Commercial & District Zero Net Energy Framework

BluePoint Planning

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zero net energy commerical

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Photo courtesy NBI: University of California San Diego - J. Craig Venter Institute

Executive Summary

Executive Summary

"Millions of Californians are installing their own rooftop solar, numerous companies are contracting for renewable resources, and local government agencies are forming community choice aggregators (CCAs) that can directly develop and buy electricity on behalf of their customers with relatively limited oversight from the CPUC. IOU retail electric load could drop by as much as 25 percent by the end of 2017 and by 85 percent in the next decade."

- Energy Commission, IEPR 2017.

Overview

In 2008, the California Public Utilities Commission (CPUC) adopted the California Long-Term Energy Efficiency Strategic Plan (CAEESP), which included an aggressive goal to achieve ZNE for new commercial buildings and existing buildings. Over the past three years, California industry stakeholders, the CPUC, and the Energy Commission (CEC), among others have worked together to develop the new Commercial & District Zero Net Energy Framework to help guide policy makers, non-profits, local governments and utilities to achieve this goal. The Framework covers all new and existing nonresidential building types except industrial and agricultural facilities. The Framework also incorporates district and community-scale projects that includes mixed use projects and large residential projects.

Since 2008, ZNE has moved from concept to reality, with a limited but growing number of commercial and residential building examples. Over the same time period, the market and policy context have changed considerably. The State of California legislature and Governor Brown have continued to move forward with legislation to **reduce carbon emissions**, double the amount of **renewable energy generation**, increase **energy efficiency** in existing buildings, and maintain the State as a **leader in addressing climate change**.

The Framework establishes a new path to achieve the State's ZNE goal and address other climate and carbon initiatives incorporating the insights by stakeholders, agencies, and market and industry research. The Framework provides a new strategic action plan, with six central drivers detailed on page iii, including the goal:

Inspire and drive all new commercial buildings and major renovations of existing buildings achieve zero net energy performance (onsite or offsite renewables) and support grid optimization.

The Framework's planning analysis indicates that many of the elements to achieve ZNE in the commercial buildings market are in play and growing in strength. There is clear movement towards green building, increased financing of green projects, and interest across the California marketplace for renewables and high performing buildings. In addition, climate change is becoming a reason to adopt and pursue resilience and climate reduction strategies for communities. In November 2017, Moody's Investor Services, the bond rating firm, indicated it will now consider the threat of climate change and a community's preparedness and planning to address those threats as part of the jurisdiction's bond rating.[1]

At the same time, the market excitement is resulting in unintended results – a substantial amount of solar rooftop installation and renewable energy generation that is not considered in the larger policy or technical context. California is now generating more solar power than it can use, needing to either curtail the use or sell it to other states.

"We're curtailing the cleanest and newest resource on the grid, and leaving alone the 2,000+ megawatts of mostly fossil imports and in-state gas."[2]

Local government, developers, and others are jumping ahead to adopt new policies and build new projects thinking they are establishing the best and most cutting-edge efforts around. At a small scale, these efforts are commendable: as a statewide precedent they are potentially problematic. The Framework is also designed as a discussion tool to help raise awareness and guide better decisions for all of these market actors.

Grid-Friendly ZNE

The following, adapted from the CEC Advance Energy Community criteria, defines what a ZNE grid-friendly project should achieve and assists in explaining why some approaches to ZNE are more desirable than others.

- Minimize the need for new energy infrastructure costs such as transmission and distribution upgrades or fossil fuel power plants.
- Provide energy savings by achieving high levels of energy efficiency and maintaining zero net energy status (accounting for behavior and increasing loads from vehicle and appliance electrification).
- Support grid reliability and resilience by incorporating technologies such as energy storage and smart inverters.
- Provide easier grid integration and alignment with the California Public Utilities Commission's (CPUC) Integrated Resource Plan (IRP), and the California Independent System Operator's local capacity requirements process.
- Provide affordable access to renewable energy generation, energy efficiency upgrades, water efficiency, and technologies that reduce electricity consumption for all electric ratepayers.
- Make use of smart-grid technologies in the project and when applicable throughout the community.
- Align with other state energy and environmental policy goals at the community level such as the Sustainable Communities and Environmental Protection Act (Senate Bill 375, Steinberg, Chapter 728, Statutes of 2008).

1 Flavelle, Christopher, "Moody's Warns Cities to Address Climate Risks or Face Downgrades", Bloomberg Reports, Nov. 29, 2017.

2 Paulos, Bentham, "Too Much of a Good Thing? An Illustrated Guide to Solar Curtailment on California's Grid", Green Tech Media, April 3, 2017.

Commercial and District Strategic Action Plan

GOAL

Inspire and drive all new commercial buildings and major renovations of existing buildings to achieve zero net energy performance (onsite or offsite renewables) and support grid optimization.

OUTCOME

ZNE buildings and districts are integrated as key distributed energy resources that substantially reduce carbon emissions, better meet customer needs, and create more resilient communities.

DRIVERS

1. Programs Enable ZNE Projects

Ratepayer-funded programs support increasingly efficient and controllable commercial buildings that enable ZNE levels of performance and can readily integrate with distributed energy resources.

2. Improved Awareness & Informed Decisions

Information, tools, and resources improve awareness and assist owners and developers to make informed decisions about ZNE, procuring and implementing renewable energy systems, storage, controls, and DERs.

3. Local Government Capacity & Readiness to Implement

Local governments have the capacity and capability to support ZNE development and projects statewide.

4. Integrated District ZNE and DER

Developers, local governments, and large corporate and institutional energy users build grid-integrated, district-scale energy systems that leverage land use planning, aggregated financing, and community infrastructure development.

5. Targeted Research & Development

IOU Emerging Technology Programs and the CEC's EPIC Program support the development and demonstration of enhanced and integrated technologies for ZNE at both the building and district levels.

6. ZNE Codes & Standards

The CEC, in coordination with local governments, drive commercial building energy codes and standards to ZNE/ZNE-Ready performance levels by 2030.

Why ZNE is Important

ZNE is critical for California for six main reasons:

1. The concept of "Zero" is compelling and has captured the attention of the **market** and California's leadership is a model for the nation.

2. ZNE projects substantially reduce the **carbon footprint** of a building.

3. ZNE buildings encourage and result in deep **energy efficiency** and substantial energy savings.

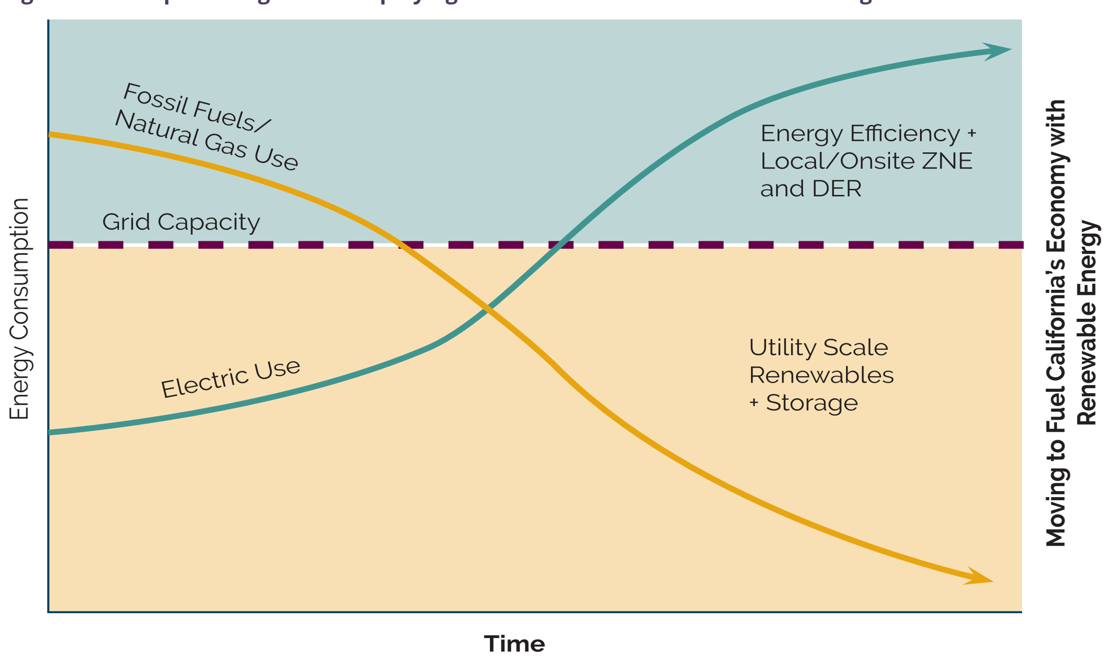
4. ZNE projects, with appropriate controls and storage, are important resources to the **electric grid**.

5. ZNE projects with renewables located on a building or onsite, substantially reduce associated **transmission and distribution costs**, as well as reduce the **environmental impacts** (land use, biological, visual, resource, etc.) related to utility-scale renewables and the associated infrastructure.

6. ZNE projects are important elements to support **resilience** policies for communities.

A central role for ZNE projects as envisioned by this Plan is the ability for ZNE Projects, with advanced building controls and storage, to become a managed resource to optimize the grid. As Figure 1 illustrates conceptually below, there is a trend of increased electric loads (fuel substitution, EVs, plug loads, etc.) overtime with the reduction of natural gas and fossil fuels. The grid has a finite capacity that in the future can be powered by utility-scale renewables and scaled storage solutions.[3] However, it is likely that there will be higher electric demand than can be managed by the grid. The expansion and development of distributed energy resources (DER), ZNE projects with demand response (DR) capacity, and energy efficiency will be essential tools to optimize the grid and improve long-term outcomes. While there is the possibility of enhancing, modernizing and increasing the capacity of the grid, there is a likelihood that creating a stronger network of

Figure 1. Conceptual diagram of employing ZNE and EE to reduce demand on the grid over time.



3 CPUC, Distribution Resource Planning (R.14-.08-013), Integration Capacity Analysis, cpuc.ca.gov.

Photo Courtesy NBI: David and Lucille Packard Foundation, Mountain View, CA.

distributed energy resources will be more cost effective than having the current grid reach the needed future capacity limiting costly improvements to the transmission and distribution infrastructure.[4]

Further, the potential for energy savings by achieving our ZNE goals is tremendous. The Energy Commission in the Integrated Energy Policy Report (IEPR) proceeding estimates that new ZNE commercial buildings will help to avoid the development of up to eight 500 MW power plants. In 2016, the California Independent System Operator (CAISO) cancelled thirteen PG&E transmission projects due to the lack of need given increased solar energy and energy efficiency resources. **The result is $192 million in ratepayer savings.**[5] Further, according to New Buildings Institute (NBI) research, the goal to develop ZNE buildings is resulting in energy efficiency improvements of 60 to 70%. The potential savings in the existing buildings sector is even more substantial and will assist in meeting Senate Bill 350's goal of increasing energy efficiency by 50% in existing buildings.

Conclusion

ZNE is a compelling advancement in the integration of building energy efficiency, renewable energy and control technologies that provide an easily understood, if not easily defined, concept – a project or building that produces as much (renewable) energy as it uses over the course of the year. California leads the country, if not the world, in the adoption of policies that support ZNE development and in the design, construction, and operation of ZNE buildings.

ZNE, as a concept, has captured the marketplace's interest and is an important brand for energy in California. The Framework builds on this interest and seeks to capitalize on the substantial opportunities present by achieving zero energy in new and existing buildings, while

4 Ibid.

5 Pyper, Julia, "Californians Just Saved $192 Million Thanks to Efficiency and Rooftop Solar", GreenTech Media, May 31, 2016.

Photo Courtesy Sonoma State: Environmental Technology Center, Rohnert Park, CA

becoming **a dynamic tool and resource for the grid**.

California's ambitious goals for carbon reduction require a diverse and aggressive set of programs and initiatives to implement. **ZNE projects are essential to meeting carbon reduction and energy efficiency goals and an approach to decarbonizing the building sector.** Establishing multiple grid-friendly paths to achieve ZNE, as promoted by the Framework, will enable California to maintain it preeminence as a national leader in climate change and play a central, catalyzing role for the market to develop ZNE projects.

Photo courtesy NBI: DPR Headquarters

I. Introduction and Overview

Moving Forward to Commercial ZNE

*"As energy systems undergo transformation, facilities are at the forefront of opportunity. There are increasing chances to go from passively consuming to actively conserving and producing energy, which **bodes well both for the environment and the...balance sheet.**"*

- Diane Moss, "Net Zero Energy For Buildings", Facility Executive, August 14, 2017.

In 2008, the California Public Utilities Commission (CPUC) adopted the California Long-Term Energy Efficiency Strategic Plan (CAEESP) that included aggressive goals for Zero Net Energy (ZNE) commercial buildings. Since then, the State of California legislature and Governor Brown have continued to move forward with legislation to **reduce carbon emissions**, double the amount of **renewable energy generation**, increase **energy efficiency** in existing buildings, and maintain the State as a **leader in addressing climate change**.

Over the last ten years, ZNE has moved from concept to reality, with a limited but growing number of commercial and residential buildings example. In addition, the market and policy context have changed. There are five elements that are transforming how to address and think about ZNE: 1. Moving from building-scale only to district scale approaches; 2. Embracing Distributed Energy Resources (DER) with energy storage and advanced energy controls; 3. Establishing ZNE projects as resources to the electric grid; 4. Finding new pathways to achieve ZNE in existing buildings; and 6. Expanding the value of ZNE to include carbon reduction, resilience, economic development, and other benefits.

The Framework is designed to help catalyze the market and drive utilities, local government, developers, and property owners to more aggressively develop ZNE commercial projects. The Framework incorporates and addresses trends in the deployment of solar renewables and storage, electric grid modernization strategies, the drive for increased community resilience, and the continued electrification of transportation. It also captures fundamental market changes as large corporations and local governments increasingly are adopting 100% renewable energy as a goal.

Ultimately, this Plan is designed as a tool to educate the market on the variety of options to achieve ZNE, inspire innovation including community-scale solutions, and drive the commercial buildings sector to achieve substantial reductions of carbon emissions in a grid-friendly manner.

Photo Rob Wellington Quigley, FAIA : Leslie Shao-Ming Sun Field Station, Santa Cruz Mountains, Stanford University.

Plan Organization

The Framework is organized into three sections as described below.

I. Introduction and Overview

The first section provides an overall policy background, a description of ZNE and its importance to California, and provides a summary of some of the critical and new drivers that have formed the Plan.

II. Strategic Action Plan

The second section of the Framework provides the core of the Plan and details the overall market trends and need, goals, primary objectives, and tactics to achieve them.

III. Discussion Tool

The third section is designed to work with the online discussion tool provided on the website at www.capath2zne.org. This new element helps a broader audience understand the potential benefits and impacts of implementing ZNE at a campus or district scale.

Evolving ZNE

The Framework addresses the "Commercial" Sector with all non-residential buildings including institutional (schools, prisons, hospitals, etc.) buildings, government buildings, and privately-owned commercial buildings, such as office buildings, warehouses, high rise multifamily properties, and retail buildings of all types. This Plan also looks at collections of buildings or districts, which could include residential homes, mixed-use commercial/ residential and campuses (educational, corporate and institutional).

The Plan's strategies are designed to establish a strong foundation for the development of a ZNE future as well as to identify and empower actions that will drive building owners and decision makers to implement ZNE across markets and throughout the state. The Framework has built on the lessons learned to date, new market research, and substantial stakeholder input over two years. The planning process assessed the major continuing barriers and developed a set of key market and policy drivers that can make ZNE efforts more effective. The Framework also frames ZNE differently than the previous Commercial Buildings ZNE Framework. Historically, ZNE was defined at the building level, and achieved with low energy use in all aspects of the building design, construction, operation, and internal equipment, and offset any additional consumption with renewables, typically solar panels on the roof. Moving forward, the implementation of ZNE will change in several significant ways.

Important Terms

The following are definitions of key terms used in the Framework. Additional definitions are in the glossary.

Distributed Energy Resources (DER)

"DERs are physical and virtual assets that are deployed across the distribution grid, typically close to load, and usually behind the meter, which can be used individually or in aggregate to provide value to the grid, individual customers, or both. A particular industry interest seems to be centered on DERs — such as solar, storage, energy efficiency, and demand management — that can be aggregated to provide services to the electric grid." *Advanced Energy Economy*

Resilience

"Resilience of the energy sector refers to the capacity of the energy system or its components to cope with a hazardous event or trend, responding in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation." *International Energy Association*

Utility-Scale/Utility-Scale Renewable

"Utility scale renewable energy (USRE), as defined by the renewable energy program, is considered on a scale equal to 10 megawatts (MW) or larger." (*CPUC)* In addition to capacity, a utility-scale renewable system is typically located remotely.

