markets for early adoption.
- **Financial viability.** Financial mechanisms that reward, or at least support, depth of energy savings need to be developed, including a cost-effective assembly of best practices in ZNE retrofits. These ZNE best practices must document lessons learned, as well as identify payback periods and provide linkages across multiple program efforts.
- **Statewide coordination.** There is need for a broadly representative group, including a range of public and private sector volunteers, to help coordinate efforts to advance the action plan. Achieving ZNE goals is a complex process requiring actions related to code development, design tool improvements and financial mechanisms. California must create ways to facilitate long-term commitments to the Strategic Plan effort from both public and private institutions.

[5] Miller, J.D., *Emerging Trends in Real Estate 2010* (Oct 2009): 1. http://www.uli.org/ResearchAndPublications/EmergingTrends.

- **Track and report on progress.** In order to advance the Plan's goals and strategies—and successfully create demand for ZNE buildings—the ZNE Action Plan must track and report on progress. Ongoing stakeholder engagement will benefit from visible demonstrations of success and how the strategies and milestones are working both independently and collectively to achieve Plan goals.
- **Technological improvement and commercial viability.** ZNE will be helped by the development and market diffusion of new technologies (e.g. LEDs, hybrid lighting, heat pumps, integrated multi-stage units, solar-thin film). The marketplace needs to supply these innovations s and consumers must begin to demand these new products instead of old technologies.

THE 2010-2012 ACTION PLAN

The Zero Net Energy Action Plan includes:

- **Strategies -** An overview of the strategy and why it is important to focus on these activities now.
- **Progress to Date (2010-2012) -** A graphical depiction of milestone progress, based on percent complete in the action plan.
- **Action Plan (2010-2012) -** Identifies the milestones to achieve the strategy and has specific activities, is time bound and is aligned with champions in the industry.
- **Priorities For The Future (2013 – 2030) -** Additional actions that were identified via stakeholders as potential strategies/milestones to include in an update to the Strategic Plan.

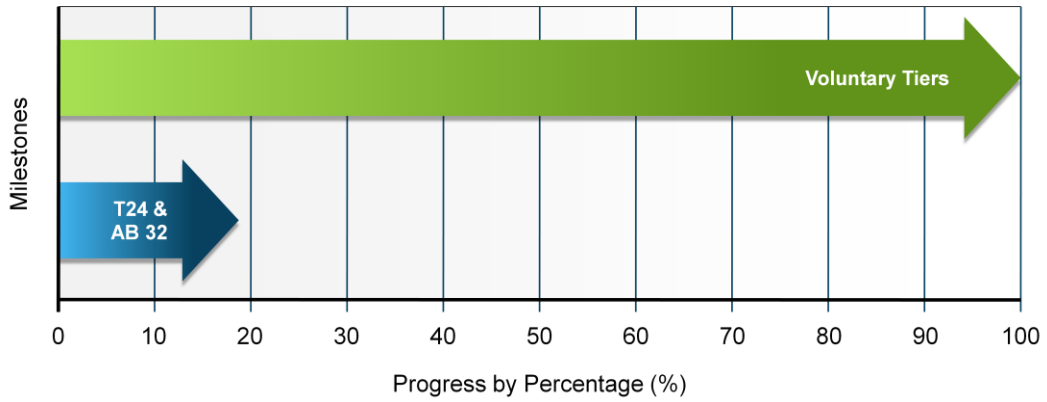
GOAL 1: NEW CONSTRUCTION

The following strategies are focused on new buildings to achieve Goal 1: "New construction will increasingly embrace zero net energy performance (including clean and distributed generation), reaching 100 percent penetration of new starts in 2030."

STRATEGY 1-1: ESTABLISH A LONG-TERM PROGRESSIVE PATH OF HIGHER MINIMUM CODES AND STANDARDS ENDING WITH ZNE CODES AND STANDARDS FOR ALL NEW BUILDINGS BY 2030

Energy codes are a key policy strategy included in the Strategic Plan to reach zero net energy buildings. To achieve 100 percent zero net energy new construction buildings by 2030, building energy codes need to be a driving policy instrument and ultimately the mechanism by which zero net energy is broadly achieved. No incentive or market-based program can achieve the market penetration routinely achieved by codes. The progressive pathway to higher codes and standards may include "reach codes" that clearly indicate to the market how codes will advance over the next few years. It is critical to begin to enable these future codes now, given the time-intensive process—and the far-reaching impact—of the 3-year cycles to update codes and standards.

PROGRESS TO DATE (2010-2012)[6]



While voluntary tiers are established (1-1-1), approximately 17 percent of the action needed to reach the Plan's near-term (2010-2012) milestones to integrate T24 and AB 32 (1-1-2) are complete. For context, here are a few accomplishments on the path to ZNE codes and standards by 2030:

- **CALGreen.** The California Building Standards Commission recently approved and enacted **CALGreen**, updating the 2008 Title 24 (T24) codes, with consensus and adoption from the Department of Housing and Community Development, Division of the State Architect, Office of Statewide Health Planning and Development and the California Energy Commission (CEC). **CALGreen** incorporates three levels of energy efficiency: a basic level (Title 24), 15 percent over T24 and 30 percent over T24. Cities and counties may adopt one of the three levels as part of their local codes process.[7] These tiers of codes can also be noted as reach codes.
- **Reach Codes.** Reach codes are voluntary and are adopted by cities and counties to signal where the market is headed. Several cities and counties are adopting reach codes that are more stringent than statewide standards (Title 24) through local ordinances. These local ordinances will provide lessons and best practices as we move toward progressive code implementation in the state. These cities include: Redwood City, Los Altos, Marin, San Rafael, Union City, Morgan Hill, Richmond, Palo Alto, Chula Vista, Santa Clara, San Jose, Sonoma, Hayward, and San Francisco.[8]

ACTION PLAN (2010-2012)

Milestone	Champions	Key Actions	Timeline
1-1-1 Establish one- or two-tiered voluntary EE	Patrick Saxton, CEC	Develop a green building code with multiple voluntary levels; Part 11 of Title 24 (California Green Building Standards Code)	Complete

[6] "Progress by Percentage" divides the number of actions completed by the total number of actions to complete a milestone. Processes that are considered "ongoing" (such as updating codes) are listed as one-third complete in 2010, two-thirds in 2011 and three-thirds in 2012. These charts will be updated regularly on www.Engage360.com.

[7] California Building Standards Commission, *California Green Building Standards Code* (Jan 2010): http://www.documents.dgs.ca.gov/bsc/documents/2010/Draft-2010-CALGreenCode.pdf.

[8] CEC, *Local Ordinances Exceeding the 2008 Building Energy Efficiency Standards* (last viewed Aug 2010): http://www.energy.ca.gov/title24/2008standards/ordinances.

standards, coordinated with green building rating systems	Pat Eilert, Pacific Gas & Electric	Develop a reach energy code that cities can adopt or utilities can incent beyond Title 24; Part 6 of Title 24 (California Energy Code)	Complete
1-1-2 Align Title 24 targets with goals of AB 32 and carbon reduction	Patrick Saxton, CEC	Coordinate policy development between Title 24 and AB 32	Ongoing
	Pat Eilert, Pacific Gas & Electric	Coordinate joint CEC/CPUC/California Air Resources Board (CARB)/California Independent System Operator (CAISO) actions to implement the AB32 Scoping Plan	Ongoing

PRIORITIES FOR THE FUTURE (2013-2030)

While California has achieved the some of the 2010-2012 milestones identified in the Plan on the path to progressive codes and standards (through CALGreen, reach codes and initial policy coordination), the ZNE goals for 2030 will require additional changes in both structure and reach of Title 24. By 2013, California must be actively implementing lessons learned from investor owned utility (IOU) 2010-2012 ZNE pilots to expand relevant incentives and direct code progression. Importantly, California must develop a path to measure outcome-based energy use, a code that continues to monitor and regulate energy use, thus ensuring ZNE performance. Additional priorities include:

- **Consider adoption of a metric to assist code development and measurement of progress through 2030.** When combined with T24, establishing a metric that references average building energy usage can help buildings achieve and maintain ZNE. In addition to looking at a building's percent beyond T24, a "distance from ZNE" metric could be utilized to measure progress. A code trajectory and schedule could be developed around this metric, e.g., a set increase for each code cycle.
- **Examine reach codes that clearly indicate regulatory progression in next code cycle.** The definition of "reach code" needs to be clarified, as one interpretation is a higher prescriptive level (not simply percent increase) that clearly signals to manufacturers, developers and designers the elements of future codes. The CEC is defining reach codes for state and local governments for consistency.
- **Consider adopting design review for code upgrades.** CALGreen sets forth mandatory requirements for comprehensive commissioning of non-residential buildings. A requirement for a design review that incorporates commissioning will be important to the future of ZNE. Acknowledging energy impacts of design decisions prior to construction, can improve operability of buildings and energy savings.[9]

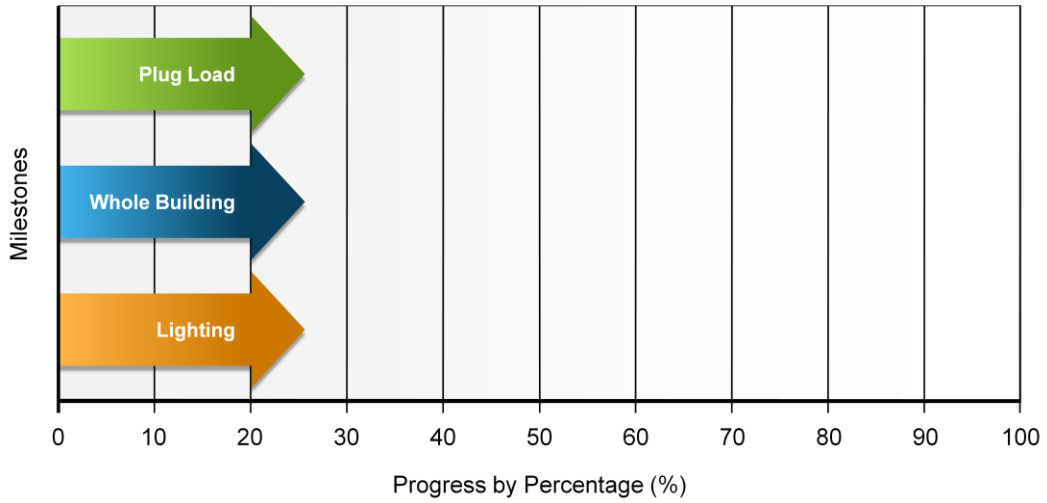
STRATEGY 1-2: EXPAND TITLES 20 AND 24 TO ADDRESS ALL SIGNIFICANT ENERGY END USES

The Strategic Plan calls to expand Titles 20 and 24 (T20 and T24) to address all significant energy end uses. There are time-sensitive opportunities to inform the next Title 24 upgrade. Non-regulated energy loads in buildings pose a threat to ZNE goals; these plug loads—including office equipment and refrigeration—account for approximately 25 percent of overall energy use. In some buildings, like restaurants and grocery stores, non-regulated loads can reach 70 percent or more of overall energy

[9] Existing guidance is provided by American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Guideline 0-2005 (Section 6) and/or Energy Design Resources Cx Assistant.

consumption[10]. In all cases, these loads are expected to grow. Title 20, which focuses on efficiency of specific products, influences a variety of purchases related to existing and new buildings. Title 20 appliance standards follow a different process and can be updated frequently, whereas Title 24 must follow the schedule dictated by the California Building Code—occurring every three to four years.