Community-Scale Renewables

"Community-scale energy projects use renewable energy to power relatively small areas such as college campuses, military installations, business parks or neighborhoods. They generate less than 20 megawatts, filling an energy niche between individual projects like rooftop solar and large projects like utility-scale power plants." - *California Energy Commission*

Further, the Plan considers Community-Scale renewables as a local energy source, limiting distribution and transmission.

The first change is scale.

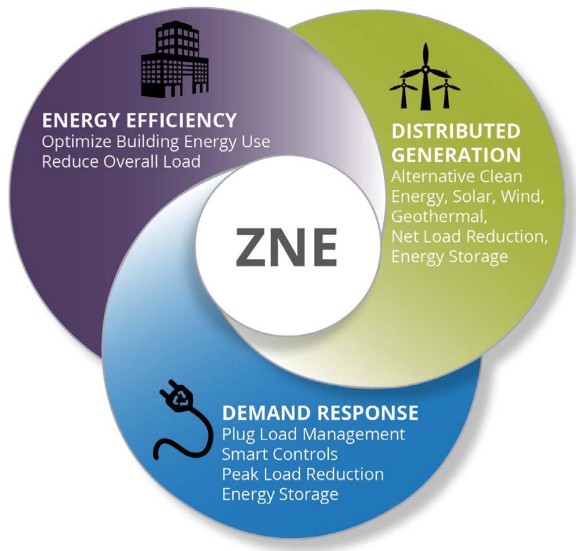
While individual buildings still must be first and foremost energy efficient, expanding ZNE to multiple buildings or district-scale can improve costs, customer benefits, grid-friendliness, and other environmental and community goals. A ZNE district is not just about community-scale renewables, but a defined geographic area inclusive of new and existing buildings and infrastructure systems that takes an integrated approach to ZNE that optimize DERs.

Moving to community, campus, corporate or city-scale resolves pragmatic questions such as inadequate available roof space, aesthetics, and shading by trees or other buildings. Scale reduces the costs of renewables and enables different business models for renewables, storage, and demand control that can replace construction upfront costs with monthly bills such as leases or paying for solar kWh production. Moving beyond building-scale also offers a future where local and state policy makers and planners can incorporate resilience, water, waste, and transportation concerns at the same scale.

The second change is distributed storage of electricity and related demand control.

While not yet standard, storage and demand control can and will likely be broadly incorporated in individual homes and commercial buildings. Battery and other energy storage systems allow individual buildings and projects to store energy from solar panels and use that energy in the evening or non-generating hours, balancing energy loads and reducing the need for grid power at high demand points. Controls help the equation by managing the storage, appliances, lighting, and other uses to optimize when and how the generated solar power is used.

Figure 2. Essential Components of ZNE: Energy Efficiency, Demand Response, and Distributed Generation



There are additional benefits at district-scale both for customers (cost, convenience) and for the grid (fewer control points, operation directly as part of the grid, and better maintenance and reliability). Distributed storage is a game changer, especially as the grid incorporates renewable energy production, electric vehicles, and as other electrification efforts continue to gain market share.

The third area of change is how ZNE interacts with the grid.

Historically, ZNE and onsite renewables have been considered a liability for the grid, pushing the limits of this one-way system. This concept is changing dramatically. The new idea is that ZNE buildings and districts (with appropriate controls and storage) are resources for grid management. The building, or the community, become part of the grid in terms of both contributing power and responding to grid requests to manage load while reducing costs and infrastructure requirements. If ZNE projects are designed as microgrids, they can further improve reliability and provide local resilience during major disruptive events or other emergencies. A better understanding of locational value can help IOUs assess and manage their distribution networks both when adding new loads and in areas that have distribution constraints.

Given private sector and local government interest in carbon reduction though renewable energy use, there is an opportunity for the State to shape and leverage private investment and local infrastructure development to help reduce grid infrastructure growth as well as meet climate goals.

The fourth change is a focus on the development of a pathway to ZNE for existing buildings.

Few existing buildings operate at ZNE levels. Typically, ZNE in existing buildings is only accomplished through major renovations. A better paradigm for achieving ZNE in existing buildings includes maximizing energy efficiency (EE) and utilizing community-scale renewables. Community-scale reduces substantial barriers to ZNE for existing buildings, as many existing buildings have shading, limited open roof space, or structural issues that make onsite renewable development more difficult and expensive. Advanced controls and monitoring can also be provided at a community level, enabling smaller businesses and buildings to benefit from new technologies. This results in significantly reduced up-front costs and complexities for existing buildings.

The final change is one of value.

ZNE buildings previously focused primarily on reducing energy use and costs as well as improvements in comfort and indoor environmental quality. However, building owners, local governments, and developers have additional reasons for designing, operating, and providing energy services in buildings and communities. These audiences may value meeting carbon commitments, improving resilience and safety, enhancing local employment and economic development, among others.

At both the building and community level, the Framework strategies can help achieve better outcomes regarding responsiveness and resilience, and be more attuned to and integrated with corporate, campus and community goals. It is a more flexible and integrated pathway that can meet consumer, policy and grid goals.

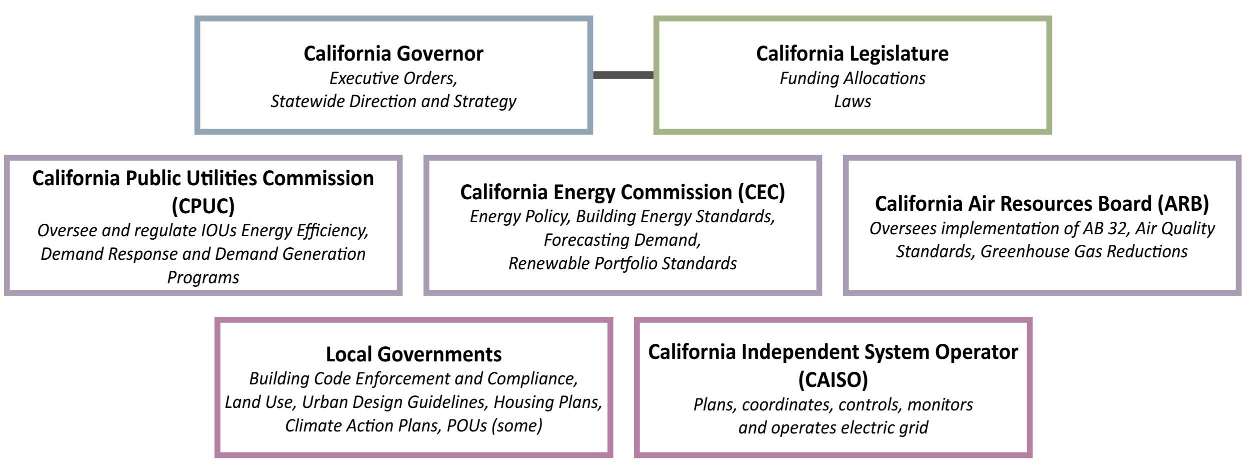
Photo: San Francisco Exploratorium Renovation

Policy Context

The State of California has been aggressively adopting legislation and funding initiatives and programs that will help to reduce California's carbon footprint. Many of these drivers directly impact the Framework and its goals. The following is a summary of the current legislation and policies that impacts achieving zero net energy.

- **AB32, Global Warming Solutions Act of 2006** and the legislation's renewal SB32, sets carbon emission reduction goals to 40% of 1990 levels by 2030 and is the guiding reason for the ZNE goals in the CAEESP. This will continue to be a critical policy in the future at the State level as well as the local level with the adoption of Climate Action Plans that incorporate solar, energy efficiency, and ZNE goals.
- **CAEESP**, drafted in 2008 and updated in 2011, provides an overarching plan and "Big Bold Goals" to achieve California's energy efficiency and GHG reduction goals.
- **Governor's Executive Order B-18-12** requires ZNE consumption for 50% of the square footage of existing state-owned buildings by 2025 and ZNE consumption from all new or renovated state buildings beginning design after 2025. The Department of General Services (DGS) has worked closely with stakeholders and has developed a feasible approach to this mandate. Their initial work will inform future commercial projects.
- The **Integrated Energy Policy Report (IEPR)** provides a comprehensive assessment of essential energy issues in California along with recommendations for how to address market and regulatory challenges. The IEPR provides a definition for ZNE based on California Building Code for new construction. (See ZNE Definitions)
- **SB 350, Clean Energy and Pollution Reduction Act,** requires the doubling of energy efficiency in buildings, a strong focus on disadvantaged communities, and the establishment of a renewable portfolio standard of 50% renewables by 2030.
- **AB 802/AB1103** establishes benchmarking and data requirements for commercial buildings over 10,000 sf., which will help to target poorly performing buildings.

Figure 3. California's Lead Organizations and Agencies in Energy and ZNE Policies



- **AB 793** requires the utilities to incentivize the installation of Energy Management Technologies as part of programs, especially for disadvantaged customers.
- **Executive Order B-16-12:** Goal for California to Deploy 1.5 million Zero-Emission Vehicles by 2025.
- The **Net Energy Metering (NEM)** program allows solar, wind, biogas, and fuel cell generation facilities to serve all or a portion of on-site electricity needs and receive credits for any excess energy that is fed back to the grid. This program has helped grow the rooftop solar industry in California. The CPUC will reevaluate the NEM program in 2019 and aims to set compensation rates that value electricity generation based on the benefits it provides to the grid at particular locations and points in time, while also maintaining sustainable solar industry growth.
- The **Green Tariff Shared Renewables (GTSR)** program adopted in May of 2016 outlined rules for Utility procurement of new renewable energy and allows customers through the Enhanced Community Renewables (ECR) to purchase clean energy/ renewables within their community. This is intended to aide in the development of community solar/renewable resources, however to date this effort has had low participation rates with zero contracts awarded as of April of 2017. The utilities have made some changes to new procurements and may result in stronger engagement in the coming year.
- The CPUC **Integrated Distributed Energy Resources (IDER)** Proceeding is in process and has the potential to impact a number of areas connected to ZNE. An early element of the proceeding is the adoption of an interim a carbon adder in program administrator cost-effectiveness calculations, enabling a broader spectrum of programs that can achieve deeper energy savings and carbon reductions.
- In 2017, the IOUs, RENs, and CCAs interested in EE programs, filed **10-year business plans** as dictated by the CPUC's Energy Efficiency Rolling Portfolio proceeding (R13-11-005). These plans provide an overview of all planned priorities and spending for the coming years, including establishing a number of ZNE programs. As part of this proceeding, by 2020, IOUs will be required to turn over 60% of their EE portfolios to third party entities who will design and deliver those programs.
- Various local and regional planning policies related to land use planning, zoning, climate, sustainability, and resilience.
- Additional policies are being considered and developed from various agencies in California represented in Figure 7 and will need to be considered and addressed to ensure alignment and common purpose.

Related Policies Issues

Many policies and programs have influenced the development of the Framework, but in several areas, there are larger policy issues that need to be resolved for the Framework's vision and goals to be fully realized. Following is a brief summary of those issues.

Electrification

California policies have supported reductions in carbon from electricity generation and for purchasing electric vehicles, but have not moved to require or incentivize fuel switching from fossil fuel to electricity (renewable) in buildings, whether new or existing. This is a complex issue, and there is ongoing research in natural gas developed from renewable resources and hydrogen options among others.

While many ZNE projects are 100% electric and employ a broad range of complimentary green building techniques that further reduce carbon emissions in the sector, fuel switching, technical need or feasibility of moving towards electrification is not addressed in the Framework but in other proceedings at the CPUC and CEC.

Cost-Effectiveness

The newness of the ZNE industry, the need to learn advance techniques, and changing technologies all result in concerns related to the cost-effectiveness of ZNE projects, particularly for existing buildings. Current ZNE buildings rely on "state-of-the-shelf" technologies, advanced design practices, and increased attention to energy related details in design and construction. Increasing the scale of ZNE will make today's uncommon technologies more common and change design and construction practices to new norms, with attendant long-term cost reductions. New innovations, such as PV imbedded in roofing material or windows, will also lead to cost reductions. The CPUC ratepayer programs are an important tool to achieve the scale necessary for this normalization.

Program Administrators are under considerable pressure to deliver near term energy savings that favors simple, cost-effective measures, such as lighting, over more complex, multi-year strategies. It would be useful to adopt a cost effectiveness framework that alters this calculation allowing for long-term holistic approaches.[6] The Integrated Distributed Energy Resource (IDER) proceeding is considering cost-effectiveness and should address the needs of ZNE projects.

Additionality of Renewable Energy Resources

The Framework includes recommendations for adding renewable resources sufficient to supply the energy needs of newly constructed buildings either on the building, on or near the building site, or at a district-scale. It is important that these resources be developed to be additional to other existing requirements (such as Renewable Portfolio Standards (RPS) for IOUs) and that the renewable resources are treated consistently whether on the building or near the building. The Framework does not recommended Renewable Energy Credits (RECs) as a permissible option, as many RECs are not defined sufficiently to assure additionality and may not represent local renewable options, which the Framework recommends for their potential to provide additional benefits to the grid as well as other local economic benefits, including resiliency of electricity service. Cleared definition of what constitutes addition, long-term renewable development from a state perspective will impact other renewable energy developments as well, including corporate and local government efforts to secure 100% renewable power and energy code requirements.

Smart Inverters

The rapid expansion of solar PV and ultimately ZNE buildings could create grid disruptions, especially with variable disconnections and reconnections around a power outage and increased two-way flows inherent in a DER system. California has recently passed new smart inverter requirements, called "Electric Tariff Rule 21" or "Rule 21" to address this concern while also providing for cost savings for consumers. Smart inverters allow DERs to be

6 Keating, Ken, et al, "Guidance on Designing and Implementing Energy Efficiency Market Transformation Initiatives", California Public Utilities Commission, Edited by Cathy Fogel, Energy Division, October 13, 2014.

connected to the grid and be more effectively managed, especially at various voltages and frequency levels than standard approaches. Ultimately smart inverters will be able to be operated remotely by grid operators to support the grid. Rule 21 is an important element for the utilities who are concerned with meeting their requirements for reliability and safety of the grid.

The Executive Director of Clean Coalition, Craig Lewis said of Rule 21, “enabling the full suite of advanced inverter functionality is essential to bring high-levels of distributed generation online quickly and cost-effectively – in California and every other leading market around the world.”[7]

Rate Structures

Rate structures could support the accel-eration of ZNE buildings much as Net Energy Metering (NEM) rates supported initial solar development. However, rate structures are complex, and especially as scale grows, may have unintended consequences to general ratepayers. As part of the solution, the locational value of renewable resources, the capabilities for load management, and the benefits of including controllable energy storage on or near building sites should be recognized in program incentive designs and/or rate structures for the addition value that they provide. Framework does not make a specific recommendation for how to resolve rate related issues, which include potential impacts that are beyond the scope of this plan.

The CPUC is planning changes to the tariffs in 2019 that may be able to address current conflicts and those that can be used to benefit ZNE projects. In different policy decisions (D.14-05-033 and D16-04-020), the CPUC has set the rules for virtual net energy metering (VNEM), which enables a community-level solar system, and other parts of the net energy metering policy. Due to conflicting policies in these decisions, incentive programs associated with VNEM are such that there is no economic incentive to install energy storage to even out the energy production of a solar system. The CPUC is currently working to resolve these policies in order to provide the intended incentive for solar PV coupled with storage.

Funding and Operational Silos

Annual IOU expenditures for energy efficiency are developed, tracked, and managed separately from renewables funding, demand, or load management. To develop the best buildings and a strong private sector industry, connecting technical and financial support into a single distinct program and/or point of entry is ideal. Program support that includes all elements from planning to operation can more directly link state climate policy, an efficient grid, and consumer benefits in individual buildings and larger projects.

Program Administrators must establish customer-centric programs that support efficiency, renewable, and load control in every major project, by flexing energy efficiency program goals and rules for buildings that are pursuing ZNE. While this could be initiated as a pilot program, the new funding will need to be increased year to year to support a growing market.

7 Brown, Gwen, “California’s New Smart Inverter Requirements: What “Rule 21: Means for Solar Design”, Aurora Blog, Nov. 8, 2017.

New Market Forces

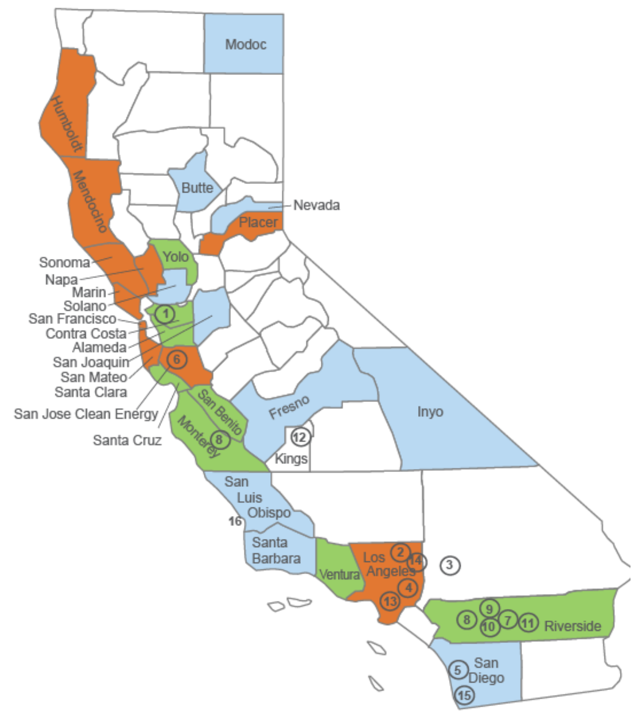
New market forces, some specific to California and some international in scope, are reshaping the commercial ZNE market and this Plan. The following is a summary of the most critical elements.

Regional Energy Networks and Community Choice Aggregators

Two new local government organization structures, the Regional Energy Network (REN) and the Community Choice Aggregator (CCA), both enabled by the CPUC, are California's newest energy entities with the potential to impact the future of ZNE and to be disrupters to the market. CCAs, in particular, can act as critical enablers for achieving the multi-faceted needs of the ZNE market. These entities are also essential partners to large scale utilities, filling gaps and playing roles that are not as well suited to for-profit utilities.

RENs were established by the CPUC in 2012 and are independent energy efficiency program administrators comprised of regional local governments, and designed to serve as new entities for innovative programs and to serve ratepayers that are underserved by utility programs. There are two approved RENs – one covering Los Angeles County and surrounding areas (SoCALREN), and one in the nine bay area counties (BayREN). Together, these RENs comprise nearly two-thirds of the State's population and receive ratepayer funding to administer energy efficiency programs and supporting activities. Proposed REN activities in their filed CPUC Energy Efficiency Business Plans include a number of initiatives to promote ZNE for municipal government buildings and to establish ZNE policies, as well as future plans to assist residents in achieving ZNE. An additional REN covering three counties on the Central Coast (3C-REN) is pending approval.

Figure 4. CCAs Operating and In Development



Operational

- **MCE Clean Energy** *includes Marin and Napa Counties, parts of Contra Costa and Solano Counties* (1)
- **Sonoma Clean Power** *Includes Mendocino County in mid-2017*
- **Lancaster Choice Energy** (2)
- **Clean Power San Francisco**
- **Peninsula Clean Energy** *San Mateo County*
- **Redwood Coast Energy Authority** *Humboldt County*
- **Silicon Valley Clean Energy** *Santa Clara County*
- **Town of Apple Valley** (3)
- **Clean Power Alliance of Southern CA** *Phase 1, formerly Los Angeles Community Energy*
- **Pioneer Community Energy** *formerly Sierra Valley Energy, Placer County*
- **PRIME** (4) *Pico Rivera Innovative Municipal Energy*

2018 Launch (anticipated)

- **City of Solana Beach** (5)
- **San Jose Clean Energy** (6)
- **Clean Power Alliance of Southern CA**** *Phase 2, formerly Los Angeles Community Energy, includes Ventura County*
- **Contra Costa County** *As part of MCE Clean Energy*
- **Desert Community Energy** ** (7) *Coachella Valley*
- **East Bay Community Energy** *Alameda County*
- **King City**** (8)
- **Monterey Bay Community Power** *Monterey, Santa Cruz and San Benito Counties*
- **Rancho Mirage Energy Authority** (9)
- **San Jacinto Power** (10)
- **Silicon Valley Clean Energy**** *Program expansion*
- **Valley Clean Energy Alliance** *Yolo County, Cities of Davis and Woodland*
- **Western Riverside Council of Gov'ts**** (11) *WRCOG*

***Impacted by Resolution E-4907*

Exploring / In Process

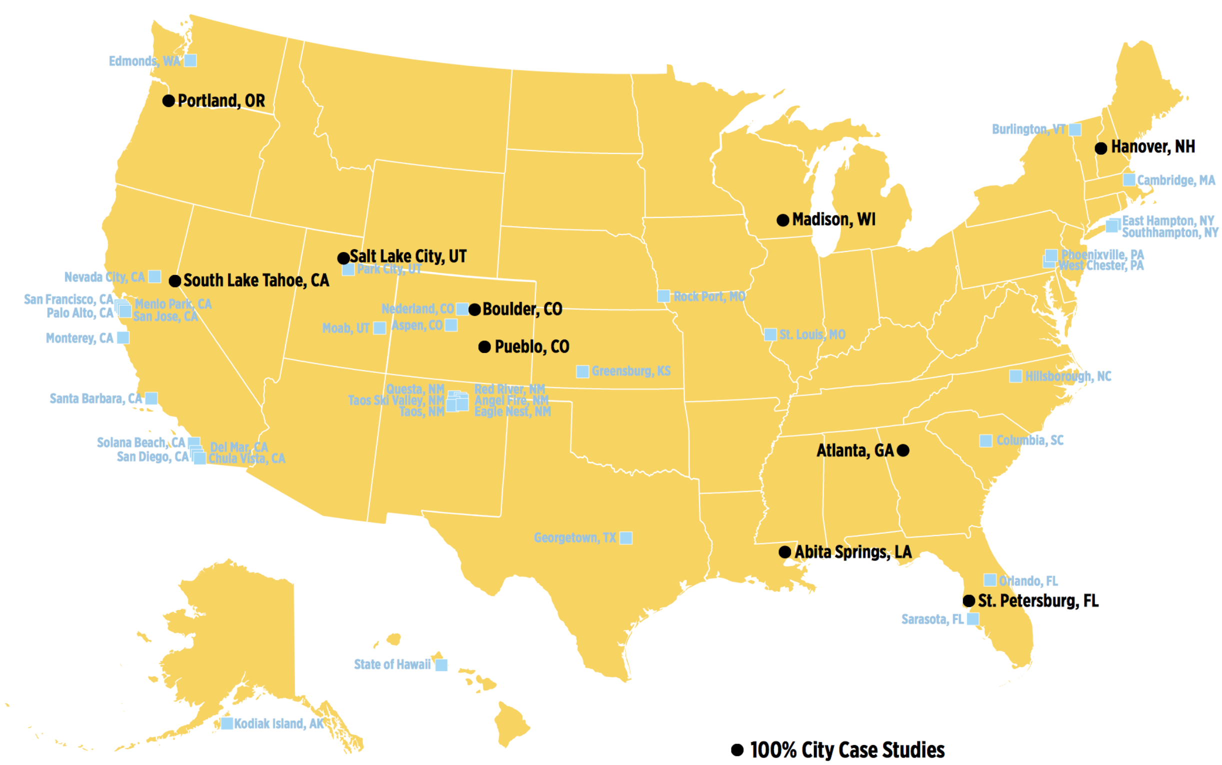
City of Hanford (12)	Modoc County
City of Hermosa Beach (13)	Nevada County
City of Palmdale (14)	City of San Diego (15)
Butte County	San Joaquin County
Fresno County	City of San Luis Obispo (16)
Kings County	Santa Barbara County
	Solano County

CCA's are designed primarily as a local entity empowered to purchase clean energy and sell it to customers at a better rate than offered by IOUs. Typically, their goal is to procure renewable and low-carbon power options that may not be available through IOUs. Marin Clean Energy, started in 2010, was the first active and operational CCA. Currently, five operational CCAs are serving one million customers with at least eleven other jurisdictions exploring creating a CCA.

CCAs have the authority to purchase and develop power generation, develop energy storage systems, and manage energy efficiency programs at the local level. This means that for more complex, local projects that are not historically attractive to IOUs, CCAs can become a leading entity. Their ability to connect with local government climate, community, and land use planning would allow them to help facilitate establishing and managing ZNE district scale projects, including renewable power procurement, billing, load management, and more. CCAs have the potential to fill the gaps in grid-enabled power, improving local resilience by partnering in the development of ZNE projects, establishing local community-scale renewables and storage, reducing constraints in power distribution, and developing distributed energy resources at the local level.

The CPUC estimates that up to 15 to 20 million customers will be served by CCAs, self-generation and electric service providers over the next ten years. This translates to transitioning 85% of the current utility loads to these alternative providers.[8]

Figure 5. US Cities Committed to 100% Renewable Energy (Sierra Club)



8 Consumer and Retail Choice, the Role of the Utility, and an Evolving Regulatory Framework, California Public Utilities Commission, 2017

Local Government Commitments to 100% Renewable Energy

International carbon accords have inspired a new movement where numerous cities across the U.S. and California are committing to 100% renewable power by 2050. Figure 4, on the following page, from a recent Sierra Club report indicates at least eleven cities in California, more than any other state, have already committed to 100% clean power standards by 2050. The U.S. Conference of Mayors has endorsed the approach.

Cities are at an early stage in the process, and there is a diversity of approaches and definitions used for 100% renewable energy. The challenge for California is how, where and when renewable energy will be developed. Locally procured, renewable energy is a goal for most of the participating cities, although some will rely extensively on existing hydroelectric as part of the renewables, which is not considered renewable and not desirable due to environmental impacts. This effort could tie into CCAs and other efforts in California.

Corporate ZNE Initiatives

Corporate commitments to sustainability and specifically to renewable energy have been building for several years. Many of the world's largest companies have committed to use 100% renewable electricity through two efforts; the RE100 (Shorthand for 100% Renewable Energy), started by IKEA and other European companies, and the RE Buyers Group, started by four U.S. based non-profits. Many major California-based companies are part of these programs, and have made commitments to use only renewable electricity, whether through purchases of power or credits, or direct ownership of renewable generation. Timing of reaching the 100% commitments varies from 2018 for Google to 2050 for some more traditional manufacturing companies. The goal of the RE Buyers Group is to purchase 60 GWs of additional renewable electricity by 2025. Figure 5 shows purchases to date along with some of the companies participating.

This desire of major companies to reach their 100% renewable electricity goals is changing how energy procurement is handled, creating new markets for renewable power outside of utilities, and possibly new tariffs to accommodate interest. A precedent setting example is a new contract between Microsoft and Puget Sound Energy that allows Microsoft to go to the open market to purchase 100% carbon-free electricity to power their headquarters offices. The commitment is beyond the Renewable Portfolio Standard requirements. Microsoft will pay a transition fee to PSE so that consumers are not harmed; is continuing to support ratepayer funded conservation programs; and has increased its contribution to low-income energy programs.[9]

9 Joint press release: Microsoft and PSE, June 13, 2017.

Falling Costs of Renewables and Storage

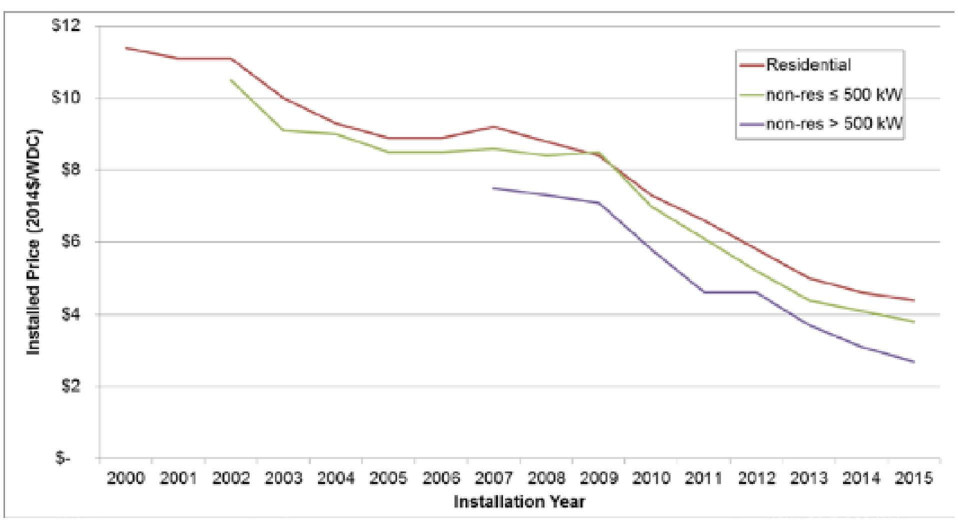
"The US Department of Energy forecasts that by 2020 community solar capacity could equal anywhere from a third to half of all installed distributed solar."

- Tom Stanton, "The Ecology of Community Solar Gardening", August 2016.

Another market force that has been evolving over the years is the decreasing cost of renewable energy. A number of current reports indicate wind and solar[10] costs are dropping steadily while renewable energy production and consumption are increasing.[11] The conventional wisdom that renewable technologies depend on subsidies and that they are too costly to integrate into the grid has become anachronistic. Community-scale solar, when paired with storage, controls, effective pricing signals, and benefiting the grid, have the **potential to transform the way utilities and power providers consider the grid and distributing power in the future.** This is especially true from a cost perspective. Non-residential solar is approximately $4.10/WDC (watts direct current) for total installed cost where community scale (over 500kW) is approximately $2.25/WDC. (See Figure 5) community-scale renewables can be located near projects, reduce transmission and distribution costs, and use available space on parking lots and rooftops as well as unusable land, community scale can be a major resource for in building more resilient communities especially when paired with grid-harmonizing technologies such as storage and smart inverters.

Energy storage is also experiencing increased demand and substantial cost reductions as it becomes a tool to manage energy loads, provide increased reliability, resilience, and a cost management tool. A recent analysis estimates storage costs dropping from 10% to

Figure 6. Residential and Nonresidential PV System Sample and Median Installed Price



Source: Barbose, Galen, Naïm Darghouth, Dev Millstein, Sarah Cates, Nicholas DiSanti, and Rebecca Widiss. Lawrence Berkeley National Laboratory, August 2016. *Tracking the Sun IX: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States*. Table B-4.

10 NREL.gov, https://www.nrel.gov/docs/fy15osti/63604.pdf.

11 eia.gov. 11/1/2017, https://www.eia.gov/totalenergy/data/browser/?tbl=T10.01#/?f=M&start=200001

43% depending on the technology employed. While transmission costs from traditional energy resources remain far more cost effective especially for the residential sector storage systems, especially at larger scales, are becoming more cost effective.[12]

Storage's role in the future of grid-friendly ZNE is substantial. The opportunity to flatten out and better manage loads that are accentuated due to solar PV generation, also known as the duck curve and illustrated below, is a game changer. The cost reduction of energy storage, particularly if deployed at a community-level rather than behind the meter at an individual building level has the ability to make ZNE projects more cost-effective and a better resource for the grid, especially when paired with appropriate controls.

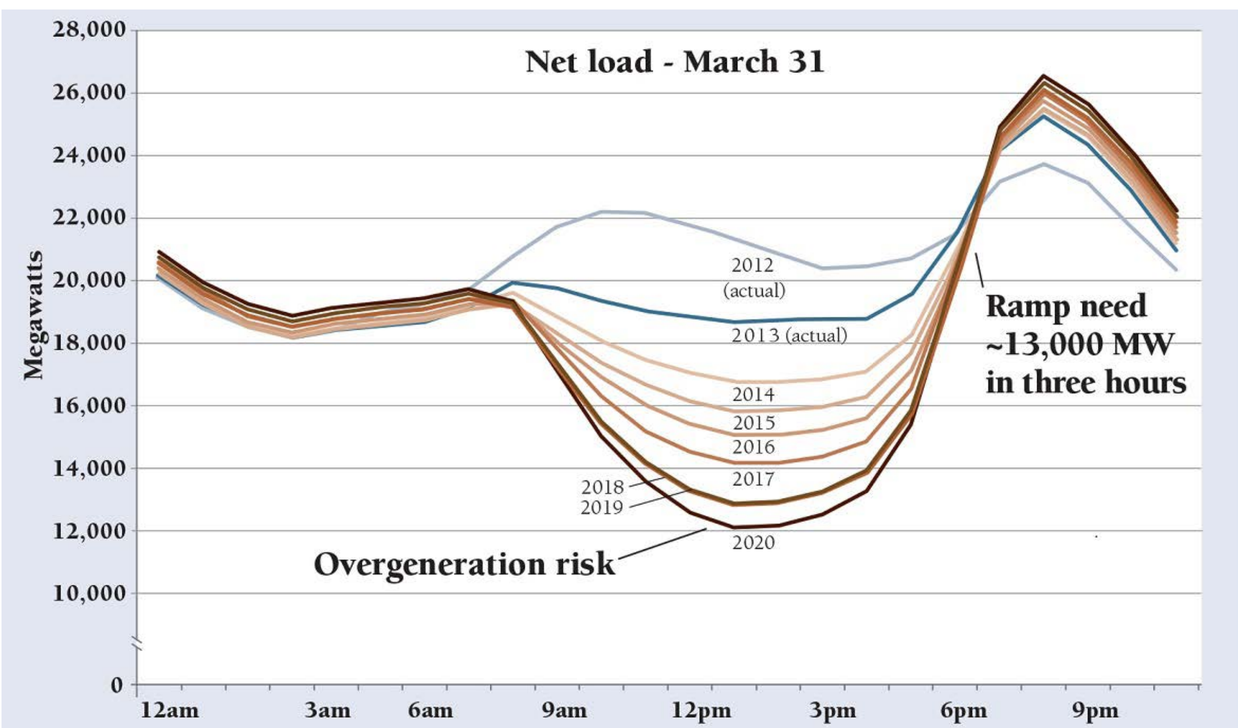
Power Supply, Grid and Infrastructure

"With so much of the existing public utility infrastructure ripe for modernization and replacement in the near future, now is the time to develop the tools and techniques needed to engage customers and communities in ways that will encourage customers to rapidly adopt more and more innovations."