PROGRESS TO DATE (2010-2012)



Upgrading Title 20 and Title 24 is a dynamic cycle that includes a formal rulemaking process, as well as the opportunity to propose innovative code changes (substantiated by case studies) that can enable zero net energy. New standards for Title 24 will have an effective date of January 2013.[11] While specific updates for certain plug loads in Title 20 are scheduled for adoption in 2012, T20 is in a continuous update process until 2016. Each milestone represented in the chart above is 25 percent complete as the research for plug loads, whole building approaches, and lighting applications is the first step of the code update process. Below are a few accomplishments on the path to expanding T24 and T20:

- **Energy efficiency television standards.** The CEC created the nation's first energy-efficiency standard for TV sets in 2009. The Tier 1 standard takes effect in 2011, and will reduce energy consumption by an average of 33 percent. Tier 2 takes effect in 2013 and, with Tier 1, will reduce energy consumption by an average of 49 percent.[12] This sets the stage for other non-regulated plug loads.
- **Public Interest Energy Research (PIER) and Emerging Technologies (ET) studies.** The CEC's PIER and utility ET research is assessing how technologies and controls can help optimize building performance, while simultaneously educating operators and practitioners. Case studies are being developed to advance codes and standards for the current cycle (including plug loads). Research by the IOUs includes fault detection and diagnostic (FDD) systems by the California Lighting Technology Center (CLTC), daylighting, evaporative cooling and passive systems.
- **Lighting Technology Overview (LTO).** Commissioned by the CPUC, the LTO provides descriptions of best practice lighting solutions, explores applications in commercial, residential and exterior spaces, reviews barriers currently facing their widespread adoption and analyzes the technical potential for energy savings associated with each.

[10] New Buildings Institute, *Rethinking Percent Savings* (Jul 2009): http://newbuildings.org/sites/default/files/Rethinking_Percent_Savings.pdf.

[11] This cycle will repeat again in 2013, to upgrade the 2011 T24 standards to 2014 T24 standards.

[12] CEC, *Staff Report, publication # CEC-400-2009-024*(Sep 2009): http://www.energy.ca.gov/appliances/tv_faqs.html.

ACTION PLAN (2010-2012)

Milestone	Champions	Key Actions	Timeline
1-2-1 Develop and adopt broader codes and standards for plug loads such as copiers, printers, battery chargers, televisions	Brad Meister, CEC David Jacobowitz, Google	Research new plug load efficiency opportunities; review/test costs and performance	Complete
		Develop case studies to substantiate costs, savings	Q3 2010
		Engage industry stakeholders on relevant changes to T20	Q2 2011
		Propose/adopt changes to Title 20	Q2 2012
1-2-2 Expand Title 24 to include whole building approaches including metering and data management, automated diagnostic systems and sub-metering for tenant-occupied space	Martha Brook, CEC Randall Higa, Southern California Edison	Research costs/benefits of metering, FDD systems and tenant sub metering for lighting, HVAC, and plug loads	Complete
		Develop case studies to document costs and benefits	Q3 2010
		Engage industry stakeholders on relevant changes to T24	Q1 2011
		Propose/adopt changes to Title 24	Q2 2011
1-2-3 Adopt progressive codes and standards for high performance commercial lighting applications	Dustin Davis, CEC Francis Rubinstein, Lawrence Berkeley National Lab (LBNL)	Review lighting technologies and control strategies that offer higher performance	Complete
		Develop case studies on promising options	Q3 2010
		Engage industry stakeholders on Title 24	Q2 2011
		Propose/adopt into codes or standards	Q3 2011

PRIORITIES FOR THE FUTURE (2013-2030)

Data gathering to better understand the impacts of plug loads and identifying control mechanisms to reduce these end-uses is underway, as is the process for expanding T24. However, California must continue identifying additional technologies, metering, information and control strategies that can be included in energy codes and standards, as these are all precursors for ZNE buildings. As suggested by this strategy, focused research on end use technologies and plug load behavior will help assess how best to influence the market for ZNE commercial buildings and create the most meaningful reforms to T24 and T20. A priority for future Plan updates should be:

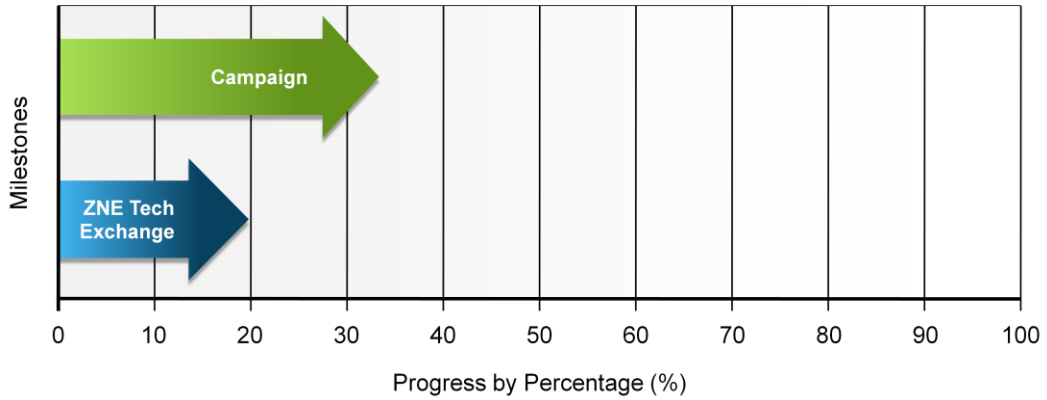
- **Incorporate smart meters and demand response devices into Title 24.** Title 24 addresses new construction, with little influence after the completion of a project. Currently there are a few demand response (DR) enabled measures incorporated into T24 standards. Requiring DR-enabled devices and smart meters into new construction would have a tremendous influence over energy use; this would

allow IOUs, building owners and operators to have rapid feedback of energy loads and enable intelligent decisions for energy management.

STRATEGY 1-3: ESTABLISH A "PATH TO ZERO" CAMPAIGN TO CREATE DEMAND FOR HIGH-EFFICIENCY BUILDINGS

The Strategic Plan calls to for a "Path to Zero campaign to create demand for high-efficiency buildings." As noted in the Plan this campaign will feature, "real-world experience and data on emerging technologies, practices and designs that deliver zero net and ultra-low energy buildings, alongside mechanisms to demonstrate effectiveness and create demand."[13] While a small number of ZNE innovators will provide inspiration and information to the marketplace, California must actively raise awareness of ZNE benefits and pave the way for its adoption. A "Path to Zero" campaign is larger than the CPUC, and must leverage the success of early adopters. To be truly effective, this campaign must plan *now* to address the bulk of the marketplace that will require a final push by regulation and codes to change building practices.

PROGRESS TO DATE (2010-2012)



Having assembled stakeholders and assessed ZNE audience groups (1-3-1), approximately one-third of the actions needed to plan and conduct a "Path to Zero" campaign are underway. Several data-exchange forums (1-3-2) have been conducted or are being planned, equating to approximately 20 percent completion of near-term (2010-2012) milestones. Some accomplishments on the Path to Zero:

- **Savings by Design.** The 2010-2012 IOUs programs include ZNE elements of Savings by Design (the statewide commercial new construction program). This program element will coordinate with the Workforce Education and Training program to offer integrated building design training to architects, engineers and other design professionals. This program targets at least 40 percent savings beyond Title 24. (A similar pilot effort in Oregon for 15 buildings was almost immediately fully subscribed.)
- **Zero Net Energy (ZNE) Workshops.** The CPUC has held three ZNE workshops (October 2009, December 2009 and April 2010) to help create this action plan. Southern California Edison (SCE) hosted a workshop on ZNE Research at the Technology Center on (May 2010). The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) also held a conference (2009) to

[13] CPUC, *California Energy Efficiency Strategic Plan*, 15.

address zero net energy in commercial buildings. The role of policy, utility incentives, emerging technologies, and renewable energy were all part of the discussion.

- **ZNE Benchmarking and media outreach.** As part of communicating and educating the public around AB 1103,[14] Resource Media, funded by the Sea Change Foundation, is surveying the commercial sector's major actors to ascertain current attitudes and inform messaging on benchmarking and ZNE.
- **National Efforts.** The Department of Energy (DOE) is advocating for ZNE buildings by 2025 through the Commercial Building Initiative (CBI). In addition to the DOE's related Zero Energy Buildings Consortium (information sharing) and the DOE's Builder's Challenge (awards), the 2030 Challenge and the Living Building Challenge are also driving awareness and providing education nationally.

ACTION PLAN (2010-2012)

Milestone	Champion	Key Actions	Timeline
1-3-1 Convene leading building industry associations to plan and conduct campaign	Keri Bolding, Resource Media Shilpa Sankaran, ZETA Communities	Convene series of stakeholder workshops	Complete
		Identify ZNE key audiences, drivers, attitudes, segments	Complete
		Develop ZNE baseline study in key ZNE segments	Q3 2010
		Develop outreach and education campaign plan (plus funding opportunities)	Q3 2010
		Launch ZNE outreach and education campaign	Q1 2011
		Track and report on progress	Q3 2011
1-3-2 Organize forums to develop and exchange experience and data on emerging technologies, practices and designs that deliver ultra-low and ZNE buildings	Peter Turnbull, PG&E Gregg Ander, SCE RK Stewart, Perkins + Will	Convene regular forums involving key market actors, technical experts	Complete
		Record and inventory data and related emerging tech at forums; publish via Engage360.com, other online resources	Q3 2010
		Survey forum participants re: best information for owners, architects	Q3 2010
		Coordinate forums with "Lead by Example" efforts (Strategy 2-1)	Q4 2010
		Identify and craft ZNE best practices and technical guides; create a ZNE Mentorship program	Q4 2010

[14] AB1103 (Saldana, 2007) requires disclosure at the time of sale and lease of a non-residential building energy use score from Energy Star Portfolio Manager for the previous 12 months. http://info.sen.ca.gov/pub/07-08/bill/asm/ab_1101-1150/ab_1103_bill_20070907_amended_sen_v94.pdf

PRIORITIES FOR THE FUTURE (2013-2030)

A host of market leading organizations—including the New Buildings Institute, ASHRAE, LBNL, the Building Owners and Managers Association (BOMA), International Facility Management Association (IFMA), Perkins & Will—are actively engaged in understanding the ZNE target markets and bringing "on the ground" experience to the Path to Zero effort. While ZNE is certainly more widely discussed since the adoption of the Strategic Plan in 2008, the Path to Zero Campaign will require the work of diverse organizations dedicated to sharing best practices, building a body of knowledge and launching a significant marketing, outreach and education initiative. Possibilities include:

- **Develop a high profile design contest to create the next generation of buildings for California.** The California Case Study Buildings concept could create a high-profile, multi-year series of buildings that embody the "next generation" attributes of sustainable, zero energy, affordable design. The case study effort could identify/create 30 to 50 exemplary projects over 5-year period through a competitive design competition to engage the broader buildings industry.
- **Establish a ZNE nonprofit organization.** A committed third party could help provide the long-term thinking and leadership needed to integrate deep energy efficiency, distributed renewable energy, and energy demand reduction to create zero net energy buildings. A ZNE nonprofit could help develop a common vision and coordinate resources over the next 10 years focused on researching, developing, and establishing ZNE buildings as a viable and common business practice in California.
- **Campaign Partnerships.** While California is in a leadership position in developing specific strategies and actions related to ZNE, there is supportive work happening at multiple levels of government and industry. With several successful groups and/or campaigns already on some path to zero, California should consider partnering with an entity such as the U.S. Green Building Council (USGBC) or the U.S. DOE to raise awareness of the Path to Zero.

STRATEGY 1-4: DEVELOP INNOVATIVE FINANCIAL TOOLS FOR ZNE AND ULTRA-LOW ENERGY NEW BUILDINGS

The Strategic Plan identified the need for new financing solutions in the commercial sector, recognizing that, "meeting the challenge of reaching ZNE levels…will likely require increased availability and use of innovative and expanded financing and financial incentives."[15] While financing is a vital element to realizing the goals of the Strategic Plan, the short-term ZNE milestones related to financing—including investigating other funding support, initiating a workshop series to examine innovative approaches, addressing split incentives and expanding on-bill financing—are being addressed internally at the CPUC in 2010. To be most effective with limited resources, this action plan will focus on ZNE financial milestones in 2011, based on the CPUC assessment.

[15] CPUC, *California Energy Efficiency Strategic Plan*, 32.

ACTION PLAN (2010-2012)

Milestone	Champion	Key Actions	Timeline
1-4-1 Develop and pilot innovative financial tools	TBD	Review CPUC assessment of innovative financial tools	Q3 2011
1-4-2 Identify building performance metrics or documentation needed to inform building performance and valuation	TBD	Identify key metrics at cross of performance and valuation	Q3 2011
1-4-3 Develop performance data	TBD	TBD	Q1 2012

STRATEGY 1-5: CREATE ADDITIONAL INVESTMENT INCENTIVES AND LEVERAGE OTHER FUNDING

The Strategic Plan recognizes the importance of investment in energy efficiency in propelling California buildings toward ZNE. It is essential to leverage existing resources from utilities, local/federal governments and the private sector, as well as investigating how innovative tools for new buildings (Strategy 1-4) can advance energy reductions in the commercial market. Energy Division has been directed (D. 09-09-047) to prepare an assessment and plans to ensure effective financing instruments are available to California. Additionally, AB 758 requires the CPUC to investigate the ability of electrical and gas corporations to provide financing options to implement a comprehensive program that would be developed by the California Energy Commission.[16] As with Strategy 1-4, to be most effective with limited resources, this action plan will begin focusing on ZNE financial milestones in 2011, and will be based on the state's assessments (expected by Q4 2010–Q2 2011).

ACTION PLAN (2010-2012)

Milestone	Champion	Key Actions	Timeline
1-5-1 Investigate other funding support that might be offered such as local government "feebates" for EE/green construction, federal funding, federal or state tax incentives, greenhouse gas reduction benefits	TBD	Identify project leads for research, investigation	Q1 2011
		Scope research project/investigation	Q2 2011
		Conduct research; synthesize findings, recommendations	Q3 2011
		Release results of study/investigation	Q4 2011

[16] AB 758 (Skinner, 2009) requires the CEC to develop an energy efficiency program for existing residential and commercial buildings. http://info.sen.ca.gov/pub/09-10/bill/asm/ab_0751-0800/ab_758_cfa_20090417_083234_asm_comm.html.

STRATEGY 1-6: DEVELOP A MULTI-PRONGED APPROACH TO ADVANCE THE PRACTICE OF INTEGRATED DESIGN

Integrated design (ID) is crucial to achieve zero net energy; ID brings together relevant players at the start of a building project to comprehensively analyze and optimize energy strategies. Ideally, ID helps drive consensus on best practices and, ultimately, leads to buildings from progressively to deep energy savings to zero net energy. To be most efficient and effective, this ID strategy will launch in 2012 and build on the success of programs and activities well underway, thanks to prior achievements in the ZNE Action Plan.

ACTION PLAN (2010-2012)

Milestone	Champion	Key Actions	Timeline
1-6-1 Promote ID development via Title 24 codes/ standards and market activities	TBD	Develop curriculum for integrated design for both graduate and continuing education	Q1 2012
		Work with professional architecture and construction boards to establish requirements for integrated design in architectural and engineering (A&E) and construction licensing	Q3 2012
		Promote widespread adoption of tools and resources that enable ID	Q4 2012
1-6-2 Identify/develop tools and protocols from building commissioning, retro-commissioning and building M&V to enable ID to be deployed	TBD	Work with USGBC to make ID a prerequisite for LEED certification	Q2 2012
		Provide incentives for projects that use ID tools during the design phase of major projects	Q3 2012
1-6-3 Form partnerships with industry and A&E schools to promote the practice of and education in ID	TBD	Leverage competition between A&E firms to accelerate adoption of ID expertise	Q1 2012
1-6-4 Provide incentive credits for professionals who maintain their accreditation with ID training	TBD	Research necessary steps to offer “incentive credits” and pursue	Q2 2012

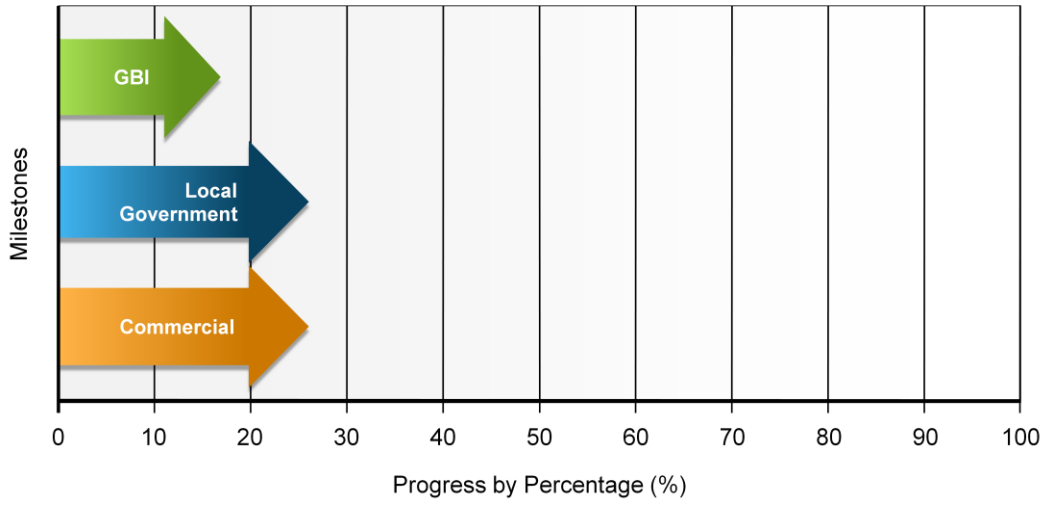
GOAL 2: EXISTING BUILDINGS

The following strategies are focused on existing buildings to achieve Goal 2: "50 percent of existing buildings will be retrofit to zero net energy buildings by 2030 through achievement of deep levels of energy efficiency and clean distributed generation."

STRATEGY 2-1: LEAD BY EXAMPLE: STATE/LOCAL GOVERNMENTS AND MAJOR CORPORATIONS COMMIT TO ACHIEVE ENERGY EFFICIENCY (OR GREEN) TARGETS IN EXISTING BUILDINGS

The Strategic Plan leans heavily on voluntary commitments and leadership from California's largest energy users.[17] While policies, such as AB 1103—which mandates benchmarking for all commercial buildings upon financing, leasing or selling—has brought visibility to the importance of gathering building energy use data, additional steps are needed to translate this information into compelling energy reducing activities. Voluntary actions of California's local governments, educational institutions and businesses encompass a significant opportunity to save energy in California's existing buildings. Given both the promise and the process of launching a leadership initiative in the state to leverage the Green Building Initiative (GBI)[18] in the broader marketplace, steps must be taken immediately to align 100 local governments and 500 million square feet of commercial space with benchmarking and retro-commissioning goals by 2015.

PROGRESS TO DATE (2010-2012)



The Green Building Initiative (2-1-1) has an independent, ongoing timeline for completion (2012) and, as such, is represented here at 17 percent. Approximately 25 percent of the action needed to reach the

[17] CPUC, *California Energy Efficiency Strategic Plan*, 36.

[18] Executive Order S 20-04 (July 2004): http://www.dot.ca.gov/hq/energy/ExecOrderS-20-04.htm.

Plan's near-term (2010-2012) milestones for the local government (2-1-2) and private sectors (2-1-3) are complete. For context, here are a few examples of progress and voluntary corporate leadership:

- **Executive Order S 20-04.** Also known as the California Green Building Initiative (GBI), this directs state buildings to reduce energy usage by 20 percent by 2015. Retro-commissioning (RCx) is a significant part of the initiative and also requires benchmarking with U. S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager (ESPM); progress updates can be found on the Department of General Service website.[19]
- **Continuous Energy Improvement (CEI).** CEI is a new subprogram in the IOU statewide commercial programs that incorporates benchmarking and retro-commissioning as complementary ongoing actions to sustaining building energy performance. In the 2010-2012 program cycle, 20 entities (4 per IOU) are expected to join the program.
- **Corporate environmental leadership.** In the last few years, there has been an explosive growth in the number of companies making public efforts to reduce energy use and carbon footprints, ranging from voluntary participation in the Global Reporting Initiative (GRI) or International Organization for Standardization (ISO) certifications. These efforts help to set the stage for the Plan's goals and help make efficiency "business as usual."
- **Free benchmarking tools.** Throughout nonprofit and private sectors, there is an abundance of free tools that entities assess, track, and compare energy performance and emissions – all of which support the Strategic Plan's goals. Examples include OpenEco by SunMicrosystems and ENERGY STAR Portfolio Manager.

ACTION PLAN (2010-2012)

Milestone	Champions	Key Actions	Timeline
2-1-1 Ensure all state-owned and leased buildings are benchmarked and retro-commissioned by 2012	Chris Stinson, DGS	Executive Order (S 20-04) issued in 2008 (~250 million square feet of state facilities in CA[20])	Ongoing
2-1-2 Conduct campaign to have 100 local governments commit to the same target	Pat Stoner, Statewide Local Government Energy Efficiency Best Practices Coordinator	Identify key bodies (e.g., Local Government Commission [LGC], California State Association of Counties [CSAC]) to reach local government building managers	Complete
		Develop high-leverage campaign strategy to secure commitments	Q4 2010
		Launch campaign to advance goals in key locales with high concentrations of	Q1 2011

[19] Department of General Services, *Green California Goals and Accomplishments* (August 2010): http://www.documents.dgs.ca.gov/dgs/pio/green/highlights.pdf.