-Stanton, Tom and Kline, Kathryn, "The Ecology of Community Solar Gardening",

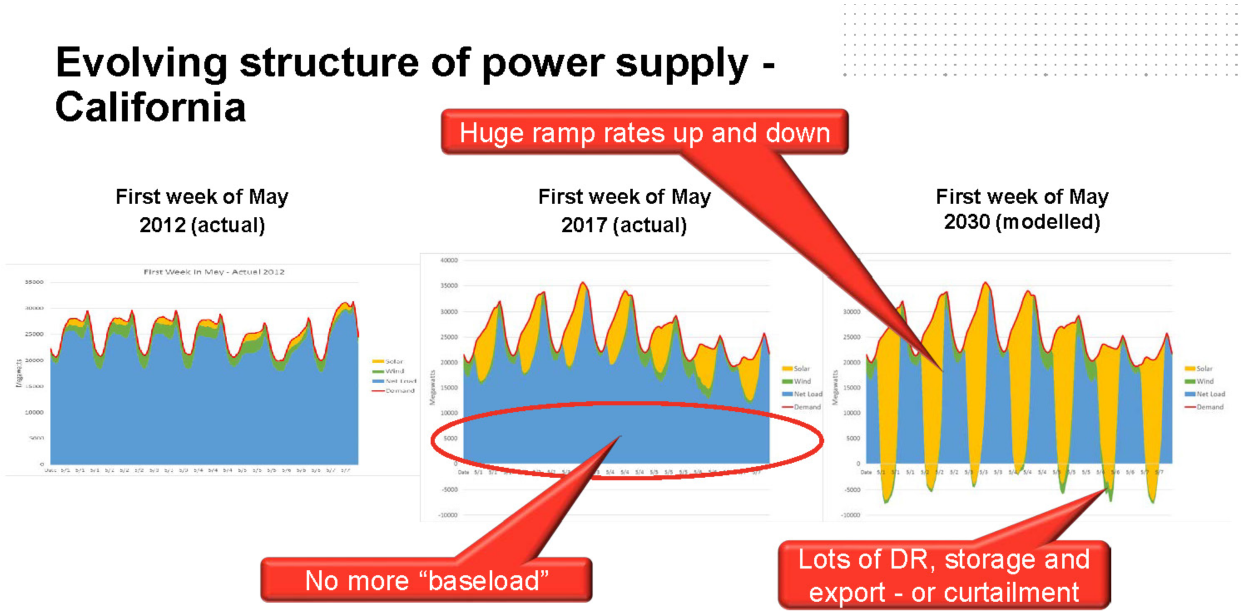
To date, ZNE programs and efforts have been housed within energy efficiency divisions at the CPUC and Energy Commission, and more often aligned with building codes and programs than with grid, power generation, and distributed energy resources. As the reality of a building code for ZNE becomes imminent for new single family residential houses, the potential for ZNE to disrupt grid operations is a growing concern.

Figure 7. California's "Duck Curve" CAISO



12 Julian Spector, "Storage Costs Come Down Across Technologies and Applications According to Lazard Report," Utility Dive, December 19, 2016.

Figure 8. California's Evolving Power Supply - the Impact of Solar PV



Source: CAISO OASIS: CEC proposed IRP; LM Power; CESA; Bloomberg New Energy Finance, 10/18/2017

ZNE as currently defined focuses on solar rooftop generation without storage, requiring grid power for times of the day when there is no solar. Statewide adoption of ZNE would result in an increase in load fluxations and an increase need for a different source for energy.

California's power supply has become more volatile and the substantial increase in solar renewable power has resulted in excess power generation or curtailment.[13] Due to the increase in renewables natural gas-fired power plants are operating less or not at all, and some have gone bankrupt. Further, California's energy infrastructure is being impacted by a number of issues: ongoing issues with and limitations to the use of Aliso Canyon gas storage and the likelihood for many more leaks throughout the natural gas system; the closure of two nuclear power plants; and the increased risk of excessive droughts and reduced power from hydroelectric plants. The end result is that California needs a greater diversity of power supplies, that are clean, renewable and flexible.[14]

ZNE projects, if redefined to incorporate distributed energy resources, including energy management controls, demand response and storage, especially at the community or district level, have the opportunity to become a more flexible and useful energy resource that can be effectively integrated with the electric grid. Moreover, IOUs will be compelled to plan carbon-free alternatives to gas generation due to legislation like SB 338 (Skinner - Integrated Resource Planning; Peak Demand). Recently signed into law by Governor Brown, SB 338 directs the utilities to evaluate how storage, energy efficiency, and distributed energy resources can meet peak demands, while reducing the need for new electricity generation and new transmission in achieving the state's energy goals while minimizing costs to ratepayers.[15] ZNE as an integrated resource can be an effective tool to achieve this goal.

13 Utility Dive, CAISO Symposium Presentation, October 2017.

14 Energy Commission, "Integrated Energy Policy Report 2017."

15 California Legislative Information, 11/28/2017, https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB338.

Zero Net Energy Definition

Defining ZNE has been one of the most complicated issues with stakeholders. Why does the ZNE definition matter? Developers and builders want to be able to claim they are achieving ZNE by a specific metric, regulators want to provide clear guidance to the market, policy makers need to know if their policies are actually making a difference, and on the whole, we need to understand if it is an effective tool to reach our goals.

In California, this discussion has been driven by two primary areas:

1. The development of the 2019 Building Code for new residential buildings and the Time Dependent Value (TDV) definition of ZNE; and

2. The State of California's Department of General Services (DGS) definition adopted for their large building portfolio, which mandated to achieve ZNE by 2025.

The Department of Energy, New Buildings Institute, International Living Futures Institute, Architecture 2030 and others have also developed definitions for ZNE. Generally, the definition can be boiled down to: A ZNE building generates as much renewable energy as it consumes over the course of a year.

Another important aspect of the ZNE definition is whether it is meant to address the design of a new building or the operation of an already occupied, existing building. The Framework covers both, as well as individual buildings and groups of buildings in a campus, in a portfolio of buildings owned by one company or government, or in a community. The DGS definitions for ZNE provide ways to address all of the scenarios anticipated by the Framework. The Energy Commission's Time-Dependent Value (TDV) definition is designed to ensure that ZNE buildings are harmonized with the California electricity grid, addressing the State's goals to avoid climate change impacts, at least cost. In order to achieve State goals, it is critical that newly constructed buildings and improvements to existing buildings be designed with a focus on time-differentiation of how the building generates, stores and consumes energy. By focusing on time-differentiation and grid harmonization, a win-win-win is realized for the building owner, the utility system, and the environment.

Ultimately, it is anticipated that the Energy Commission will adopt an updated definition and Code approach for new nonresidential buildings that incorporates a time-differentiated Energy Design Rating (EDR), similar to the EDR for residential buildings. Although the DGS definition lacks this time-differentiation, grid harmonization focus, DGS recommends that projects endeavoring to achieve ZNE under their definition also incorporate specific measures that will encourage grid harmonization and project cost reduction.

(See sidebar)

ZNE Definitions

DGS ZNE Source Definition: Energy Efficient building that produces as much clean renewable energy as it consumes over the course of a year, when accounted for at the energy generation source. The following are additional DGS definitions to achieve ZNE.

ZNE Building – An energy efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the onsite renewable exported energy.

- The building footprint (i.e. rooftop), or around the building site (i.e. parking lot, adjacent land) can be utilized for onsite renewable generation.

ZNE Campus – An energy efficient campus where, on a source energy basis, the actual annual delivered energy is less than or equal to the onsite renewable exported energy.

- A multiple building campus can be utilized as a boundary for onsite renewable generation to offset energy use of all or a portion of the campus buildings.
- This approach would allow ZNE to be achieved for energy efficient buildings within the campus where the capacity for onsite renewable energy is very restricted.
- This would also provide an outlet for onsite energy use for periods of the day when overgeneration of electricity is likely, to avoid financial losses from selling back excess energy wholesale to utilities.*

ZNE Portfolio – An energy efficient portfolio where, on a source energy basis, the actual annual delivered energy is less than or equal to the onsite renewable exported energy.

- Multiple building sites by the same owner could be used and aggregated so that the combined onsite renewable energy could offsite the combined building energy from the aggregated project sites. This could apply to the entire portfolio, or portions of the portfolio.
- This approach would allow ZNE to be achieved for energy efficient buildings within the portfolio where the capacity for onsite renewable energy is very restricted.
- This would also provide an outlet for onsite energy use for periods of the day when overgeneration of electricity is likely, to avoid financial losses from selling back excess energy wholesale to utilities.*

ZNE Community – An energy efficient community where, on a source energy basis, the actual annual delivered energy is less than or equal to the onsite renewable exported energy.

- This could be applied to allow long-term purchase agreements of locally generated, renewable energy, dedicated to providing energy for the building(s). Agreements should extend a minimum of 20 years.

Code Building Definition Time Dependent Valuation (TDV)

"A Zero Net Energy (ZNE) Code building is one where the net of the amount of energy produced by onsite renewable energy resources is equal to the value of the energy consumed annually by the building, at the level of a single "project" seeking development entitlements and building code permits, measured using the California Energy Commission's Time Dependent Valuation (TDV) metric. A ZNE Code Building meets an Energy Use Intensity (EUIs) value designated in the Building Energy Standards by building type and climate zone that reflect best practices for highly efficient buildings." - Energy Commission, "2013 Integrated Energy Policy Report", January, 2014, pg. 36.

** This approach is not currently allowed for IOUs under NEM laws. CCA's, Municipal Owned Utilities, and other entities would be able to negotiate these activities.*

Photo Courtesy NBI: Alameda County ZNE Library

II. Action Plan

Driving Change & Inspiring Innovation

"There's a way to do it better—find it." — Thomas Edison

The commercial market for ZNE has changed significantly in the past few years, and especially in the last year. Corporations and local governments are adopting goals of 100% renewable energy, and are essentially ZNE policies. Part of the recent surge in activity is a reaction to the change in federal direction regarding climate goals, and part is due to the significantly reduced costs of solar and wind. These large corporations, jurisdictions, and CCAs are investing in large-scale renewable energy, although typically at the DER level with corporate or city control, rather than at remotely located utility-scale plants.

From a California (CPUC, CEC, and CARB, et al.) perspective, it is essential to channel this new investment and the re-envisioned concept of ZNE in ways that also help meet state climate goals and support better utilization of the existing grid rather than additional grid expansions.

The drivers detailed in the following pages first focus on getting new construction and major renovation programs right, so that all buildings are better from a grid perspective, and use as little energy as possible. The second focus is supporting and working with a wide variety of market actors engaged or potentially engaged in renewable energy investment and policies especially at the community scale to improve critical decisions around the investment. The third focus is the development of ZNE projects at various scales that increase the potential for cost effectiveness and for larger impacts in a community.

New Goal and New Focus

"Inspire and drive all new commercial buildings and major renovations of existing buildings achieve zero net energy performance (onsite or offsite renewables) and support grid optimization."

The revised goal below differentiates from the original vision of the the 2008 CAEESP goal in several fundamental ways.

1. The new goal focuses on achieving ZNE for new commercial buildings and **major renovations** of existing buildings instead of 50% of all existing buildings. This change is significant from a cost and feasibility standpoint. Using major renovation events allows for a clear trigger with building permits to enforce the goal and is more feasible from a construction perspective.

2. The new goal allows for renewables to be provided **onsite** (within a property) **or offsite** (ideally as close to the project as possible) and requires buildings to reach zero net energy performance so that they can achieve ZNE with the addition of an appropriate level of renewable energy.

3. The new goal directs projects to support **grid optimization**. This focus is critical as more and more buildings become ZNE as discussed in earlier sections of the Plan.

4. The Plan and the goal outcomes allow for ZNE at either a **building-scale, a community-scale, or portfolio** where a project may aggregate energy savings over a campus, neighborhood or project.

5. The new goal is designed to achieve an outcome that **reduces carbon emissions**, meet **customer needs** and help to develop more **resilient communities**. These three outcomes link directly to a number of State goals including supporting disadvantaged communities and small and medium customers, and directly addressing buildings' role climate change.

Ultimately, the Action Plan is designed to allow for innovation, changes in technologies, and solutions that we cannot currently conceive by focusing on performance rather than prescriptive approaches.

The specific tasks identified under each "Driver" have varying leads and timeframes that will all work together to build a foundation and tools to help the market become strong advocates and channels for ZNE.

ZNE Performance and ZNE Ready

ZNE Performance refers to any building or large-scale project that achieves deep energy efficiency with robust advance energy controls that with the addition of renewable energy source can achieve ZNE, ideally with energy storage ZNE Ready refers to a similar project but may not include the level of controls or energy storage.

Major Renovation Defined

For purposes of the Framework, "major renovation" means the remodel requires: (a) The total cost of the renovation relating to the building envelope or the technical building systems is higher than 25% of the value of the building, excluding the value of the land upon which the building is situated; or (b) More than 25% of the surface of the building envelope

Strategic Action Plan

GOAL

Inspire and drive all new commercial buildings and major renovations of existing buildings to achieve zero net energy performance (onsite or offsite renewables) and support grid optimization.

OUTCOME

ZNE buildings and districts are integrated as key distributed energy resources that substantially reduce carbon emissions, better meet customer needs, and create more resilient communities.

DRIVERS

1. Programs Enable ZNE Projects

Ratepayer-funded programs support increasingly efficient and controllable commercial buildings that enable ZNE levels of performance and can readily integrate with distributed energy resources.

2. Improved Awareness & Informed Decisions

Information, tools, and resources improve awareness and assist owners and developers to make informed decisions about ZNE, procuring and implementing renewable energy systems, storage, controls, and DERs.

3. Local Government Capacity & Readiness to Implement

Local governments have the capacity and capability to support ZNE development and projects statewide.

4. Integrated District ZNE and DER

Developers, local governments, and large corporate and institutional energy users build grid-integrated, district-scale energy systems that leverage land use planning, aggregated financing, and community infrastructure development.

5. Targeted Research & Development

IOU Emerging Technology Programs and the CEC's EPIC Program support the development and demonstration of enhanced and integrated technologies for ZNE at both the building and district levels.

6. ZNE Codes & Standards

The CEC, in coordination with local governments, drive commercial building energy codes and standards to ZNE/ZNE-Ready performance levels by 2030.

Driver 1. Programs Enable ZNE Projects

Ratepayer-funded programs support increasingly efficient and controllable commercial buildings that enable ZNE levels of performance and can readily integrate with distributed energy resources.

DESIRED OUTCOME

New and Existing Commercial Building Programs and funding are increasingly dedicated to the development of ZNE and ZNE-Ready Buildings. One hundred percent of program projects are ZNE or ZNE ready by 2030. New and renovated commercial buildings are designed and operated for complete grid integration and enhanced demand management.

Driver 1. Overview

Buildings that used to be simple energy users are now sources of power generation, load shifting, and energy storage, and should be considered and developed to be a benefit to the grid. California ratepayer funds dedicated to energy efficiency are more than $1 billion annually. While existing buildings account for the vast majority of this funding, optimizing new construction from an efficiency and grid interaction perspective is critical.