[20] Clinton, Jeanne, and Dan Emmett, *Green Building Action Plan, Back-Up Technical Document* ((2004): http://www.energy.ca.gov/greenbuilding/ab2160/documents/resource_docs/GBI_RATIONALE_ACTIONS_TIMELINE_2004-09.PDF.

		commercial buildings	
		Track and report on progress	Q2 2011
2-1-3 Conduct campaign to have 500 million square feet of commercial space where owners/tenants pledge to reach the same target by 2015	Matthew Hargrove, BOMA	Identify key bodies (i.e., BOMA, IFMA, CEC) to reach commercial buildings owners and managers	Complete
		Develop high-leverage campaign strategy (i.e., working with BOMA) to secure commitments	Q4 2010
		Launch campaign to advance goals in key locales with high concentrations of commercial buildings	Q1 2011
		Track and report on progress	Q2 2011

PRIORITIES FOR THE FUTURE (2013-2030)

A large number of governments (e.g. City of Santa Monica, City of San Francisco) and businesses (e.g. Adobe, Hewlett Packard) are not only engaged in benchmarking and RCx, but have gone far beyond the scope of "leading by example" envisioned this strategy. California must leverage existing leadership efforts to maximize the chances of success. Additional priorities include:

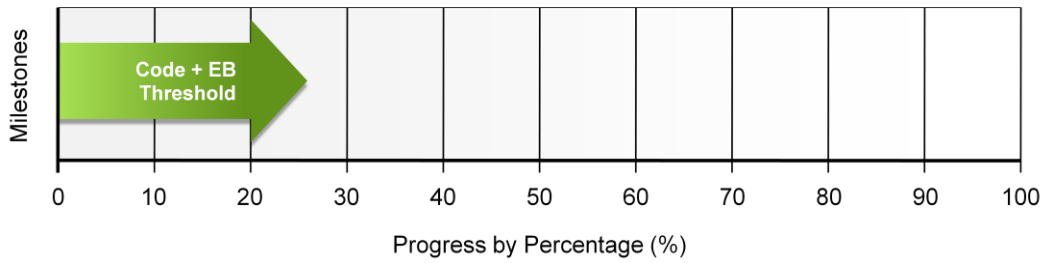
- **Reward leadership.** While many large energy users proactively pursue benchmarking and RCx for the savings alone, public recognition is another motivator. Recognition not only reaffirms commitments to making energy efficiency a way of life (and work), but also helps educate others. Partnership with existing award programs—such as the Governor's Environmental and Economic Leadership awards (GEELA) —can help advance the ZNE movement with minimal resource demands.
- **Encourage competition.** Contests such as EPA's National Building Competition or the San Francisco Earth Hour 24x7 Energy Challenge can be effective vehicles for inspiring action and measurable results.
- **Engage the real estate community.** Until energy efficiency is proven to drive up the value of a commercial building in the same way as other renovations, ZNE will be hamstrung. California must ensure real estate has the knowledge and tools to leverage benchmarking and commissioning into higher property values.
- **Engage the financial community.** Energy efficiency is not recognized by the lending community as a whole and is an afterthought in the appraisal community. Developing mechanisms to lower upfront investment and perhaps reducing risk to lenders will help spur energy efficiency actions in the future.

STRATEGY 2-2: LOWER THE THRESHOLD FOR APPLYING CODES TO EXISTING BUILDINGS

Building energy codes impact existing buildings (EB), as well as new construction, including renovations, remodels and additions. Given the abundance of existing buildings in California, the energy savings potential of applying codes to the current stock also presents a great opportunity to achieve ZNE goals.

The Strategic Plan recommends modifying current thresholds or triggers for code applications, so that renovation projects will deliver maximum savings.[21] This could mean lowering the percent of building value that triggers code requirements, or reducing floor area requirements that trigger codes. Given the downturn in new building starts, changes to code requirement thresholds may be more important over the next few years. It is critical to begin the process to enable these future codes now, given the 3-year cycles to update codes and standards. It should also be acknowledged, that challenges can exist for particular existing building structures depending on their location, vintage, and previous modifications.

PROGRESS TO DATE (2010-2012)



Approximately 25 percent of the actions (1 of 4) needed to reach the Plan's near-term (2010-2012) milestone for applying codes to existing buildings are complete. For context, here are a few examples of progress in the broader marketplace:

- **Changes to T24.** The CEC has investigated options to reduce thresholds for existing buildings and anticipates making recommendations for the near-term Title 24 approval cycle.
- **National Trust for Historic Preservation and Existing Building Codes.** This nonprofit has initiated an innovative project that focuses on how energy codes can be met in existing buildings and/or lock in code minimum energy treatment (rather than supporting more comprehensive treatment of building energy use), without reducing investment. Once complete, this project may have application for California.

ACTION PLAN (2010-2012)

Milestone	Champions	Key Actions	Timeline
2-2-1 Adopt regulations to lower threshold applied to existing building renovations	Charles Eley, Architectural Energy Corporation Jamy Bacchus, National Resources Defense Council	Investigate options to reduce thresholds for state and local existing buildings	Complete
		Analyze the cost-effectiveness of threshold options, enforcement feasibility, and affect on renovation business	Q1 2011
		Propose reduced thresholds into the next T24 code cycle	Q2 2011
		Develop and propose enforcement alternatives for local governments	Q1 2012

[21] CPUC, Energy Efficiency Strategic Plan, 36.

PRIORITIES FOR THE FUTURE (2013-2030)

There is huge potential for deep energy retrofits in the state, but without reforms to code thresholds, California will suffer missed opportunities. The Plan has recognized the importance of reducing thresholds for renovations to advance zero net energy; important progress towards lower thresholds includes access to tools and information necessary for renovation compliance. Further priorities include:

- **Investigate how outcome-based codes could be used to support innovative approaches to energy efficiency in existing buildings.** Stricter enforcement of prescriptive codes in existing buildings could discourage investment and renovation. Alternative mechanisms to improve energy performance need to be developed, and may include review of overall building and/or system performance rather than prescriptive code approaches.
- **Examine how to effectively retrofit the building envelope to achieve deep savings.** There are limits to what can be achieved with lighting systems, plug loads and HVAC strategies, if the building envelope does not sufficiently incorporate low-energy strategies. Strategies to be studied (perhaps by PIER, ET, LBNL) should include passive solar, day lighting, insulation, glazing, shading, radiant barriers and natural ventilation.

STRATEGY 2-3: ENSURE COMPLIANCE WITH MINIMUM TITLE 24 CODES AND STANDARDS FOR BUILDING RENOVATIONS AND EXPANSION

Ensuring compliance with codes and standards is essential to determine if ZNE on-ramping policies can deliver the energy resources promised. Via groups such as the HVAC Performance Alliance, massive progress is underway. As the Alliance pilots new compliance approaches (including online permits and on-site “stings”), the ZNE Action Plan will economize by applying HVAC’s lessons learned to the broader ZNE effort, beginning in 2012. The upcoming HVAC Action Plan will provide more detail on these efforts.

ACTION PLAN (2010-2012)

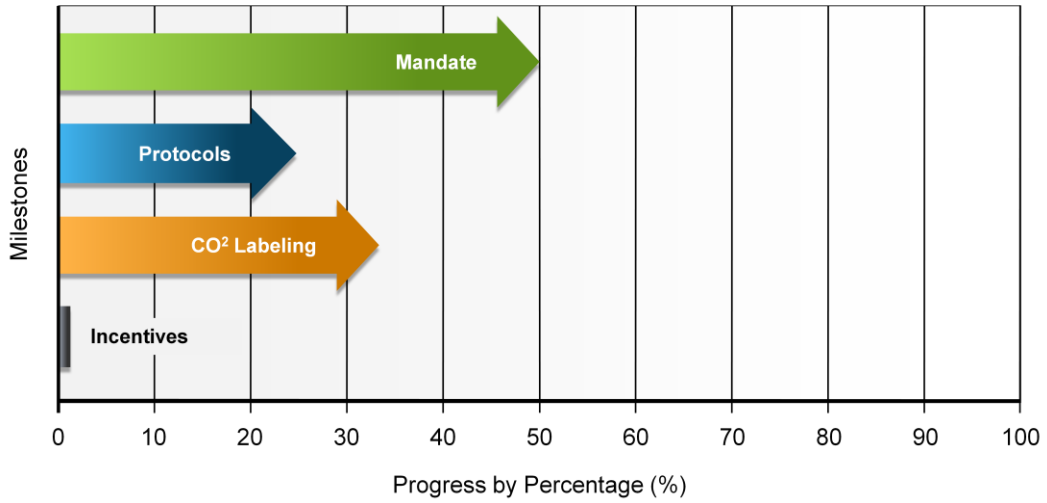
Milestone	Champions	Key Actions	Timeline
2-3-1 Analyze and adopt best options to ensure compliance with minimum standards	TBD	Review successful compliance initiatives, including HVAC partnership with state licensing board	Q2 2012
		Determine best compliance strategies and policies	Q3 2010
		Develop and apply best compliance strategies	Q4 2010
2-3-2 Establish accepted certification methods	TBD	Inventory and assess certification methods	Q2 2012
		Complete gap analysis with regard to voluntary higher performance in buildings	Q3 2010

for voluntary levels of high-performance buildings		Make formal recommendation on certification method	Q4 2010
2-3-3 Fifteen percent of HVAC sales by 2015 are for advanced air conditioning technologies optimized for climate variations	TBD	Collaborate with HVAC Performance Alliance on sales and installation of advanced technologies in commercial buildings	Q3 2010
		Define hot/dry climate equipment	Q2 2011

STRATEGY 2-4: ESTABLISH MANDATORY ENERGY AND CARBON LABELING AND BENCHMARKS

Benchmarking is one of the first steps on the Path to Zero for existing buildings. Benchmarking buildings provides a baseline diagnostic of energy usage, and can be used to compare building performance as well as develop a plan for continuous energy efficiency improvements. Benchmarking large commercial buildings will identify relative energy performance and will, as stated in the Strategic Plan,[22] "help drive a competitive market demand for greener, more efficient buildings." Benchmarking will increase market awareness of the importance of energy performance, and place market pressure and market rewards to achieve better performing buildings.[23] While mandates such as Executive Order S-20-04, AB 1103, and a range of CPUC policies have raised awareness of benchmarking, this strategy provides a unique opportunity to look at protocols, compliance and carbon footprints to create the most effective policies possible.

PROGRESS TO DATE (2010-2012)



[22] CPUC, *California Energy Efficiency Strategic Plan*, 37.

[23] Eichholtz, Piet, Kok, Nils, & Quigley, John M., *Doing Well by Doing Good? Green Office Buildings,* (Sep 2009): 2. http://escholarship.org/uc/item/507394s4.

With the advent of AB 1103, California benchmarking mandate (2-4-1) is 50 percent complete. The CEC has created a California-specific rating tool (an important first step to achieve milestone 2-4-2, improving protocols) and is 25 percent complete. Carbon labeling (2-4-3) has been incorporated to Energy Star Portfolio Manager (ESPM), one-third of the way to the Plan's milestone for carbon footprint labeling. IOU incentives and benchmarking (2-4-4) has a longer timeline and will begin in 2011. Some examples of progress include:

- **Executive Order S 20-04.** Also known as the California Green Building Initiative, this directs the state-owned building sector to reduce energy usage by 20 percent by 2015. Retro-commissioning is a significant part of the initiative and also requires benchmarking with ESPM.
- **AB1103 (Saldana, 2007).** Requires disclosure at the time of sale and lease of a non-residential building energy use score from Energy Star Portfolio Manager for the previous 12 months.
- **CPUC Decision (D). 09-09-047.** Requires benchmarking for all commercial buildings entering into a statewide commercial energy efficiency programs in the IOU territories, and benchmarking for local government buildings impacted by an energy efficiency program in a substantial way.[24]
- **Buildingrating.org.** Scheduled to launch in the fall 2010, Institute for Market Transformation (IMT) will be launching the website Buldingrating.org to house resources pertaining to energy performance ratings and disclosure. Reports, legislation, and technical information and policy analysis, as well as blogs will be available.[25]

ACTION PLAN (2010-2012)

Milestone	Champions	Key Actions	Timeline
2-4-1 Mandate benchmarking for all commercial buildings, triggered by changes in building ownership, financing or tenancy	Amy Barr, Heschong Mahone Group Barry Hooper, San Francisco Department of Environment	Mandate commercial benchmarking at time of sale and lease	Complete
		Implement the statute through AB 1103 rulemaking	Q4 2010
2-4-2 Develop or approve protocols for benchmarking and compliance options	Steve Galanter, Southern California Edison Kent Peterson, P2S Engineering,	Develop California-specific rating tool	Complete
		Pilot CEC's California-specific rating	Q2 2011
		Develop additional tools as needed to improve market penetration and benchmarking value (including asset-based ratings Building EQ[26],	Q3 2011

[24] CPUC, *D. 09-09-047* (Sep 2009): http://docs.cpuc.ca.gov/PUBLISHED/GRAPHICS/107829.PDF.

[25] Institute for Market Transformation, *BuildingRating.org* (2010): http://www.imt.org/files/FileUpload/files/387425539_buildingrating%20org%201-pager%20FINAL.pdf.

[26] Building EQ is a new ASHRAE tool in progress that incorporates both an "operational rating" which reports actual energy use, and an "asset rating," which uses design specifications and an energy model. Building EQ does not compare buildings to the existing building stock or any type of baseline. http://buildingeq.com/.

	Inc.	and Building Energy Asset Rating [BEARS] [27] and Energy IQ[28])	
		Pilot new benchmarking protocols such as BEARS with CPUC/IOU/POU	Q1 2012
2-4-3 Incorporate carbon footprint into labeling	Max Perelman BuildingWise	Assess ESPM carbon foot print for California	Complete
		Add carbon footprint number to existing benchmarking protocols (e.g., into the labeling)	Q2 2011
		Incorporate upstream energy calculation	Q2 2012
2-4-4 Link IOU and other incentives to benchmarks	Brenda Hopewell, PECI Gregg Ander, Southern California Edison	Conduct a study to determine the effectiveness of benchmarking scores and impact on energy efficiency actions	Q3 2011
		Examine incentive structures to compensate for building performance over time	Q2 2012

PRIORITIES FOR THE FUTURE (2013-2030)

The momentum and knowledge around benchmarking is growing, both through the recent CPUC decision (D.09-09-047), EPA's National Building Competition, and the CEC's AB1103 working group. As we continue along the Path to Zero, benchmarking tools will be a key weapon in the arsenal against energy waste. Of vital importance is increasing access to data by the end-user. Additional actions to consider:

- **Coordinate across benchmarking initiatives.** California's efforts should coordinate with other benchmarking-related initiatives—including American Society for Testing Materials (ASTM), Leadership in Energy and Environmental Design (LEED), ASHRAE, International Green Construction Code (IGCC)—and align common elements for implementation.
- **Develop design tools that support and are linked to predictive energy analysis.** Design tools that better estimate actual energy use and that can be readily corrected to account for occupant-generated loads, (e.g. operating hours and number of occupants), is an important first step in better tuning our buildings.
- **Consider labeling buildings "as designed" versus "as operated."** Labeling increases public visibility of energy use. Comparing "as designed" to "as operated" ensures that both good design and good operation are valued. To ensure savings, codes should be designed to work cooperatively with benchmarking strategies to ensure buildings are being operated appropriately and efficiently.

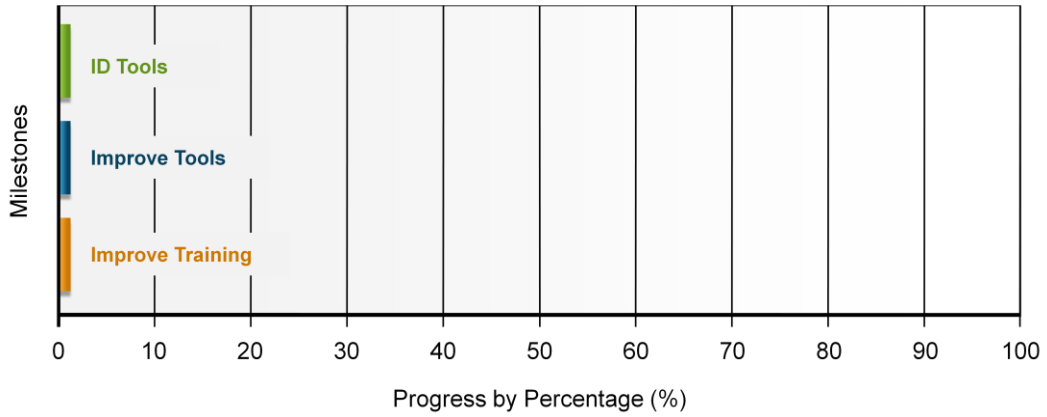
[27] BEARS is an asset rating tool being developed in conjunction with AB 758 implementation to assist in achieving energy savings in the existing building stock in California.

[28] EnergyIQ, also known as "action-oriented" benchmarking, provides energy use (operational rating) in comparison to similar buildings. This tool fills the gap between receiving energy feedback and gives decision-support information to support action plans. This tool was developed through LBNL and funded through PIER. http://energyiq.lbl.gov/

STRATEGY 2-5: DEVELOP TOOLS AND STRATEGIES TO USE INFORMATION AND BEHAVIORAL STRATEGIES, COMMISSIONING, AND TRAINING, TO REDUCE ENERGY CONSUMPTION IN COMMERCIAL BUILDINGS

The Strategic Plan calls to "develop tools and strategies to use information and behavioral strategies, commissioning, and training, to reduce energy consumption in commercial buildings". As noted in the Plan (these activities are a necessary precursor and complement to codes and standards and benchmarking for achieving energy savings. Building owners and building operators need tools and strategies to make and support the business case for zero net energy existing buildings (including training, motivation, and support to adopt energy-efficient practices). Understanding human and organizational behavior requires in-depth studies that often require 1-2 years of data gathering. Given these long lead times, the research timeline, additional tools and strategies should be developed and tested now to best inform the mid-term and long-term strategies of the Plan.

PROGRESS TO DATE (2010-2012)



While there are many inventories of "the business case" for energy efficiency, few include the role of behavioral strategies, comfort and productivity (2-5-1). At the same time, building commissioning guidelines (2-5-2) and building operator training (2-5-3) both exist, but are in need of improvement and expansion to better address zero net energy. For context, here are a few examples of leadership and progress in the building commissioning field:

- **California Commissioning Collaborative (CCC) study.** CCC is currently conducting a PIER-funded research project focused on integration of energy information and retro-commissioning services into commercial real estate transactions. The pilot results will be used for outreach on the opportunities and benefits of benchmarking and retro-commissioning.
- **Lawrence Berkeley National Lab Commissioning Study.** LBNL has recently completed a report on "Building Commissioning" for the California Energy Commission, which documents costs and savings for a variety of commissioning and retro-commissioning projects.[29]

[29] Mills, Evan, *Building Rating: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions* (Jul 2009): http://cx.lbl.gov/2009-assessment.html

ACTION PLAN (2010-2012)

Milestone	Champions	Key Actions	Timeline
2-5-1 Identify new or improved tools and strategies that apply information and behavioral strategies, including presentation of economic, comfort and productivity cases to owners, occupants, and appraisers	Steve Galanter, Southern California Edison Malcom Lewis, CTG Energetics	Formulate new business case prototypes that includes behavior, comfort and productivity that will appeal to owners and occupants	Q4 2010
		Develop information and tools (such as metrics and goals that include behavior, comfort and productivity correlations to energy management)	Q1 2011
		Test business case strategies/tools w/ pilot audiences	Q2 2011
		Integrate business case strategies into the Continuous Energy Improvement program	Q3 2011
2-5-2 Strengthen tools and practices for building commissioning	Brenda Hopewell, PECI Diane Vrkic, Waypoint Building Group	Identify, assess, and eliminate barriers to Cx as a comprehensive energy efficiency solution	Q4 2010
		Hone outreach and incentive strategies to improve market adoption of Cx	Q1 2011
		Develop improved marketing messages and incentive strategies to support commissioning with key customer groups and underserved market sectors	Q3 2011
		Promote Existing Building Commissioning (EBCx) as a comprehensive and long-lasting solution to reducing whole-building energy use in commercial buildings	Q4 2011
2-5-3 Strengthen Building Operator Certification (BOC) training for commissioning	Brenda Hopewell, PECI Diane Vrkic, Waypoint Building Group	Enhance BOC materials with more hands-on instruction and activities, focused on functional testing and the use of diagnostic tools	Q4 2010
		Expand BOC's Energy Performance Tracking curriculum beyond benchmarking to cover more sophisticated tracking tools/methods	Q2 2011
		Leverage resources (e.g., ARRA) for Northwest Energy Efficiency Council (NEEC) to update BOC commissioning modules	Q3 2011
		Begin offering the commissioning model as part of ongoing BOC training and improve outreach in California to increase participation in BOC program	Q4 2011

PRIORITIES FOR THE FUTURE (2013-2030)

California's efforts to strengthen retro-commissioning activities through research (including CEC, CCC and LBNL) is crucial to reducing energy consumption in commercial buildings and a key part of developing the business case for ZNE buildings. There is a continued need for R&D on the adoption of individual and organizational behavioral strategies and how this will impact building energy use. The findings of these studies, along with innovative energy management technologies, will be vital in showcasing the potential for energy savings that influence the bottom line for businesses.

- **Establish a statewide behavioral working group and best practices.** With massive energy savings available through behavior change, California's energy agencies should establish a working group to monitor the field, as well as how to integrate the proliferation of smart grid and feedback systems. This group should work with IOUs, the CEC, the U. S. Department of Energy, General Services Agency (GSA), and others to ensure that behavioral and informational strategies are well documented via websites, conferences and other public venues.
- **Expand case studies and best practices for informational and behavioral strategies.** Federal and state agencies are advancing "smart buildings" that combine technology and information feedback. To harness all savings potential, California should expand research and development, including examination of user and operator behavior. Importantly, research should include studies of the benefits from ZNE through behavioral changes, including tenant satisfaction, productivity, operator incentives and recognition.
- **Consider advanced policies.** Ranging from rate structures to retro-commissioning at time-of-sale, California must proactively create mechanisms to support the ZNE Action Plan. Achieving the Plan's goals requires new ways to incentivize owners and tenants to pursue ZNE. The business case should consider rates and projections of utility costs that support ZNE, including strong signals for energy efficiency, demand response (DR), and distributed generation (DG), as well as changing tariffs to incentivize, tenants, DR and DG.

STRATEGY 2-6: DEVELOP EFFECTIVE FINANCIAL TOOLS FOR ENERGY EFFICIENT IMPROVEMENTS TO EXISTING BUILDINGS

Building the best business case for Integrated Demand Side Management (IDSM or DSM) and EE includes access to capital and the right tools for all building renovations and expansions. As noted in Strategy 1-5, financing options for the IOUs will be examined by the CPUC through the implementation of AB 758, and should be used to inform progress on this strategy, as the comprehensive program being developed under this bill is focused on achieving deep energy savings in existing commercial buildings. Success of these efforts is dependent on the progress of activities begun in 2010 and 2011 and champions will be secured for actions in 2011-2012.