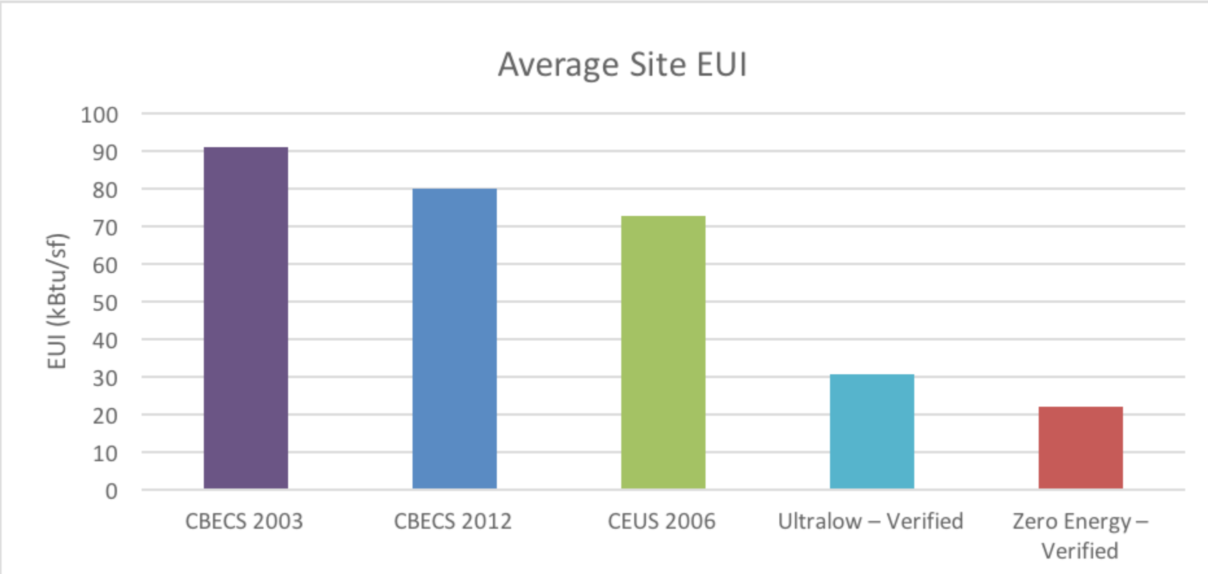
All new construction and major renovation programs, including Savings by Design (or a targeted new commercial ZNE program), existing commercial building programs and specific programs for campuses and state buildings, should be designed to meet ZNE goals and enable ZNE projects and pilots, not just improve energy efficiency. **Ratepayer funding and associated programs are essential to encourage customers to adopt ZNE for new and renovated buildings.** Ratepayer-funded programs provide essential technical and financial assistance as well as more general awareness, education, and related training.

ZNE Commercial Buildings

ZNE buildings represent a systems approach to efficiency. They use state-of-the–shelf technology combined with integrated design and a detailed consideration of all energy uses to minimize energy use. ZNE buildings are connected to the grid with a goal to create sufficient renewable energy, typically solar photovoltaics (PV) on the building, on the property, or in the community to annually offset their energy purchases from the grid. The ZNE concept can be broadened to include renewable energy at the campus, community or portfolio scale rather than individual buildings.

Currently the ZNE market is extremely small, but is well positioned to come to scale. Part of coming to scale is simply riding the massive cost reductions in PV that are a significant part of the ZNE equation. (Tariffs introduced by the current administration may have impacts on PV pricing, but it is not yet known what that might be.) A

Figure 9. EUI of ZNE Buildings Compared to CBECS/CEUS Standard Building (NBI 2017)



second part of scaling is moving to a broader definition of where the renewable resource can be located, which resolves a variety of pragmatic concerns and reduces costs.

How Many and Impact

The number of ZNE buildings in California is growing steadily, particularly for residential developments. The Net Zero Energy Coalition residential building survey indicates that there are approximately 3,100 residential units (single family and low-rise multifamily) that have been built to ZNE standards. The commercial ZNE market is considerably smaller but growing. The New Buildings Institute (NBI) reports that there are over 200 verified or designed to ZNE commercial buildings in California. NBI has also found that the goal of ZNE has help to drive substantial energy efficiency gains in buildings with a 60 to 70% reduction in energy consumption compared to Energy Information Association (EIA) Commercial Buildings Energy Consumption Survey[16] (CBECS) building. (See Figure 9.)

Energy Use Intensity (EUI)

EUI provides a standard measurement for the amount of energy that is used on a per square footage basis. This "energy intensity" changes with the number and kind of building users –or intensity of use. EUI is calculated by dividing the total energy consumed by a building in one year (measured in kBtu) by the total gross floor area of the building.

ZNE Market Characterization

While buildings are complicated and the design and construction industry is fragmented, there is ample evidence that ZNE buildings are positioned to expand in the marketplace. Success depends on market configuration and building up the value chain (e.g. training for designers and builders and making customized financial products available), as well as technology advancement. Key findings from reviewing current ZNE buildings and related research include:

16 The Commercial Buildings Energy Consumption Survey (CBECS) is a national sample survey that collects information on the stock of U.S. commercial buildings, including their energy-related building characteristics and energy usage data.

- ZNE buildings are technically feasible for nearly every building type (hospitals and high-rise buildings are more challenging).
- Current ZNE buildings include careful and comprehensive design/construction combined with some less common technologies (ground source heat pumps, ductless heat pumps, LED lighting, daylighting technologies, more efficient windows, radiant cooling and direct outdoor air systems, for example), all technologies that are currently available to the design and construction industry.[17]
- Cost is a complex issue for integrated building projects. However, a variety of ZNE buildings have been designed and built within normal cost parameters and the largest identifiable incremental cost – the PV system – has dropped dramatically in price over the last few years. Improved knowledge, training, and experience with ZNE building development has also been proven effective in reducing costs for developers.
- The Energy Commission is poised to approve a 2019 building standard under Title 24, Part 6 for residential building energy efficiency, which pushes new residential buildings to a high level of performance that is equivalent to ZNE-ready. The Energy Commission has developed a new rating called the Energy Design Rating (EDR) that provides a variety of approaches to reach this high level of performance including incorporating solar.
- The dominant building types that have achieved ZNE are educational, office and multifamily, but a wide variety of buildings have pursued ZNE status, including relatively high energy use buildings such as laboratories and health care.
- Zero energy systems have been applied to increasingly large and complicated buildings over the last few years. Now, more than one-third of commercial ZNE Buildings are over 50,000 square feet.

17 ARUP, "The Technical Feasibility of Zero Net Energy Buildings in California," for PG&E, December 2012.

RECOMMENDATIONS

Breakdown silos

It is essential that program silos be removed to allow for **more integration of design and construction activities with renewables, storage, and demand response**. More attention is required to ensure operational performance after construction and occupancy, which currently is a neglected area. Further, the IOUs need to become full partners – via programs, technical assistance, and account services - with property owners and local governments to evaluate and develop solutions that can maximize the benefit to the grid and the customer. Finally, it is essential that individual buildings can effectively and affordably procure offsite renewables.

California must address and remove policy barriers to innovate program approaches where possible. Currently, the IOUs are not allowed to use energy efficiency funds for renewables that are required to achieve ZNE. There are other substantial issues related to community solar programs, net energy metering, fuel switching (three prong test), rates and tariffs, and the need address unintended consequences of older policies.

Targeted and Enhanced Programs

Programs should focus on building and property-ownership types that are most able (and willing) to achieve ZNE before it is required by code to demonstrate the feasibility and business case for the approach. Further, programs should support multi-building ZNE districts to further reduce costs and improve grid integration. The following have been identified by stakeholders as promising initial targets and should be assessed to determine priorities for programs.

- Local Government Buildings and Campuses
- Educational and Institutional Campuses
- Multifamily/Mixed Use Mid-Rise
- Low-rise Office
- Small and Medium Commercial

Supportive Programs

Another critical area for program administrators (PAs) to lead is in the development of technical training and education for the industry. This must be complimented by community colleges and higher education degree programs. Overall, California needs focused ZNE training and education for market actors to improve the ability of the industry – architects, engineers, builders – to meet increased demand from owners. There should be a focus on integrated design and construction education to reduce project costs and take advantage of continuing technological innovation. Additionally, project managers, administrative staff and financial experts in both the government and the private sector need the capacity, skills, policies and financial tools to support all the pathways to ZNE.

Business Plans and Implementation Plans

In 2017, all PAs were required to submit ten year Business Plans identifying key strategies and programs to support the State goals and the CAEESP. These plans should be approved in 2018, triggering the need for the PAs to develop implementation plans for the actual programs[18]. Currently, the Business Plans do not reflect the goals and needs identified in the Framework. There is an opportunity to align these efforts in the development of the Implementation Plans moving forward, if so directed by the CPUC.

The PAs need to expand, improve, and redesign their programs so that incentives for renewable energy investments meet clear criteria, based on the value to the grid of location, storage, and control. In addition, it is critical that programs align and continue to incentivize the development of energy efficiency buildings that are high performing, easily controlled, and that can be used as a dynamic resource to the grid. New programs should also address:

- Promoting demand shifting and/or control within facilities to reduce loads. This could include measures such as thermal storage and off-peak water heating within buildings, which are currently lower cost than electricity storage.
- Incorporating advance energy controls at the building level and system level that work together to allow for cost-effective grid management.
- Encouraging tilting axis solar arrays to the generation profile throughout the day.
- Incorporating EV charging infrastructure as part of DERs to support workplace and public charging during peak generation hours.

18 The Plan's tactics are relevant regardless of the lead - IOU, REN, CCA, or third party - as long as it is understood the need to dedicate ratepayer funding to these efforts.

DRIVER 1. KEY TACTIC AREAS

Tactic	Lead	Partner
1.1 IOU, third party, and PA Commercial Buildings Programs and Alignment		
• Focus on deep efficiency and ZNE/ZNE-Ready as the objective of all new construction and major renovation programs. - Programs actively pursue and incentivize targeted building types to achieve ZNE. - Utilize a market transformation framework for ZNE incentives to reduce cost barriers over time. - Ensure that buildings served by the program are capable of complete grid integration. - Align energy efficiency program efforts with IDER, DER, and EV program efforts to expand the breadth of program services to meet customer needs.	IOUs	RENs/CCAs
• Provide technical assistance services to customers to support the integration of new technologies and design strategies.	IOUs	RENs
• Provide additional incentives and/or rate structures that recognize locational value of specific projects.	IOUs	CCAs
• Establish programs and funding for technical planning of ZNE projects. - Align with local government and institutional facility planning.	IOUs	RENs
• Leverage the implementation planning process to ensure there is alignment with Framework's goals and strategies, and proposed ZNE programs and budgets.	CPUC	PAs
1.2 Ongoing Building Performance Programs		
• Evaluate the potential and feasibility to pilot pay-for-performance programs in target sectors.	IOUs	
• Ensure that system and building level performance data are routinely captured and reported by advanced control systems and/or smart meters.	IOUs	Manufac-turers
• Create training and technical assistance programs for building operators and remote contractors to diagnose problems and maintain system and building performance levels.	IOUs	
• Establish incentive structures to reward property owners that maintain and enhance building energy performance. - Explore Pay-for-Performance programs for commercial ZNE projects.	IOUs	

Tactic	Lead	Partner
1.3 Pilot Programs • Develop pilot programs to support ZNE performance by demonstrating new approaches, including projects that incorporate multiple buildings. • Develop demonstrations of grid integration at the campus and community scale. (Connected to Driver 4) • Document and share lessons learned from pilot efforts to inform future market activity. • Develop programs that extend beyond energy efficiency and link to DERs, DRP, and other IOU efforts.	IOUs IOUs IOUs IOUs	EPIC CCAs/RENs RENs RENs/CCAs
1.4 Align PA Programs and Policies • Evaluate and actively address gaps and needs for aligning CPUC and CEC policy with innovative and necessary program approaches. • Establish new commercial program(s) for both new construction and major renovations that offer a single point-of-contact for a full set of services from planning through to occupancy and operation of the facilities. • Encourage and support coordination and partnerships between IOUs, RENs, and CCAs to establish innovative approaches to achieving goals. • Evaluate and pilot new tariffs and rate structures that incentivize ZNE projects.	CPUC PAs CPUC CPUC	RENs/IOUs/ LGP IOUs
1.5 ZNE Industry Training and Education • PA Programs, IOU Workforce Education and Training, and other private providers coordinate to offer a full spectrum of educational degrees, certificates and career training. • Provide targeted training for the full spectrum of commercial contractors (small, medium and large commercial contractors) on quality installation, commissioning, and advanced controls.	PAs/ WE&T	CCC/ WIBs

DRIVER 1. SUCCESS INDICATORS

- Program Administrator Implementation Plans support and align with Framework's goals and strategies.
- Percentage of total new commercial construction and major renovation projects (and square feet of projects) that are built to meet ZNE or ZNE-Ready increase annually.
- Program dollars dedicated and spent for ZNE and ZNE-Ready projects increase annually to support market growth.
- Buildings served by the program are designed and operated to control loads and generation to support and enhance grid operations, including onsite energy storage.
- Measure and reward energy performance after one year of occupancy that incorporates energy loads not regulated by building energy codes.
- Multi-building scale ZNE-scale programs and pilots are undertaken and documented.
- Industry and IOUs promote and support ZNE education for both new and existing construction throughout the state for architects, engineers, contractors and the building trades.

Existing ZNE IOU Programs

California Advance Homes Partnership

This is an IOU program that offers up to $7,000 in incentives for new residential construction in order to develop homes beyond code with high performance attics and walls. The program offers trainings and information for contractors about the best materials and building practices to get a new home beyond code. The program includes marketing and recruitment of builders, builder and rater training, design assistance, plan review, construction and verification services. The program also helps builders with early adoption of measures slated for the next code cycle.

Savings by Design

This is a program offered by all of the IOUs for commercial buildings. There are two approaches to the program. The Whole Building approach allows a design team to consider integrated energy efficiency solutions that balance electric and gas use, and may lead to buildings that offer greater comfort and reduced operating costs. Incentives are based on measures that increase the building's efficiency over the Title 24 building code by at least 10%, with incentives that go up to $.40 per kwH for projects that exceed Title 24 by 40%. There is also a "Systems Approach," which is a method of optimizing energy efficiency choices for less complex buildings. By considering building systems holistically rather than as a collection of components, the whole building approach encourages greater energy efficiency by designing "whole" building systems, rather than individual equipment or fixtures.

Zero Net Energy Schools Pilot

Proposition 39, the California Clean Energy Jobs Act of 2012, authorized $550 million a year to improve energy efficiency and increase the use of clean energy in public schools and community colleges. The IOUs are implementers of the program, and the CPUC oversees program activities.

Codes and Standards

Building and appliance Codes and Standards are a key tool to achieve ZNE for new buildings as well as building retrofits and additions. To achieve the state's ZNE goals, the IOUs provide assistance to the CEC to update the appliance and buildings codes. The IOUs also advocate for higher appliance, lighting and equipment efficiency levels at the federal level. In addition, the IOUs advocate for "Reach Standards" that encourage municipalities to go above the planned minimum statewide standards to get closer to ZNE.

Emerging Technologies Program (ETP)

ETP is focused on identifying and evaluating cost effective technologies and whole building approaches that can support ZNE new construction and retrofits. California ZNE goals are a primary driver of current ETP planning initiatives, with widgets filling identified market gaps and feeding into whole building ZNE approaches. Implementation takes the form of lab tests, demonstration projects, and accelerated commercialization projects, informing the adoption of energy efficiency measures into the IOU incentive portfolio.

Workforce, Education, and Training (WE&T)

CPUC's Energy Division oversees workforce education and training programs implemented by the investor-owned utilities. The WE&T programs' primary goal is to support the development of an energy workforce that is capable of meeting state energy goals, including Zero Net Energy objectives. The IOUs run energy training centers where energy professionals can take courses on ZNE technologies, policy, and practices. The WE&T programs seek to educate and train members of the workforce chain, from designers and architects to contractors in the building industry.

Driver 2. Improved Awareness & Informed Decisions

Information, tools, and resources improve awareness and assist owners and developers to make informed decisions about ZNE, procuring and implementing renewable energy systems, storage, controls, and DERs.

DESIRED OUTCOME

Owners and developers have a working understanding of what ZNE means to them, know what the options are to reach ZNE, and have the resources to make an informed decision for their project. Building developer investments align with carbon reduction and grid operation goals.