ACTION PLAN (2010-2012)

Milestone	Champions	Key Actions	Timeline
2-6-1 Quantify magnitude of	TBD	Identify lead agency to quantify building investment	Q2 2011

building investment needed in California to meet long-term EE goals, and identify business-types expected to benefit from EE investments		Identify stakeholders and coordination for quantification	Q3 2011
		Define parameters for quantification; release results	Q4 2011
2-6-2 Build and quantify strong business case for DSM/GHG reduction	TBD	Review progress from Strategy 2-5	Q2 2011
		Review select case studies from private sector	Q2 2011
		Add financial opportunities to studies (e.g., on-bill financing [OBF], Property Assessed Clean Energy [PACE])	Q3 2011
		Quantify incremental costs and return-on-investment of ZNE v. "Deep EE"	Q3 2011
		Add tools developed through 1-5-1 (above)	Q4 2011
2-6-3 Identify tools, instruments, and information necessary to attract capital to EE	TBD	Identify financial and organization partners to involve	Q3 2011
		Survey financial partners regarding tools, info, etc	Q4 2011
		Review survey; create a gap analysis	Q4 2011
		Identify creative financial packages and combinations that would attract capital to EE	Q1 2012
2-6-4 Explore changes to standard lease terms to address perceived tenant/owner "split incentives" issue	TBD	Review work on Strategies 1-4/1-5	Q4 2011
		Identify key organization to partner with (i.e. BOMA, IOUs)	Q4 2011
		Review alternatives and options to launch statewide effort and secure broader adoptions	Q1 2012
2-6-5 Explore expanding on-bill financing offerings to other DSM programs	TBD	Assess current status of OBF	Q4 2011
		Assess applicability of OBF to other DSM programs	Q4 2011

STRATEGY 2-7: DEVELOP BUSINESS MODELS AND SUPPLIER INFRASTRUCTURE TO DELIVER INTEGRATED AND COMPREHENSIVE "ONE-STOP" ENERGY MANAGEMENT SOLUTIONS

Developing "one stop shop" solutions are important to (1) ensure that ZNE-on-ramping policies can deliver the efficiency resources promised and (2) improve the ease and access to more integrated energy management (a precursor for ZNE). The success of this effort is dependent on the progress of activities begun in 2010 and 2011 (such as the Continuous Energy Improvement pilot program); therefore

champions will be secured for additional actions in 2011-2012. Please note: while some of this timeline is complete, time-mapping via progress indicators will begin in 2011-2012.

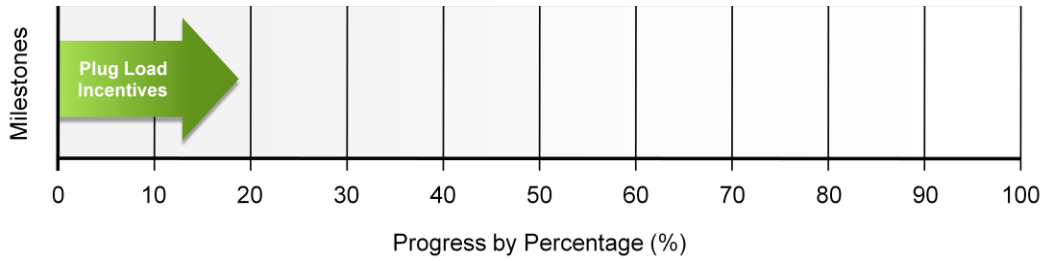
ACTION PLAN (2010-2012)

Milestone	Champions	Key Actions	Timeline
2-7-1 Initiate utility incentive pilots that test the viability of integrated DSM service delivery models (ESCOs, aggregators, etc.)	TBD	Hold stakeholder roundtables on IDSM services	Complete
		Direct utilities to create Continuous Energy Improvement program as part of 2010-2012 filing	Complete
		Launch IOU pilots	Q3 2010
		Measure and evaluate early pilot results	Q4 2011
		Make recommendations for 2013-2015 program cycle	Q2 2012
2-7-2 Explore other mechanisms to more highly reward comprehensive energy management retrofits	TBD	Assess results of CEI pilot program incentives	Q1 2012
		Evaluate feasibility/value of other types of incentives	Q1 2012

STRATEGY 2-8: IMPROVE UTILIZATION OF PLUG LOAD TECHNOLOGIES WITHIN THE COMMERCIAL SECTOR

Plug loads include office equipment, computers and peripherals, charging devices, task lights, space heaters, coffee makers and a wide variety of other devices that are used in buildings. As noted in the Strategic Plan, plug loads are an increasingly large part of the overall energy use within buildings and are generally not covered by building codes. As energy used for lighting, HVAC and water heating is reduced, plug loads will become an increasingly significant energy end use, and efforts to address them need to be started now. While some types of plug loads are covered by state or federal standards, large potential additional savings are possible through device management strategies, sometimes as simple as turning off loads when spaces are unoccupied. (Note: This strategy focuses on the non-code side of managing plug loads; see Strategy 1-2 for the code-side of plug loads.)

PROGRESS TO DATE (2010-2012)



With studies published on plug loads in the recent past (Ecos, 2008), the near-term milestones for this strategy (2-8-1) are approximately 17 percent complete. Existing studies will inform upcoming efforts to prioritize, test and promulgate effective plug load strategies. Examples of progress include:

- **Ecos Plug Load Study.** In 2007 and 2008, Ecos Consulting and RLW Analytics conducted a plug load field monitoring study in commercial offices in California. Findings demonstrated that plug loads consumed up to 30 percent of total office electricity, and also identified priority loads to address.
- **Office plug load pilot studies.** Office of the Future (OTF)[30], a utility consortium, has developed a comprehensive protocol to set up controls and monitor lighting and plug loads in offices in California (and East Coast utilities). The program approach is geared to address whole building tenant occupied space over time and give feedback of plug load energy savings in a variety of offices space. One of seven pilot studies has been completed with California pilots currently in progress.
- **UC Irvine Plug Load Energy Efficiency Center.** Planning for the new plug load center will help define further research projects to better understand and analyze plug loads, including monitoring office spaces at the device level and estimating savings from best in class devices (e.g., low energy computers) and control strategies.
- **Software solutions.** Software solutions to manage plug loads are being developed by a range of companies in the private sector—including Cisco and Microsoft. A common focus of plug load management software has been on PC networks, but is expanding to whole-office systems. Some of these technologies have been incubated by the public sector, and may be sources of information for code updates.

ACTION PLAN (2010-2012)

Milestone	Champions	Key Actions	Timeline
2-8-1 Test and deploy package of rebates, incentives and voluntary industry agreements to bring significant numbers of the best available technologies for managing plug loads within the commercial sector	David Kaneda, Ideas, inc. Rich Lauman Ecos Consulting	Conduct research into plug load energy impacts	Complete
		Define a set of plug load strategies	Q3 2010
		Conduct pilot efficiency strategies in initial buildings to evaluate effectiveness and user response to plug load efficiencies	Q4 2010
		Review and test additional plug load control strategies	Q4 2010
		Create recommendations for 2013-2015 programs	Q4 2011
		Collaborate with commitment campaign in Strategy 2-1	Q1 2012

PRIORITIES FOR THE FUTURE (2013-2030)

[30] The Office of the Future (OTF) program is working to create opportunities for comprehensive energy savings in commercial office buildings through development of a carefully targeted, nationwide incentive program. http://newbuildings.org/advanced-design/advanced-energy-office

Plug loads, as noted above, will become a larger percentage of the buildings total energy use as heating, cooling, and lighting loads are reduced through code-directed and owner initiated retrofits. A zero net energy building is going to be driven by plug loads. Efforts to address this end use will minimize the need for supplemental renewable energy—making this a highly cost-effective strategy.

- **Conduct additional research on technologies and behavioral aspects of plug load management.** While initial efforts are being piloted, in general this is an area where additional research is needed.
- **Research additional markets for plug load implementation.** While offices are the dominant market of concern for plug loads, many other types of spaces have offices within another type of space (schools, retail) and some additional plug load needs.
- **Collaborate more closely with industry partners and ENERGY STAR to promote plug load related educational strategies and procurement guides.**

APPENDIX A

KEY STAKEHOLDER RECOMMENDATIONS

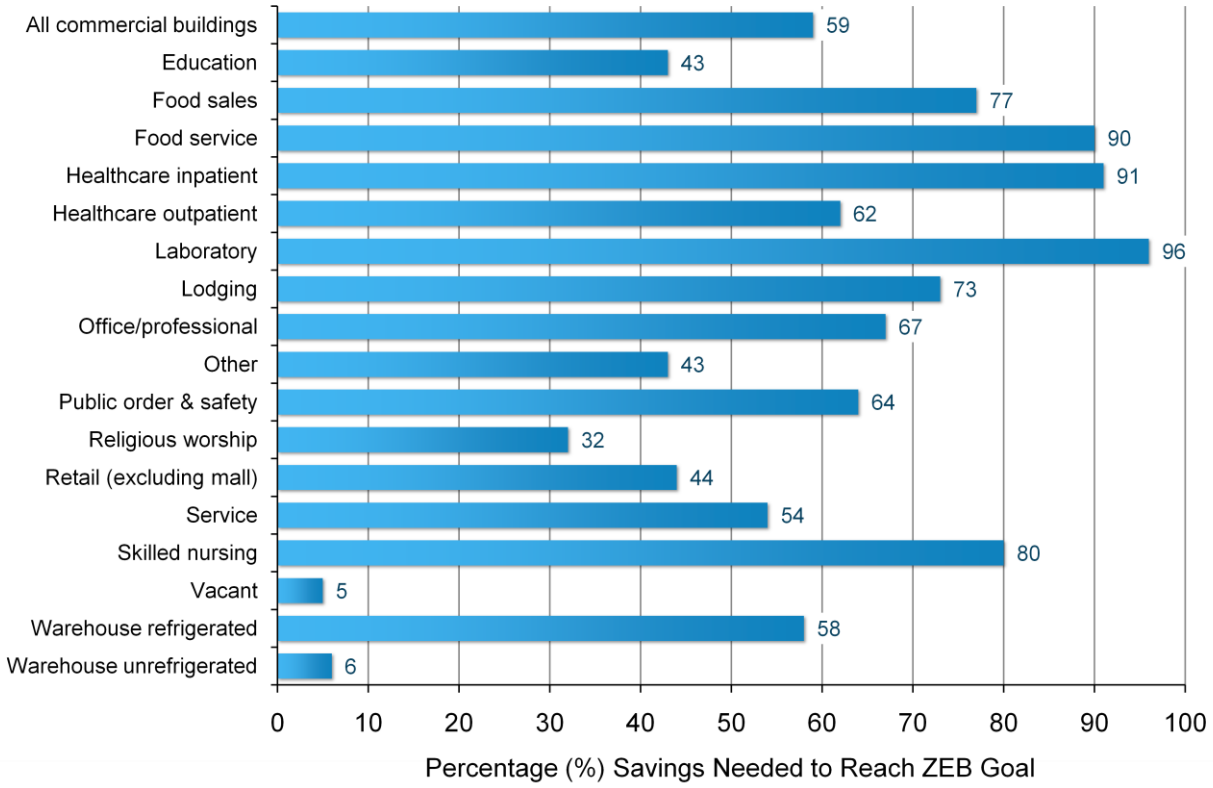
Recommendation	Milestone	Details
Review policies and incentives for alignment with ZNE goals (e.g., cost-effectiveness calculations)	1-1, 1-2, 2-4, 2-8	• Review cost-effectiveness calculations governing both code development and utility programs • Develop incentive strategies for a comprehensive plug load approach • Explore CPUC Policy on energy usage disclosure of buildings benchmarked in D.0909047 and AB1103 • Develop strategies to more effectively integrate commissioning and passive systems
Expand existing efforts to build beyond code and create runway for ZNE	1-1, 1-2, 2-2, 2-4	• Leverage the CEC's AB1103 working group to address ENERGY STAR Portfolio Manager and California-specific rating tools • Interagency and stakeholder coordination on AB758 will inform the milestones in the ZNE action plan • Develop a threshold "reach code" that encourages progressive local governments to transforming the thresholds for activating the reach codes • Make building performance information widely available and more effective in stimulating the market; a state-specific rating tool may benefit the Plan
Include behavior change	1-1,1-2, 2-8	• Behavioral and operational issues are difficult to regulate through the current T24 and T20 processes • Test user education and feedback mechanisms to better understand behavioral implications regarding plug loads and energy conservation
Identify and cultivate ZNE early adopters and industry leaders	1-1, 1-2, 1-3, 12-1, 2-2, 2-8	• Create alliances between public and private sectors to advance deep energy efficiency and ZNE
Provide case studies and best practices	1-3, 2-1, 2-2, 2-5	• Provide case studies and technical assistance to key markets, including detailed cost and performance data for specific building types, e.g., K-12 schools • Provide technical assistance and education on GBI and RCx • Develop specific business cases for key end-user groups, including the language of the target audience (e.g., ROI, security, lease structures) • Provide a "toolkit" of retrofit packages (including installation, financial and systems issues) for deep savings in existing buildings
Provide tools, technical assistance and training to guide industries towards ZNE	2-5	• Develop retro-commissioning guidelines • Benchmark to advance retro-commissioning • Prioritize collaboration among the Energy Commission, CPUC, the building industry, and national laboratories, in order to develop and disseminate necessary tools and strategies

APPENDIX B

DEEP SAVINGS IN ENERGY EFFICIENT BUILDINGS

The goal of 50 percent of existing buildings achieving ZNE by 2030 is significantly more challenging than achieving 100 percent ZNE in new construction. A study conducted for the U.S. Department of Energy (Figure 1) lists the depth of energy savings required by building type to achieve ZNE within the footprint of the building (assuming solar installation to create the required renewable energy).[31] The study indicates that achieving ZNE in warehouses should be simple; doing so in hospitals and labs would be extremely difficult. On average, a two–thirds reduction in energy use is required to approach ZNE goals.

NEED 60% TO 70% DECREASE IN ENERGY CONSUMPTION OF COMMERCIAL BUILDINGS



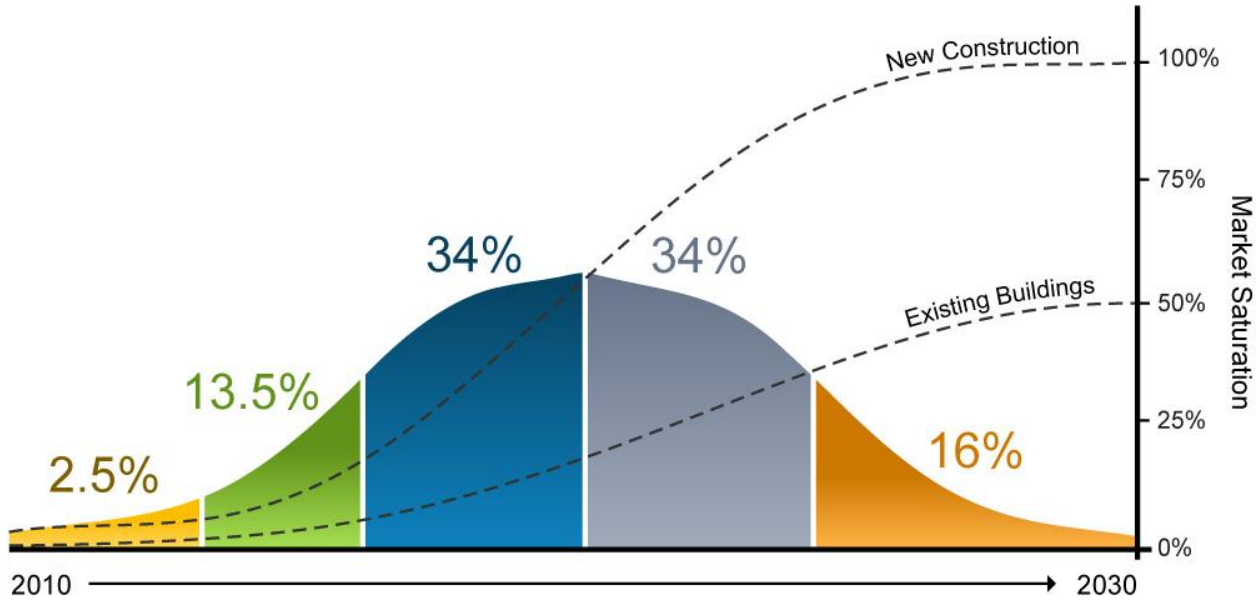
From a financial perspective, achieving deep savings in existing buildings goes against the current paradigm: efficiency measures with relatively short payback periods, frequently two to five, define typical investments both in the market and by utility program offerings. “Going deep” may require a change in thinking about efficiency investment or a change in the underlying financial mechanisms that support such investments. Most owners of commercial properties (school districts, commercial real estate firms, chains) own a portfolio of buildings; maximizing returns on efficiency investments would typically follow a pattern of investing in strategies of relatively short payback measures across the portfolio rather than focusing extensive efforts on one building. The financial barriers in the existing building market may be more difficult to resolve than the technical barriers to achieve deep savings.

[31] Crawley, D., et al, *Assessment of the Technical Potential for Achieving Net Zero-Energy Buildings in the Commercial Sector* (Dec 2007): 65. http://www.nrel.gov/docs/fy08osti/41957.pdf

APPENDIX C

KEY TARGETS

CONCEPTUAL MARKET DIFFUSION FOR ZERO NET ENERGY TARGETS



Innovators	Early Adopters	Early Majority	Late Majority	Laggards
1-4/1-5: Innovative Finance Tools & Incentives	**1-3:** Path to Zero/ZNE Pilots **1-6:** Integrated Design **2-6:** Existing Building Finance Tools **2-8:** Plug Loads	**2-1:** Lead by Example **2-4:** Benchmarking **2-5:** Business case **2-7:** Integrated Energy Management	**2-2:** Codes for Existing Buildings	**1-1**: ZNE Codes **1-2:** T24 and T20 **2-3:** Code Compliance

Market diffusion theory can be applied to California's effort to improve market penetration of low-energy and ZNE buildings. The graph above shows how the market will transform to ZNE between now and the year 2030, when 100 percent of newly constructed buildings will be zero net energy, and 50 percent of existing buildings will be retrofit to zero net energy, as code requirements reach that level... As suggested above, innovators (the first 2.5 percent of the market) will reach zero net energy with their buildings in the next few years. Early adopters, 13.5 percent of the market, will reach ZNE levels of performance on average in the latter half of the decade... Early Majority, 34 percent of the market are driven by benchmarking, retro-commissioning, behavior and energy management strategies, and will ramp up deep energy savings approaching 2020 and beyond. Late majority, 34 percent of the market will utilize existing codes and build off finance and energy management innovations in the previous time segment. Utility programs and reach codes will continue to stay ahead of Title 24 and codes, (the last 16 percent, e.g. Laggards), but realizing that over the entire time period, it is these efforts combined that will drive the mass of the market to zero in the final few years before 2030.

The Strategic Plan created multiple pathways leading to zero energy over the next 20 years, including:

- Codes, with an increase in energy efficiency every three years
- Utility programs (including Savings By Design) and local advanced/reach codes with results that will influence the majority of commercial square footage in California

- Early adopter buildings that are striving for the higher levels of green building rating systems and may also be supported by IOU ZNE pilots
- Innovators, the leaders among practitioners and the private sector, who have already delivered a series of ZNE highly efficient buildings, and work with utility and national zero energy programs to use the most advanced designs and technology (e.g., Adobe Systems).

Diffusion begins with a very small set of innovators (perhaps 1 percent to 2 percent of the market) who are inspired to create zero net energy properties. In general, owners and designers of projects that achieve Gold and Platinum levels in LEED New Construction (NC) represent this leadership, along with a handful of ZNE buildings already developed in California over the last few years. In an application of market diffusion theory, the earliest adopters of LEED-NC tended to be private schools, colleges and universities, environmental groups and corporate offices—all entities with a business interest in being seen as innovative, and also markets where more time spent on design was allowable within the business framework. More recently, LEED-NC has become almost a market requirement for new commercial office real estate in urban centers as tenant interest, reduced costs of compliance and marketing benefits made standard construction riskier than following the market leaders into green construction. A similar pattern of innovators leading to early adopters leading to broad market adoption is anticipated for the zero net energy marketplace. Strategies that consciously support the market adoption strategy should be able to accelerate the market adoption curve. Three key target groups that, with the right cultivation and support can help advance ZNE adoption:

- **Schools**—Both K-12 and higher education have already demonstrated an interest in deep energy efficiency and ZNE projects. More, schools have substantial related activities underway, and are well organized to cooperate on projects (e.g., the Collaborative for High Performance Schools, UC Merced, and UC Davis). Educational buildings also offer opportunities to engage students and the community in learning activities related to energy, energy densities are relatively low, and most buildings are low rise with reasonable solar access, making zero-net energy projects more feasible than in many other markets.
- **Offices**—Corporate, public and commercial real estate owner offices, are the largest commercial building market in California (approximately 1 billion square feet). Office properties are the most active market in ENERGY STAR benchmarking. California utilities have organized with leading utilities around North America to initiate the Office of the Future Consortium, which has created pilots incentive programs to “go deep.” Offices are a target market for the U.S. Department of Energy (DOE) Commercial Lighting Solutions program and also are included in the Commercial Real Estate Alliance. Within the office market, the best candidates for zero-net energy will be smaller, low-rise buildings, although deep savings are possible for all office types.
- **Retail**—particularly chain dry goods, retail is another very large commercial market with relatively low energy intensities and some leadership in deep efficiency and zero-net energy. Walmart, Target and other major retailers have been active in the DOE Retailers Alliance. Because chain retailers build to a prototypical design and share stores features, a given design/technology/control solution set can be applied to many projects with limited variation, reducing design costs and supporting bulk purchase arrangements.

APPENDIX D

ADDITIONAL STATE AND NATIONAL PARTNERS

While California is in a leadership position in developing specific strategies and actions to develop zero net energy buildings, there is related work happening at multiple levels of government and industry. As part of this action plan, we will track strategies for adoption in California and develop partnerships that help coordinate efforts and advance ZNE goals. Examples include:

- **The U.S. Department of Energy** has set a goal to achieve marketable zero net energy commercial buildings in all climates by 2025. As part of its Commercial Building Initiative (CBI), DOE has developed key alliances and partnerships to involve industry representatives in setting research priorities and offer advice on real-world implementation and deployment. Key CBI alliances and partnerships include:
  - **Commercial Building Energy Alliances** (CBEA) are informal associations among commercial building owners and operators wanting to reduce the energy consumption and operating costs of their buildings. Members work directly with DOE and its national laboratories to identify and implement energy efficiency technologies and practices. Alliances for retail, commercial real estate and hospitals, with more to come.
  - **Commercial Building Partnerships** (CBP) work with companies and organizations selected by DOE to conduct cost-shared research, development and deployment. CBPs will construct new buildings that achieve savings of 50 percent above ASHRAE/IESNA Standard 90.1-2004, or retrofit buildings that achieve 30 percent savings.
  - **Zero Energy Commercial Buildings Consortium** is a broadly representative building industry group that works with DOE to accelerate the commercialization of high-performance building technologies by disseminating new technologies within the commercial building community.
- **US Green Building Council** (USGBC) has been a driving force in integrated design, commissioning and energy modeling. While some green buildings have not reached their performance potential, USGBC has carried a strong message, and many of the best energy buildings are also LEED certified. California chapters of USGBC are potential partners in reaching the design and owner communities.
- **The Living Building Challenge** is a project of the Cascadia Green Building Council that requires measured net zero energy as well as other equally stringent requirements in materials, water and waste. Over 60 projects are involved in the Living Buildings Challenge internationally, making it perhaps the largest current effort in zero net energy buildings and an early source of case study projects.
- **Architecture 2030** provided the initial call for carbon-neutral buildings by 2030 and maintains strong alliances with the design community and local governments.
- Both the **American Society of Heating, Refrigerating and Air-Conditioning Engineers** (ASHRAE) and the **American Institute of Architects** (AIA) have projects and/or policies targeted to zero-energy buildings. ASHRAE has produced events and design guidance, with a planned series of 50 percent energy reduction guides for new construction. The AIA has endorsed the goals of the 2030 Challenge to reach net zero by 2030. Both organizations have chapters in California that should be useful in getting messages out to the communities they serve as well as more broadly.
- **The Energy Trust of Oregon** has announced a pilot program for commercial new construction that is 50 percent more efficient than Oregon code. The pilot project of 15 buildings was nearly instantly subscribed, with many buildings aiming for zero-net energy. This program experience may be usefully coordinated with the Savings by Design efforts in California.
- **The National Trust for Historic Preservation** has recently initiated a Preservation Green lab project to explore how to get deeper energy savings in existing buildings, not just historic properties.