Driver 2. Overview

Informing and guiding the decision-making processes for property owners and developers can leverage billions of dollars to create the next generation of energy resources needed to power California's future. This includes new developments and developments with new and existing buildings. However, the complexity of ZNE projects and the dynamic nature of the regulatory, legislative, and market in general, make good decision-making difficult for the owners, developers, and other key actors. Issues related to grid optimization, energy pricing, storage options, cost tradeoffs, and conventional thinking about the benefits of solar on roofs is confusing to the most sophisticated property owner.

To enable the market to move forward, the CPUC, CEC, and program administrators must work together with other partners to educate property owners and the market about the options for grid-friendly ZNE. There must be simple to use and understand tools to help decision-makers pursue and develop projects that are right for the market, for the grid, and for carbon reduction goals.

Decision-Makers and Leadership

"The leadership role embraced by California goes to the heart of what has long been a central part of its identity. For more than three decades, California has been at the vanguard of environmental policy, passing ambitious, first-in-the-nation measures on pollution control and conservation that have often served as models for national and even international environmental law."[19]

The ultimate success of ZNE as a tool to address climate change and carbon emissions in California is heavily reliant on people: the owners who will demand and pay for ZNE; the planners, architects, and engineers who will design the project; builders ability to develop high performing buildings; occupant/facility

19 Coral Davenport and Adam Nagourney,"Fighting Trump on Climate, California Becomes a Global Force", New York Times, May 23, 2017.

manager behavior to make sure the building operates at ZNE levels; as well as leaders in local government agencies who can approve and facilitate ZNE developments. It is essential to the Framework's success to understand these various actors and their capabilities, and interest in adopting green buildings and ZNE projects.

Property Owners

Property owner demands are currently the primary driver for the development of ZNE and green building projects. In the interim before codes require ZNE, it is critical to understand owner perspectives as well as the industry that interacts with owners to develop projects.

A recent 2017 industry survey of 1500 facility and management leaders by Johnson Controls illustrates these trends. The report indicates that 54% of respondents are "**planning to achieve near zero, net zero or energy positive status for at least one building within the next 10 years**." Further 52% are likely to have one or more facilities operate off the grid and 48% plan to invest in storage. 71% of the respondents indicate that energy security and resilience is very or extremely important for their future energy investments.[20]

Dodge Data and Analytics report, "The Drive Toward Healthier Buildings 2016" details the drivers (Figure 14) for owners to develop heathier buildings, which aligns closely to the measures required for ZNE buildings, including enhanced air quality, thermal comfort, and better lighting. Energy performance is a major driver for 74% of owners, 79% of architects, and 60% of contractors. Operating costs are also a major driver for 85% of the owners. Only 68% of architects and 63% of builders thought that operating costs are important.

The report also indicates a strong correlation between interest in green projects and healthy buildings with 81% of respondents with high interest in green projects also influenced by health, compared to 59% with a low interest in green projects. Based on what owners consider

Figure 10. Factors Influencing Design and Construction Decisions

	Owners	Architects	Interior Designers	Contractors
MOST IMPORTANT (80% or More)	• Design and Construction Cost Savings (85%) • Operating Cost Savings (82%)	• Design and Construction Cost Savings (84%) • Aesthetics (81%)	• Aesthetics (92%) • **Occupant Health and Well-Being (83%)**	• Design and Construction Cost Savings (81%)
IMPORTANT (70% to 79%)	• Aesthetics (74%) • Building Energy Performance (74%)	• Building Energy Performance (79%) • **Occupant Health and Well-Being (74%)**	• Design and Construction Cost Savings (75%)	No items selected
MODERATELY IMPORTANT (60% to 69%)	• **Occupant Health and Well-Being (67%)** • Return on Investment (63%) • Tenant Demand (61%)	• Operating Cost Savings (68%)	No items selected	• Operating Cost Savings (63%) • Building Energy Performance (60%)
LESS IMPORTANT (50% to 59%)	No items selected	• Materials Resource Conservation (51%) • Water Conservation (50%)	• Building Energy Performance (54%) • Operating Cost Savings (54%)	• **Occupant Health and Well-Being (51%)** • Aesthetics (51%)

Source: Dodge Data and Analytics, "The Drive Toward Healthier Building 2016"

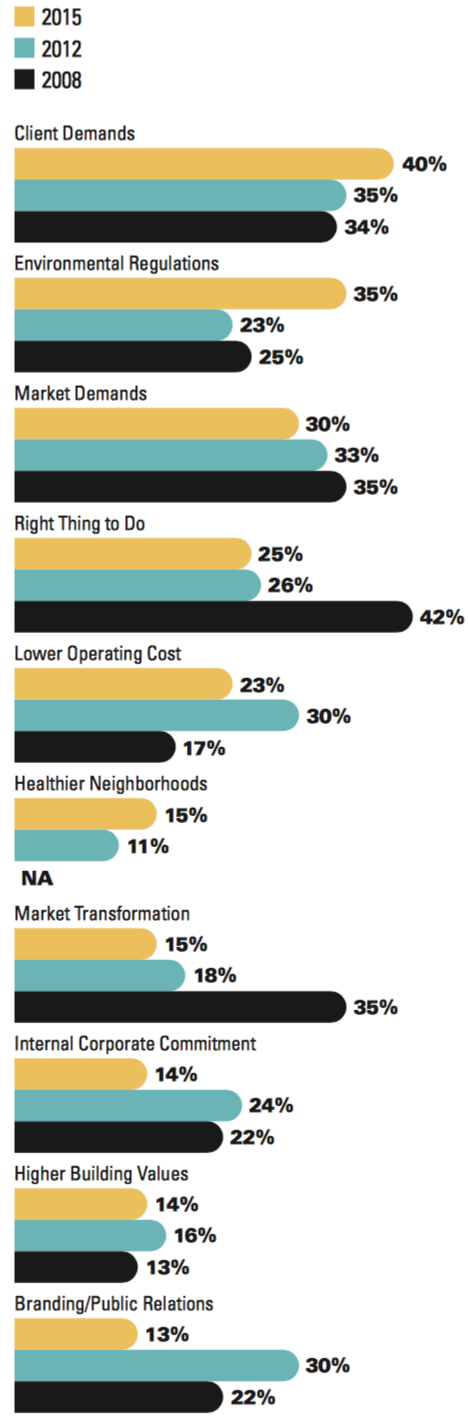
20 Johnson Controls 2017 Indicator Survey, http://www.johnson-controls.com/media-center/news.

healthy features – indoor lighting, thermal comfort and enhanced ventilation - this is not surprising.

Dodge Data and Analytics 2017 Construction Index is a regularly updated survey of approximately 2,700 contractors and design-builders used to gauge the market place, including the perceptions and demands of owners. In this report, some of the trends[21] identified in the Johnson Control survey are supported, while there are some indicators that are less encouraging:

- 63% of government projects, and nearly 50% of education and healthcare projects require skills in green building indicating a positive trend.
- 48% of large companies' owners request energy efficient products, while just 7% of small companies do. This divide is consistent with other data that illustrates that larger projects and companies are more likely to be able to and interested in implementing environmental-oriented projects. This is a problem when combined with the numbers of small commercial buildings and companies in California that need to achieve ZNE.
- 60% of survey respondents in the west are concerned about having skilled labor to complete their work. ZNE and similarly high performing buildings require a higher level of skills and training than traditional buildings. Creating a robust and supportive trades and building industry is fundamental to achieving ZNE goals.
- 79% of respondents are doing some green (or environmentally friendly) projects but only 30% of their total projects are actual considered green (or certified as such). The difference illustrates what people say they

Figure 11. Triggers Driving Future Green Building Activity by Year



Source: Dodge Data and Analytics, "World Green Building Trends 2016"

21 USG + U.S. Chamber of Commerce, Dodge Data and Analytics, "Q2 2017 Commercial Construction Index", 2017.

are doing and what is actually being implemented. While interest alone is not going to make difference in current buildings, it does offer an opportunity to catalyze those who are doing some things.

- The Dodge World Green Building Report provides a similar analysis based on global trends. The top three reasons for owners to invest and develop green projects are: owner demands, environmental regulations and market demand. Corporate commitment, higher building values and public relations score very low as influencers.[22]

RECOMMENDATIONS

The investment by corporations and communities (and their third-party partners) in renewable energy needs to incorporate additional DER technologies and resources that result in a high level of grid friendliness. Given that the movement is new, **market education** is essential so that local government, corporations, and communities understand how to optimize their investment from a grid perspective, while considering other benefits, such as resilience, equity, or economic benefits.

There are several aspects to assisting with this decision-making:

- Building awareness of what ZNE means, understanding of benefits ZNE, and increasing information availability about grid-friendly project development. This will need to happen through various channels including leveraging Energy Upgrade California marketing, and other communications related to renewables, solar, and DERs.
- Inspiring and rewarding early adopters with targeted outreach and recognition programs to help encourage the development of ZNE projects.

22 Dodge Data & Analytics, "World Green Building Trends 2016", 2016, page 14.

Corporate Commitment

Commercial building owners typically control multi-building portfolios and are the critical decision makers in committing to a pathway that targets ZNE performance in both new construction and renovation. The range of ownership includes diverse categories of buildings such as school districts, municipal governments, retail chains, and commercial real estate developers and owners/ managers. Owners can apply lessons learned in early ZNE projects to similar buildings in the future, finding ways to reduce costs and support improved performance. Leadership in the many categories of commercial building ownership is an essential

- Enhancing and increasing the availability of effective decision-making tools that relate to the needs and interests of property owners and aligns with State goals.
- Addressing the unique needs and challenges of specific owner and developer types such as owner-occupied, merchant developer, etc.

DRIVER 2. KEY TACTIC AREAS

Tactic	Lead	Partner
2.1 Overall Awareness of Benefits of ZNE Projects		
• Launch a grid-friendly ZNE Marketing Campaign (potentially as part of Energy Upgrade California) that establishes ZNE as part of California's carbon reduction and grid modernization efforts.	IOUs	CPUC/CEC
• Increase building owner/developers' awareness of the options to achieve ZNE and grid integration, supporting customer choice and their objectives and needs.		
- Provide information about ZNE benefits from property owner and business perspective. - Provide information about financial and structural/operational options that support incorporation of grid-friendly ZNE within development plans. - Develop and promote specific case studies that represent best practices within the owner communities. - Educate the development community on the integration of distributed energy resources and related financing options for larger scale planning and development.	IOUs/ RENS	Local Gov't
• Enhance quantified value of ZNE buildings and projects with Real Estate Brokers, Appraisers, and Financial Markets to ensure appropriate valuation and funding, etc.		
2.2 Leadership and Commitment Campaigns		
• Outreach to property owners (including key accounts) at the community, corporate, and campus levels to support incorporation of district-scale integration of renewables, storage and grid integration/ resilience.	EPIC/ IOUs	RENs/CCAs
• Develop ZNE commitment campaigns targeted to corporate leaders. - Institutional, corporate, and commercial real estate. - ZNE higher education (including community colleges) campuses and communities. - Expand K-12 recognition and commitment efforts.	EPIC/ IOUs	RENs/CCAs
• Support and recognize leadership within commercial building professions, planning, and implementation.	TBD	

<table>
<tr><th>Tactic</th><th>Lead</th><th>Partner</th></tr>
<tr><td>2.3 Decision-Making Tools
• Work with stakeholders, developers, and pilot programs to establish a diverse and robust set of business models and governance approaches for more complex ZNE projects.
- Provide proof-of-concept and business case information.
- Provide economic analysis of utility incentives and rate benefits based on locational value.
- Engage the financial community to better understand costs, value and benefits.
- Provide data that can support the improved valuation of low-carbon buildings.</td><td>TBD</td><td>Advocacy Groups</td></tr>
<tr><td>• Create and launch a ZNE discussion/decision-making tool to help facilitate informed decision-making and awareness of key issues and benefits.</td><td>CPUC</td><td></td></tr>
<tr><td>• Support the development and deployment of high-level modeling and visualization tools to help communities make informed decisions at a larger than building scale.</td><td>EPIC/ ET</td><td></td></tr>
</table>

DRIVER 2. SUCCESS INDICATORS

- Increase market awareness and demand for ZNE projects as measured by statewide surveys of owners and developers.
- Annual increase in projects that utilize renewable energy to meet all energy requirements as part of their overall development strategy.
- A commitment campaign is launched, including communications development, media strategy, and key partners.
- Increased commitments to ZNE or 100% renewables at the community, corporate, and campus levels.
- Technology tools are customized for the California market and provide insights into the best approach to ZNE in line with customer needs, value to the grid, and policy goals.
- There is ongoing ratepayer funding and support for library of resources that provide best practices, case studies, and governance/ financial models for ZNE projects at all scales.

Driver 3. Local Government Capacity & Readiness to Implement

Local governments have the capacity and capability to support and implement ZNE development and projects.

DESIRED OUTCOME

The foundation for implementing ZNE at a building and district-scale is broadly established with local governments, including policy development, long-term and short-term planning, development entitlement process, and in demonstrating ZNE in municipal buildings.

Driver 3. Overview

Local governments are integrated to achieve the State's aggressive climate goals. Local governments need to be supported, encouraged, and recognized as leaders in enabling innovation and pursuing ZNE projects. Maximizing the potential of local governments includes leveraging RENs, CCAs, state, and regional government efforts.

Role of Local Government

Government regulations are second to owner demands in driving green building and ZNE development and as such is an essential player in reaching ZNE goals. (Figure 15) In addition, local governments oversee land use planning through the development of land use policies in general plans and specific plans. These policies in turn set the stage for how new buildings and district or community projects can be developed. The following are some of the primary ways local governments will impact and direct the market.

Climate Action and Resilience Planning

Based on AB 32/SB 32, local governments have developed local climate action plans for most of the jurisdictions in California. Over forty counties have developed Local Hazard Mitigation Plans following FEMA and California Office of Emergency Services guidelines that help to mitigate against disasters and build community resilience. Many of these plans will be updated in the coming years. This provides an opportunity to integrate ZNE goals and multiple approaches to energy related carbon emission reduction and ZNE into the plans.

Land Use Planning

Land use planners are one of the most important actors not actively involved in green building or ZNE currently. Typically, planners are in charge of long-term development of a city/town through a General Plan or Specific Plan (smaller area than the city), setting zoning rules, developing urban design guidelines and transportation networks, and dictating the mix and

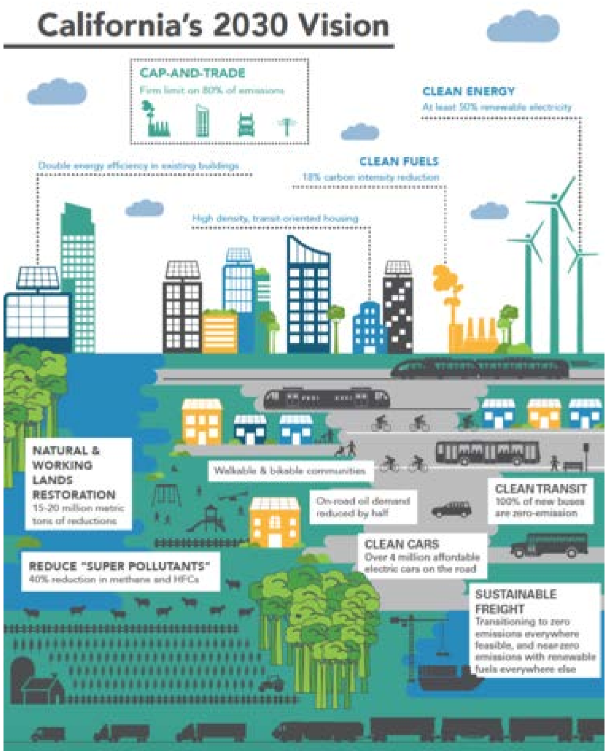


Photo: Vision from California Air Resources Board

location of building types and uses. Planners rarely consider energy or the potential for renewables in these Plans (the State Office of Planning and Research (OPR) tracks the various elements in general plans and has identified approximately 11 California jurisdictions – city and counties - with some level of energy element – mostly dedicated to energy efficiency for buildings). The lack of engagement makes it difficult to consider and integrate infrastructure improvements, from sewer and water to transportation networks, that may facilitate the development of a distributed energy resource network. There is an opportunity to incorporate guidelines for energy and DER within the State of California's General Plan and Specific Plan Guidance through the Office of Research and Planning.