APPENDIX E

CALIFORNIA'S ZNE SUCCESS STORIES[32]

The number of California's zero net energy buildings is growing every year. In addition to the detailed examples provided below, Leyva Middle School, Aquarium of the Pacific, the Exploratorium, the Venter Institute, OUSD Education Center, Stanford's Green Dorm, the Yosemite Institute, Marin County Day school, and several private residences—have all helped to advance the Path to Zero.

IDeAs Z Squared Design Facility (Retrofit, 6560 sq.ft. —San Jose)
IDeAs's headquarters is believed to be the first commercial building in the United States to be designed to a "Z2" energy efficiency goal; that is, net zero energy and zero carbon emissions. The building harvests daylight and uses automatic lighting controls, occupancy sensors, high-efficiency (plug in) office equipment and innovative automatic controls to minimize plug loads. In addition, IDeAs uses high-efficiency HVAC system featuring radiant heating and cooling in the floor and a ground-source heat pump. A 30-kW rooftop and shade canopy-integrated PV delivers 100 percent of electricity needs.

Audubon Center at Debs Park (New Construction, 5020 sq. ft. —Los Angeles)
The Audubon Center at Debs Park is the first building in the U.S. to achieve the USGBC's LEED Platinum rating (version 2). The Center is operated entirely off-grid, using only power generated on site. It is expected to use only 25,000 kWh of energy each year (around five kWh per square foot). The Center is designed to use 70 percent less water than a comparable conventional building, and to treat all wastewater on site. Features include daylighting, photovoltaics, and thermal mass. Occasionally, the Center uses a small generator to charge the storage batteries.

Challengers Tennis Club (New Construction, 3500 sq. ft. —Los Angeles)
Challengers Tennis uses 60% less energy compared to a similar building constructed according to California's Title 24 requirements. The building has a PV array on the roof that provides 100 percent of the facility's annual electricity consumption. The building has no mechanical cooling, but is kept comfortable through natural ventilation, unhindered air circulation, ceiling fans, internal thermal mass, superior insulation and glazing, and appropriate shading. Ample daylighting minimizes the use of artificial lighting, and all lighting fixtures use fluorescent lamps with either photocell or motion-sensor controls.

Environmental Technology Center (New Construction, 2,200 sq. ft. —Rohnert Park)
The Environmental Technology Center (ETC) building includes energy-efficient and water-efficient landscaping, "smart building" control technologies, environmentally sensitive building materials, passive-solar heating and cooling, advanced window systems and daylighting, solar electric technology, and electronic control systems. Designed to use only 20 percent of the energy allowed by state energy code for similar buildings, ETC serves as a model of public sector fiscal and environmental responsibility for California's universities and colleges.

Packard Foundation[33] (New Construction, 45,500 sq. ft. —Los Altos)
With a target completion date of 2013, the Packard Foundation new headquarters is designed to be one of the first replicable zero net energy buildings in the nation and a LEED Platinum Certified building. The Foundation plans a careful deconstruction process on the site that will seek to recycle a majority of the materials used in the original construction. The building will reduce energy demand by 50 percent and have remaining energy use offset through on-site power generation. (Note: at publication, this design was still awaiting approval from the Los Altos Planning Commission.)

[32] http://zeb.buildinggreen.com

[33] http://www.packard.org

APPENDIX F

RELATED DOCUMENTS

California Long Term Energy Efficiency Strategic Plan. (California Public Utilities Commission, 2008): http://www.californiaenergyefficiency.com/docs/EEStrategicPlan.pdf
The CPUC's roadmap for energy efficiency in California through the year 2020 and beyond.

Getting to Zero: Final Report of the Massachusetts Zero Net Energy Buildings Task Force. (Massachusetts Zero Net Energy Buildings Task Force, 2009): http://www.mass.gov/Eoeea/docs/eea/press/publications/zneb_taskforce_report.pdf
The final report of Massachusetts's Zero Net Energy Buildings (ZNEB) Task Force summarizing a range of recommendations to reduce energy consumption in buildings and increase onsite renewable energy generation.

Summary and Recommendations of the Getting to 50 Summit. (New Buildings Institute, 2007): http://www.gettingtofifty.org/documents/GT50_Summit_Final_Report.pdf
The planning document that came out of the Getting to Fifty Summit including a range of recommendations encompassing policy, education, marketing, and research and development.

Federal Research and Development Agenda for Net-Zero Energy, High-Performance Green Buildings. (National Science and Technology Council Committee on Technology, 2008): http://www.ostp.gov/galleries/NSTC%20Reports/FederalRDAgendaforNetZeroEnergyHighPerformanceGreenBuildings.pdf
Lays out goals and objectives for net-zero energy, water and materials use, indoor air quality, performance measurements and metrics, and barriers to the adoption of these new technologies by the buildings sector in the context of current Federal programs.

Energy Efficiency in Buildings: Transforming the Market: Roadmap. (World Business Council for Sustainable Development, 2009): http://www.wbcsd.org/DocRoot/E1erYPqD60xOaOlAdV5V/91719_EEBReport_WEB.pdf
Recommendations and an actionable roadmap to transform the building sector based on modeled impacts of consumer preferences and behaviors, designs and technologies, and policies on energy consumption.

Steering through the maze # 2: Net zero energy buildings: definitions, issues and experience. (European Council for an Energy Efficient Economy, 2009): http://www.eceee.org/buildings/MazeGuide2-NetzeroEnergyBldgs.pdf
Paper considering the issues around low/zero energy buildings, reviewing the progress of different countries towards improved energy performance of buildings.

Improving the Energy Performance of Buildings: Learning from the European Union and Australia. (RAND Corporation, 2009): http://www.rand.org/pubs/technical_reports/2009/RAND_TR728.pdf
A study to aid American policymakers considering energy and carbon efficiency programs for commercial real estate in the United States.

APPENDIX G

ZNE ACTION PLAN OUTREACH LIST & WORKSHOP ATTENDEES

Jai Agaram, Digital Energy
Jerine Ahmed, Sempra Utilities*
Mahlon Aldridge, Ecology Action*
Abdullah Ahmed, Sempra Utilities
Gregg Ander, Southern California Edison*
Ren Anderson, National Renewable Energy Laboratory
Bruce Baccei, Sacramento Municipal Utility District*
Jamy Bacchus, NRDC*
Rocky Bacchus, Efficiency Power*
Ann Banning-Wright, Syska Hennessey
Lynne Barker, ICLEI
Amy Barr, Heshong Mahone Group*
Aravind Batra, P2S Engineering, Inc*.
Max Baumhefner, NRDC*
Glen Berryhill, Thomas Properties
Clark Bisel, WSP Flack & Kurtz*
Keri Bolding, Resource Media*
Martin Bond, Community Energy Services Corporation*
Gail Braeger, UC Berkeley*
Randy Britt, LAUSD*
Martha Brook, CEC*
Cal Broomhead, City of San Francisco*
Karl Brown, UC*
Tim Brown, IDEO
Chris Buntine, Greenworks Studio*
Bill Burke, PG&E*
Jonathan Butner, SCE*
Jordana Cammarata, CPUC*
Bill Campbell, Equilibrium Capital*
Craig Christensen, NREL
Jeanne Clinton, CPUC*
Tom Conlon, GeoPraxis, Inc. *
Rob Cord, Kennedy Wilson*
Stuart Cooley, City of Santa Monica
Hilary Corrigan, California Energy Markets*
Ron Cortez, UCSB
Rory Cox, Pacific Environment*
Heidi Creighton, Davis Langdon
Greg Cunningham, Enovity
Janet Curtis, Commonwealth of MA - Dept of Energy Resources*
Allan Daly, Taylor Engineering
Dustin Davis, CEC*
Kecia Davison, Conservation Services Group*
Chris Day, Swinerton*
Edward Dean, Harley Ellis Devereaux*
Brandon Dekker, GKK Works
Stephanie DeMartinis, Cushman & Wakefield
George Denise, Cushman & Wakefield
Sean Dennison, New Buildings Institute*
Michael Deru, NREL*
Jim Dewey, UCSB
Rick Diamond, Lawrence Berkeley National Laboratory*
Brendan Dillon, Pythagoras Solar*
Sandra Doyle, Sea Change Foundation*
Karen Dzienkowski, PVT Solar Inc.*
Elizabeth Dunn, National Trust for Historic Buildings*
Elizabeth Echols, U.S. Green Building Council*
Devi Eden, California Energy Commission*
Patrick Eilert, PG&E*
Charles Eley, AEC*
Ethan Elkind, UC Berkeley School of Law; UCLA School of Law*
Dan Emmett, Douglas, Emmett and Company
Lara Ettenson, NRDC*
Moe Fakih, AEF Consulting
Gary Fernstrom, PG&E*
James Finlay, Wells Fargo RETECHS - LA
Ian Finlayson, Commonwealth of MA - Dept of Energy Resources
Jennifer Finnigan, CPUC*
John Flynn, Harley Ellis Devereaux
Cathy Fogel, CPUC*
Chip Fox, Sempra*
Mark Frankel, New Buildings Institute*
Paul Frankel, California Clean Energy Fund
Jared Freidman, Energy Beyond Design
Grant French, Swinerton*
Eric Friedman, Commonwealth of MA - Dept of Energy Resources*
Tom Gackstetter, LADWP
Steve Galanter, SCE*
Lisa Michelle Galley, Galley Eco Capital*
Dan Geiger, USGBC—NCC
Barry Giles, Building Wise*
Matt Golden, Efficiency First
David Goldstein, NRDC
Noah Goldstein, Lawrence Livermore National Laboratory
Frank Gorke, Commonwealth of MA - Dept of Energy Resources
Ron Gorman, Sempra Utilities*
Yaara Grinberg, Commonwealth of MA - Dept of Energy Resources*
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Kathleen Gumbleton, SCE
Matthew Haas, Low Income Investment Fund*
John Haig, Sonoma County*
Tom Hamilton, First Carbon
Gregg Hardy, Ecos Consulting*
Matthew Hargrove, CA Business Properties Associations*
Mark Harmon, Cal-Earth Institute
Sommer Harvey, CPUC*
Elaine Hebert, CEC
Sung Hee Han, PECI*
Jeffrey Heller, Heller Manus Architects
Dave Hewitt, New Buildings Institute*
Gina Hicks, SBW Consulting*
Randall Higa, SCE*
Cathy Higgins, New Buildings Institute
David Hodgins, Clinton Foundation*
Bill Holloway, PG&E
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* Denotes participation in at least one workshop and/or champion

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Steve Lee, P2S Engineering*
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