Local Government ZNE Reach Codes, Policies and Initiatives

The CAEESP goals combined with State legislative goals (SB 350, AB 758, AB 1103 et al), AB32/SB32 and local climate action planning is spurring local governments to adopt policies, and develop programs and initiatives to push their buildings and residents to reduce carbon emissions in a number of ways. These policies include aggressive energy efficiency, solar PV, and/or ZNE initiatives in line with their community development priorities and climate action plan (CAP) goals. Notable highlights of broad ZNE progress in local government efforts include:

- The City of Lancaster has reached 80% of its Phase I goal of generating the city's peak load of 215 MW via renewable sources in a utility-scale solar project.
- The City of Santa Monica has adopted the first full ZNE reach code ordinance based on 2016 Title 24, Part 6 standards. The cities of Palo Alto, Chula Vista, San Mateo, Fremont, and the County of Santa Barbara have solar requirements/ZNE residential reach codes for new construction.
- The cities of Hayward, San Diego, and the County of Santa Barbara have adopted solar requirement for municipal buildings.

Many local governments are implementing streamlined permitting and related policies to encourage the use of alternative renewable energy, particularly solar installations.

RECOMMENDATIONS

Policies

Enabling policies, particularly around land use planning, governance, and zoning, should be adopted to smooth the path to ZNE at a community-level and allow for more innovation and success in pursuing ZNE projects. Policies must allow for more dynamic and layered approaches to projects, and accommodate and support the economies of scale possible at the district level.

Governance

There is a need to identify and establish governance mechanisms for implementing ZNE at the building and district-scales. Currently, there are barriers for how owners can share energy resources from community-scale renewables. Creating new approaches to governance and enabling new organizations to own and manage their energy is essential. For example, business improvement districts who already collect taxes may be allowed to establish energy districts to streamline ZNE project adoption.

CCAs and RENs

ZNE implementation, at either the building or district-scale, is complex. The industry and market may not have the appetite to take on new projects if they determine the risk or challenge is too high. Equally, IOUs may not be well suited to assist with projects that are in planning stages or that require long-term engagement. RENs as extensions of local government, are important leads and allies for local government initiated projects, including planning for ZNE municipal buildings and large-scale developments. CCAs can play a role in becoming a local government clean energy provider, and governance body for a large project.

ZNE Municipal Buildings

Local governments can significantly support and accelerate adoption of ZNE projects by modeling best practices and commitment in their own buildings and facilities. Municipal facilities, particularly those that are public are important visual and actual models for the community. Utilizing resources from CCAs and RENs as well as IOU programs, cities can demonstrate the benefits, challenges and opportunities in achieving ZNE by showcasing new and existing building remodels that are designed to be ZNE.

DRIVER 3. KEY TACTIC AREAS

Tactic	Lead	Partner
3.1 Local Government Enabling Policies		
• Develop model policy guidance for local governments. - ZNE Commercial Building Policies. - 100% Renewables Policies. - Support development of Reach Codes.	RENs	IOUs, CEC/ Advocacy Groups
• Work with the Governor's Office of Planning and Research (OPR) to incorporate guidance and language on general plans and specific plans for local governments.	OPR	
• Local Governments work with Appraisers, Real Estate Brokers to develop local polices that establish and value ZNE projects appropriately.	RENs	Advocacy Groups
• Coordinate and facilitate the ability of local governments to establish locational value of ZNE projects.	RENs	
3.2 Local Government Education		
• Provide supportive ZNE education, training, and technical assistance to local governments. - Provide tools, education, and training for local government planning (e.g., general plans, specific plan, urban design, zoning, climate action plans) to address renewables siting, energy storage, demand variables, EV infrastructure, financing, and grid integration. - Provide education and assistance for establishing local government policies and programs that support ZNE, renewable energy development and deep efficiency including zoning and benchmarking tools.	RENs	IOUs, Advocacy groups
3.3 ZNE Model Municipal Buildings		
• Encourage the provision of incentives, technical assistance, and programs that support cities in the development of ZNE projects for new and existing municipal facilities.	CPUC	RENs/IOUs
• Provide cities tools and assistance to integrate advance building energy controls into existing and new municipal buildings to help move towards ZNE performance.	CPUC	RENs/IOUs
• Establish programs to enable local governments to install community scale solar and renewable systems with batteries to achieve ZNE for municipal campuses.	CPUC	IOUs/CCAs

Tactic	Lead	Partner
3.4 State Enabling Actions • Conduct a policy/legislation needs assessment to identify gaps, conflicts, and approaches to support ZNE projects and districts. - Support development of legislation or policies that remove barriers, provide adequate market signals and addresses issues such as NEM, and sharing loads among multiple buildings. - Update and improve community solar and community storage policies to enable ZNE District programs. • Continue to support, fund, and direct RENs and CCA's to support grid-friendly ZNE at the regional and local level. • Consider the potential to develop tax credits or other tax incentives for property owners and developers to develop ZNE projects.	CPUC CPUC Legist.	CEC/ Governor's Office

DRIVER 3. SUCCESS INDICATORS

- Local governments adopt ZNE commercial building policies in advance of 2030 to support and provide a foundation for future state energy codes.
- Local government land use planning, zoning, and building departments understand and support ZNE design and development needs.
- State, regional and local policy forums consider ZNE goals and discuss related policies and programs.
- The CPUC works with key stakeholders to identify and address barriers to grid-friendly ZNE development at the local level, for example, sharing renewable resources and improving resiliency benefits of local projects.
- The State Office of Planning and Research (OPR) provides guidelines and supports the development of ZNE districts in Specific Plan and General Plan guidelines by 2019.
- CCAs and RENs are supported and leveraged as channels to support to local government efforts and utility efforts.

Driver 4. Integrated District ZNE and DER

Developers, local governments, and large corporate and institutional energy users build grid-integrated, district-scale energy systems that leverage land use planning, aggregated financing, and community infrastructure development initiatives.

DESIRED OUTCOME

ZNE levels of performance are achieved through community-scale DER systems, providing flexibility and viability to support ZNE for a broad range of building types and configurations while improving resilience and reducing grid requirements for centralized generation and distribution upgrades.

Driver 4 Overview

New infrastructure, such as district-scale renewable energy and storage projects, can serve multiple buildings including existing buildings while forming the basis for enhanced grid interaction and resilience. Campus and district-scale projects can take advantage of a variety of ownership and financing mechanisms, which may reduce first costs and long-term costs.

Districts, Campuses & Portfolios

ZNE project development, especially at the district-scale, is relatively new and there are not a lot of examples or best practices to build upon. However, there is a growing body of projects and pilots that are exploring and establishing new approaches to achieve ZNE. The following are a sample of some of those efforts that shape and inspire this new Driver.

District-Scale Advanced Energy Communities and ZNE Districts

Adopting community-scale or district efforts for renewable energy and storage is becoming an attractive and a more economically viable approach than building by building. District-scale ZNE efforts have the ability to address and encompass existing buildings in a district by sharing renewable energy, storage, enhanced controls and other elements, enabling a more sustainable approach to development. Establishing fully functioning and integrated ZNE districts is a relatively new concept with most projects still in the conceptual and planning phases. Nationally, there are three notable district initiatives: EcoDistricts, Department of Energy District Accelerator Program, and Architecture 2030 Districts. In California, districts approaches are using the national initiatives as well as being funded by the CEC's EPIC program.

Photo Courtesy NBI: Bishop O'Dowd High School, Oakland, California

Microgrids

A microgrid is a small energy system capable of balancing captive supply and demand resources to maintain stable service within a defined boundary. They combine local energy assets, resources and technologies into a system that is designed to satisfy the host's requirements like basic electrification and balancing variable DER's into an integrated ZNE system.[23] Like Districts, there are not a large number of mainstream examples of non-military or commercial-oriented microgrids, but they are growing in number and breadth.

University and College ZNE Initiatives

Universities and colleges are also reducing their carbon footprints using ZNE initiatives. The University of California has committed to become carbon neutral by 2025 through their "Carbon Neutrality Initiative". The California State University (CSU) system has also been working towards energy efficiency and ZNE by incorporating a mix of sustainability measures throughout the universities. Currently, 23% of the systems electric power is from renewable sources. For example, CSU Long Beach installed 4.5 MW of solar. This is the largest PV installation in the CSU system and it powers one-third of the CSU's campus during peak demand. There are plans to reach carbon neutrality by 2030.

K-12 Schools and Community Colleges

Beginning in 2013, Proposition 39 has allocated over $1.3 billion dollars to fund clean energy jobs and support reduction of energy use and costs for schools. (K-12 and Community Colleges) The funding has resulted in over a thousand projects and $8 billion in energy savings for the schools.[24]

Over $165 million in funding has been provided for community college projects statewide

23 microgridinstitute.org, 11/7/2017, www.microgridinstitute.org/about-microgrids.html.

24 http://www.energy.ca.gov/efficiency/proposition39/index.html

including energy efficiency and solar arrays.[25] The Pasadena Community College District and the Peralta Community College District are two examples of community colleges interested in developing Zero Net Energy campuses and districts. The potential impact of reaching zero net energy in all of the state higher educational institutions is substantial from an energy savings perspective but also in the opportunity to lower operating costs and reallocate those funds for education programs. Further, these intuitions can become learning labs to establish the careers and talent needed in California to build and support a clean energy economy.

The IOUs managed a ZNE K-12 School Pilot Program and ZNE Existing Buildings Retrofit Program using funding from Proposition 39. Over 4,000 school sites have benefited from the funding to add solar panels, improve energy efficiency and develop ZNE projects. Oakland Unified School District and San Diego School District have recently been recognized as early leaders with their commitment to ZNE.

Grid Optimal Buildings within a District

With the increased advancement of the overall energy system and integration of DERs, it is essential not to underestimate the importance of constructing buildings at the highest level of energy efficiency and performance possible. Buildings must be designed (and renovated) to effectively "plug and play" into the future advanced system (whatever that may be moving forward) and respond to the needs of the grid seamlessly. NBI has begun a new initiative called "GridOptimal Buildings", which captures the essence of this concept and the idea of a building as a good citizen.

"It is illuminating to consider the impacts of individual buildings on the grid through the lens of a building's "grid citizenship." A good grid citizen is a building that contributes to, rather than detracts from, the reliable, safe, and affordable operation of a clean electric grid. For instance, a good grid citizen building may be carefully designed and operated in a way that minimizes its power demand during the grid's peak hours while maintaining energy-efficient operation throughout the year. Some features that may enhance a building's grid citizenship characteristics and capabilities are passive HVAC and lighting systems, energy storage systems, renewable energy generation management, and peak load management."[26]

To further enable individual buildings to be part of the solution and a contributor to a grid-friendly ecology, effective mechanisms for procuring offsite renewables must be identified and secured. A 2018 report by Charles Eley and Architecture 2030 explores a range of options that include self-owned offsite systems, community solar, virtual PPAs, green tariffs, and green energy investment funds.

25 California Community Colleges Chancellor's Office, 11/27/17, http://extranet.cccco.edu/Divisions/FinanceFacilities/Proposition39.aspx.

26 https://newbuildings.org/wp-content/uploads/2017/06/NBI-USGBC-GridOptimal-Factsheet-FINAL-042717.pdf

Financial Market

"In 2016, green bonds became a significant and growing component of the overall bond market, with $93 billion in new bonds issued. Investor interest in these bonds has been driven by a growing pool of investors looking for low-risk instruments that meet environmental and social criteria."[27]

Developing a robust and active market that supports ZNE projects, particularly larger district ZNE projects, requires a financial and investment market that considers the projects good investments and good business. The Plan's market analysis indicates that environmentally oriented projects are building strength in the market and that there is an opportunity to leverage this activity. Perhaps the most important indicator is the announcement by Moody's Investor Services threatening to downgrade the bond ratings of communities that are not activity addressing the impacts of climate change. Moody's announcement provides a strong incentive for cities and local governments to aggressively plan and implement projects that will protect them from climate change and add to resilience, including ZNE projects.

Access to "green financing" and green investing is growing substantially. Rising interest in sustainability and climate change is driving the capital market to develop new financial products that are designed for socially and environmentally minded investors and developments. In 2013, $11 billion[28] in green bonds were issued in the United States. This market is expected to grow to $200 billion in 2018.[29]

27 PwC and Urban Land Institute, "Emerging Trends in Real Estate® 2018," Washington, DC, 2017.

28 climatebonds.net, 10/29/2017, (https://www.climatebonds.net/market/explaining-green-bonds)

29 PwC and Urban Land Institute, "Emerging Trends in Real Estate® 2018," Washington, DC, 2017, page 35.

Financial Terms

Green Bond

"A green bond is a debt security that is issued to raise capital specifically to support climate related or environmental projects." - World Bank

These bonds follow agreed upon principles called the Green Bond Principles (GBP) to identify eligible projects, which include:

- Renewable energy
- Energy efficiency
- Sustainable waste management
- Sustainable land use
- Clean transportation
- Sustainable water management (including clean and/or drinking water)
- Climate change adaptation

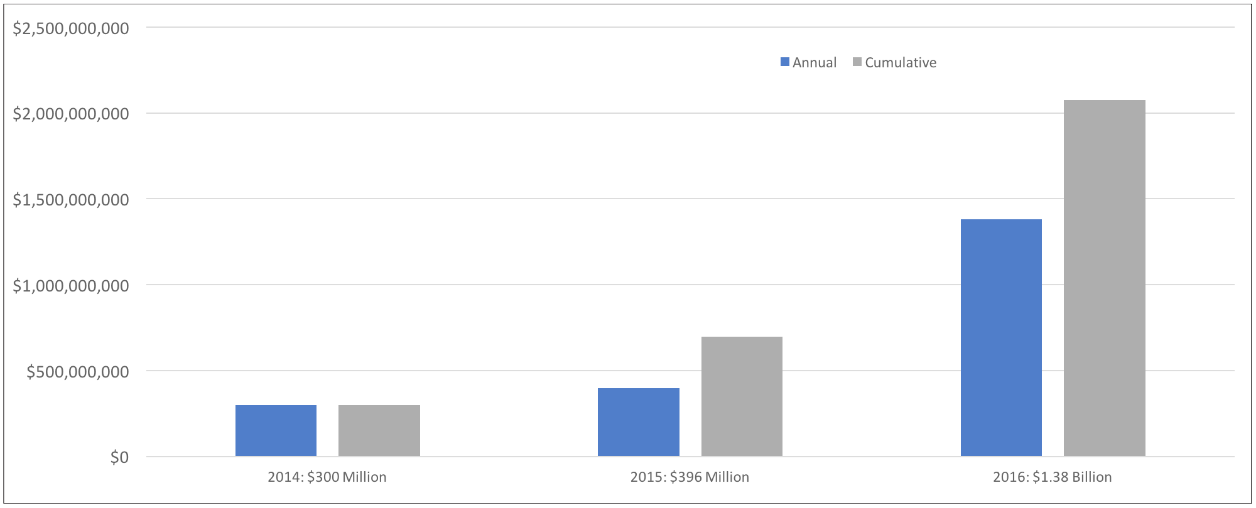
Triple Bottom Line

"Triple bottom line (TBL) is a concept which seeks to broaden the focus on the financial bottom line by businesses to include social and environmental responsibilities. A triple bottom line measures a company's degree of social responsibility, its economic value, and its environmental impact." Investopedia

Socially Responsible Investments (SRI)

"An investment that is considered socially responsible because of the nature of the business the company conducts. Common themes for socially responsible investments include ... seeking out companies engaged in ... environmental sustainability and alternative energy/clean technology efforts. Socially responsible investments can be made in individual companies or through a socially conscious mutual fund or exchange-traded fund (ETF)." Investopedia

Figure 11. California Green Muni Bond Issuances: Annual and Cumulative



Source: CalGreen Finance, "California Green Muni Bonds"

In Q3 2014 the State of California issued its first green bond. By 2016, agencies in the state issued over $1.38 billion in labeled green bonds, growing over a $1 billion (Figure 16)[30]. At the end of 2017, California had issued $5.03 billion in green bonds, more than any state in the nation.[31]Another growth area is in Socially Responsible Investments (SRI) which equaled $8.7 trillion in the United States in 2016. These activities are fueled by investors looking for triple-bottom line investments in industries that face risks due to climate change and who are addressing these risks accordingly[32]. From 2012 to 2014, the number of U.S. investment funds incorporating environmental, social and corporate governance (ESG) criteria jumped 28%, and their assets more than quadrupled, to **$4.3 trillion.**[33]

In California, a relatively underused financing mechanism called the Enhanced Infrastructure Financing District (EIFD) defined in SB 638/ AB 313, allows infrastructure improvements, including renewables and energy efficiency, through a tax increment financing mechanism at the district or neighborhood level. The legislation emphasizes projects that support sustainable community goals, energy efficiency, and reducing the carbon footprint of California's economy.

Taken together, these financial market trends reduce the potential risks and offer an opportunity to build on investment interest and assist forward thinking local governments and developers to build ZNE projects.

30 calgreenfinance.com, 10/29/2017; (http://www.calgreenfinance.com/2017/01/california-green-muni-bonds-top-13.html)

31 Whiley, Andrew, "California Municipal Green Bond Issuance Passes $5 Billion: New US Green Finance Record", Climate Bonds Initiative, Nov. 30, 2017.

32 PwC and Urban Land Institute, "Emerging Trends in Real Estate® 2018," Washington, DC, 2017, page 35.

33 Davidson, Alex, "A Guide to Sustainable Investing", Wall Street Journal, Nov. 8, 2015.

RECOMMENDATIONS

District-Scale Programs & Pilots

Program support for ZNE districts is a new activity that requires organizational development, program development, and a pilot phase before 2030 to fully develop community potential and skills. Public-private partnership may be a critical organizational element, but a variety of other arrangements are possible. Districts may encompass residential, commercial, and/or institutional buildings.

Incorporating storage in district-scale projects can provide options to improve demand management and grid interaction while also enhancing grid resilience during major disruptive events such as earthquakes, fires, flooding, and cyber-attacks. Community-scale ZNE provides additional flexibility and scale that can substantially increase the number of buildings that achieve ZNE. More holistic community planning that can incorporate improved infrastructure and integrate water, waste, and transportation outcomes provides multiple benefits and broadens opportunities to build coalitions, financing, and development options.

District Finance

Financing for simpler individual buildings is typically well established. For district-scale projects, local governments can use a variety of taxation and financial strategies to achieve goals, including enabling special taxation districts. Areas that need additional attention and options include financing for deep efficiency retrofits for major renovation existing buildings and the development and/or demonstration of financing products and strategies for larger, more complex projects, including public-private partnerships and public-public partnerships (local government and state government). DGS is an important partner especially when there are adjacent projects that can benefit from economies of scale.

DRIVER 4. KEY TACTIC AREAS

Tactic	Lead	Partner
4.1 Coordination of District-Scale Planning		
• Coordinate a working group including the CPUC, CEC, CASIO, CCAs, RENS and local government organizations focused on district-scale projects with local community involvement.	CEC	CPUC/ CARB
• Evaluate and document lessons learned from current District projects.	CEC	CPUC
• Develop a clear statement of needs, objectives and strategies to support district efforts.	CPUC	CEC
• Create initial guidance to better support district-scale projects to accomplish carbon reduction and grid stability goals while also providing multiple other community services.	CPUC	CEC
4.2 District-level Planning and Financial Support		
• Ensure that utility planning coordinates with district-scale projects to enhance grid utilization, stability, and resilience.	CPUC	IOUs
• Demonstrate the specific benefits of locational value for community-scale projects to the grid by offering incentives to reduce grid constraints.	IOUs	CPUC
• Identify funding from EPIC and other state and local resources to help fund pilot and demonstration programs.	CEC	EPIC
• Develop DER/ZNE pilot and demonstration programs. - Establish a portfolio of options to finance district-scale projects. - DGS public-public partnerships. - Expansion and support for enhanced infrastructure finance districts (EIFD).	IOUs	
• Explore and develop existing building financing mechanisms that benefits from district-scale renewables and energy systems.	State/ CPUC	
• Quantify the value of ZNE projects for real estate brokers, appraisers, and financial markets.		
4.3 Align IOU and PA and District Efforts		
• Ensure that pilot utility DER programs align and support district-scale goals such as resiliency and local economic development.	IOUs	RENs/CCAs
• Align utility grid planning so that it interacts with larger building projects and district-scale projects.	IOUs	
• Facilitate integrated grid management to accommodate new and infill projects.	IOUs	
• Enable CCAs and RENs to facilitate, partner, and support ZNE/DER projects in partnership with the IOUs.	CPUC	

DRIVER 4. SUCCESS INDICATORS

- Establishment of initial ZNE districts guidance, support and incentives for pilot programs by January 2019.
- Establishment of the value of integrated distributed resource to the grid.
- Increased annual growth in ZNE districts with integrated storage.
- Demand load curves are flattened and better managed in areas with ZNE districts and buildings.
- ZNE districts become a central strategy in local resilience and economic development planning.
- Distributed Resource Plans (DRP) utilize ZNE districts as a tool for meeting goals.
- Development of enhanced ZNE district support resources.
- There are a variety of accessible financing and funding tools and resources for ZNE projects.
- A mechanism exists to fund and incentivize deep energy retrofits or renovation of existing buildings that can include ZNE level of performance.
- Public-Private Partnerships and other innovative strategies are used to support large infrastructure projects.

Driver 5. Targeted Research & Development

IOU Emerging Technology Programs and the CEC's EPIC Program support the development and demonstration of enhanced and integrated technologies for ZNE at both the building and district levels.

DESIRED OUTCOME

The CPUC, CEC, and IOUs commit a percentage of research, development and demonstration program funding to advance ZNE building and district energy performance, and enhanced integration of distributed energy resources into the grid.

Driver 5. Overview

For ZNE projects to be routine, cost-effective, and successful models for carbon reduction, technology needs to continue to advance to establish scalable solutions for all types of buildings, projects, and climate zones. Research and development of enhanced technologies, practical applications, and expanded knowledge of building professionals are core components of making the transition to routine practice and ultimately to building codes and standards.

Advancement of Technologies

The advancement of building and system controls, technology advancements in solar thermal, solar glazing, building integrated PV, wind power, and other DERs are going to continue to propel the market forward and make ZNE buildings and projects more feasible, cost-effective, and attractive to the broader market. In addition to these more well-known technologies, advances in bioenergy, geothermal, and hydrogen and hydrogen fuel cells are providing more options and approaches that can be effectively deployed in a wider range of projects.

Some HVAC technologies used (such as ground source heat pumps, energy recovery ventilation and natural ventilation) have been part of high performance buildings for a decade, while others, such as ductless heat pumps, are expanding into the U.S. market from a strong international base. For some technologies, the costs or the additional complexity are the major barriers to more wide-spread utilization. Some advanced HVAC technologies are not well defined in common modeling applications, which can make them difficult to include in efficiency programs.

Lighting is improving with more efficient lamp technologies, better controls and better lighting design, at both the luminaire and space level, all contributing to higher levels of efficiency that can be 50% better than standard lighting applications. Daylighting strategies are part of most ZNE buildings, which impacts fenestration design, glazing selection and luminaire selection

and controls. Again, costs and complexity are major issues restricting broader adoption, and the interface between occupants and lighting is a significant consideration. Luminaire-level controls that permit both occupant and centralized controls have shown great potential, as have simple task–ambient solutions.

System-level monitoring, diagnostics, and information dashboards are frequently part of ZNE construction for both commercial and residential projects. These systems may become more important as plug loads continue to increase (with entertainment and computer technologies) and become a major challenge in meeting ZNE performance levels. ZNE buildings include a level of detail associated with plug loads that is a significant change from conventional design and operations, and changes almost constantly.

Electric car charging stations are being integrated into ZNE projects, requiring larger PV systems to offset use. This technology, paired with storage and the related controls, are currently in use but are evolving and improving quickly. Electric charging in the non-residential sector is more complex and is typically not linked to building energy. As we evaluate District approaches, this integration is essential.

Many of the ZNE challenges will come from defining best practices for a wide variety of building types and applications and working with the developers, designers, manufacturers, suppliers and others to reduce costs and complexities as one way to increase scale. Additional challenges will come from some of the changing dynamics around utility infrastructure (distributed generation and storage) and developing solution sets for existing buildings and multi-tenanted buildings, both of which add additional layers of complexity.

Recommendations

Research and development need to include the costs, values, and benefits of different approaches to ZNE including expanding the knowledge about how energy storage can be most effectively integrated and how deploying technologies behind the meter or on the grid side will impact costs, grid integration, and project success. In addition, a substantial amount of research needs to be conducted to better understand the tradeoffs, benefits and challenges with moving to zero emission buildings and how incentivizing zero emissions rather than just zero energy impacts costs, grid integration, and the market.

Occupant Behavior

Additional research is needed to improve the occupant interface and support whole building performance and behavior over time. This may include building controls as well as more intuitive building design and operations that allow tenants and occupants to be “mindless” about the technical advancements and requirements in the building.

Community- and District- Scale

At the community level, there is a need for research to improve support for planning when integrating multiple buildings into district projects, as well as better planning tools to support grid integration. Critical categories of research and development include complete grid integration of distributed renewables and storage, and better tools for planning and demonstrating the value of distributed resources.

Partnerships

Several players are currently engaged in advancing research and development for ZNE in buildings and should be integrated into this effort. At the national level, the U.S. Department of Energy funds partner with the Building America program to demonstrate new technologies for low-energy buildings in a cost-effective manner. And the DOE Building Technology Office recently spearheaded an effort to define ZNE for commercial buildings, in an effort to bring market players in alignment with low-energy goals. In California, the Emerging Technologies Coordinating Council (ETCC), a group representing the IOUs, Energy Commission and CPUC, share R&D efforts in advancing new energy-efficient technologies for the building sector.

DRIVER 5. KEY TACTIC AREAS

Tactic	Lead	Partner
5.1 Building Performance • Conduct research and development of building-related systems including advanced controls systems, passive system approaches and storage integration to better control demand. - Support improved efficiency in appliances/plug loads. - Research mechanisms to provide feedback on building performance and maintain building performance over time. - Support development of innovative products and technologies that reduce costs, and implementation barriers. - Focus on new and cost-effective ways to upgrade and improve energy efficiency and ability of existing buildings to achieve ZNE performance levels. • Develop Research paths to evaluate and compare zero emissions verses zero energy approaches and the associated benefits and challenges.	IOU ET/ CEC/ EPIC EPIC/ET	Manufact.
5.2. Planning and Modeling Tools • Improve land use and energy planning and modeling tools for grid integration of distributed resources. - Enhance modeling for ZNE of advanced building systems and grid integration. - Develop new tools to analyze grid needs at a community level. - Explore building-scale distributed resource tools (storage, alternatives to PV, EV). - Improve the ability to more fully visualize, integrate and manage electric transportation options and alternative energy integration at the campus and community scale. - Improve building simulation tools, including those used for compliance (e.g. CBECC).	CEC/ EPIC	Nat'l Lab/ Private firms

Tactic	Lead	Partner
5.3 District-Scale Systems • Develop and utilize energy analytical tools to understand and manage ZNE Districts including electrical vehicle integration. • Develop new ways to integrate water and waste into ZNE Districts, and create new energy sources. • Create innovative approaches to balance transportation, EV, and storage needs. • Establish energy modeling approach for district and portfolio-level support for grid harmonization. • Explore and quantity the effectiveness of various approaches to providing renewable power at a district-level beyond rooftop solar.	CEC Local Govt	Local Govt RENs
5.4 Research Partnerships • Coordinate and engage with DOE and National Labs. • Leverage lessons learned from district energy systems and stormwater to fiber optics and transportation systems.	ET/CEC RENs	DOE/ NL Local Govt

DRIVER 5. SUCCESS INDICATORS

- ZNE cost-effectiveness is improved across all building types and is within 5% of standard building practices for 90% of buildings in 2030.
- Performance monitoring and adjustments to routinely maintain or improve performance become common place in commercial buildings.
- Number of demonstration projects illustrating new ZNE-ready technologies and grid harmonization at both the building and district level.
- Integrated software energy management tools to balance loads and energy use and output at a district level.

Driver 6. ZNE Codes and Standards

The CEC, in coordination with local governments, drive commercial building energy codes and standards to ZNE/ ZNE-Ready performance levels by 2030.

DESIRED OUTCOME

Title 24, Part 6 energy codes and standards require ZNE performance levels for all new commercial buildings and major renovations by 2030, allowing renewables to be provided locally offsite or onsite.

Driver 6. Overview

California has had a very active and effective energy code process for many years. IOUs work to demonstrate and test emerging technologies and document why changes in code should be made. Local governments provide a valuable role by using stretch codes to help move the local markets to higher levels of energy performance while testing costs and practicality. The CEC will ultimately evaluate the cost effectiveness and feasibility of making ZNE code for all commercial building types.

Commercial Market

The commercial sector is large and diverse, encompassing a wide variety of building types, ownership scenarios, age and construction. To establish an effective path to ZNE, it is important to understand the character and composition of the market place for commercial buildings.[34] The following information builds from data in the Existing Buildings Energy Efficiency (EBEE) Action Plan and reports developed for the Energy Commission and CPUC.

The commercial sector in California contains a broad spectrum of building types with approximately 600,000 buildings equaling over 4.9 billion sf[35] of floor stock. This includes both private and public facilities:

- Office buildings (Including local and state government)
- Restaurants
- Retail
- Food Stores
- Warehouses
- Schools
- Colleges
- Health Facilities
- Lodging

34 The data for the types, size and location of commercial buildings is not precise, especially in terms of distinguishing between public and private buildings. Datasets include different methodologies and count buildings in different ways.

35 Itron, Inc., California Energy Commission, "California Commercial End-Use Survey", March 2006, Page 8.

- Miscellaneous buildings (includes churches, gas stations, prisons, entertainment and movie venues, etc.)

Multifamily buildings over four units (also referred to as high rise) were not substantially covered in the New Residential ZNE Action Plan as buildings over four floors are regulated by the Commercial Building Code. There are approximately 3.1 million multifamily buildings in California, representing the fastest growing segment.

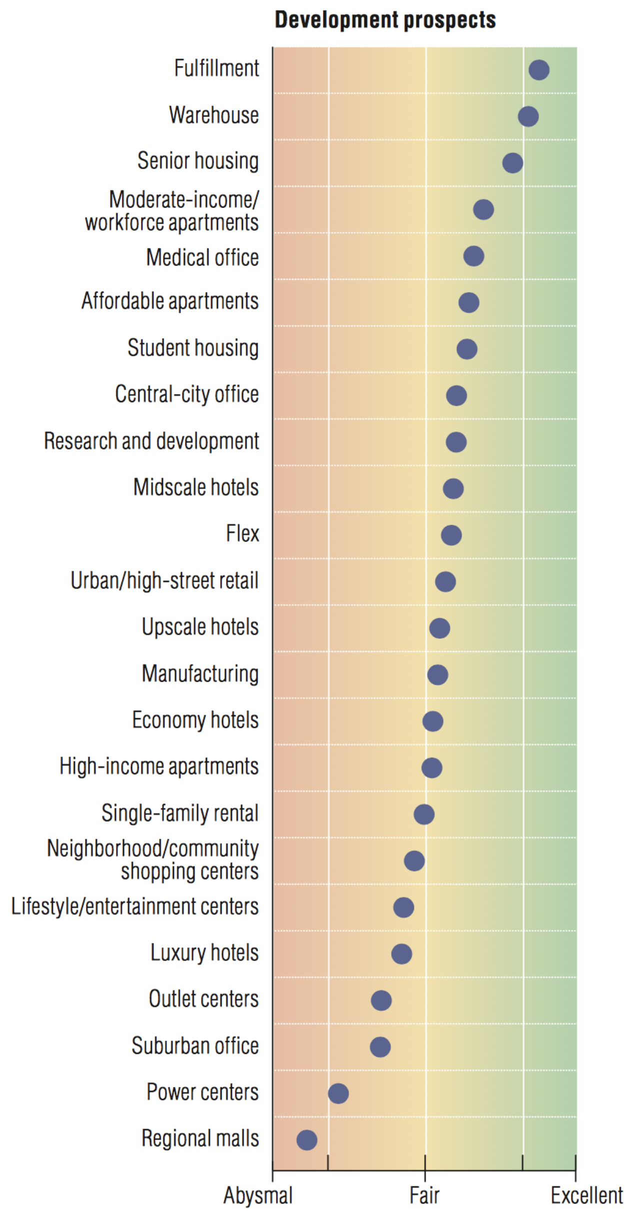
Future Construction Trends

Forecasting the potential market for ZNE commercial buildings beyond a year or two is challenging due to changing economics, demand, and trends related to demographics and needs. Data from the Energy Commission and the Arup report[36] on the Technical Feasibility of ZNE Buildings in California estimates that there will be 198 million sf of new commercial buildings, including high rise multifamily buildings built in 2020.

The current forecast for commercial construction for 2017/2018 varies by geography with multifamily buildings consistently leading the market with increases across the State. Overall, forecasts from the American Institute of Architects (AIA), Dodge Data and Analytics, and Allen Martin/UCLA Commercial Real Estate Survey[37] all indicate continued, though modest growth in commercial construction in the coming year.

The Urban Land Institute report, "Emerging Trends in Real Estate 2018", indicates that development of multifamily housing, medical offices, warehouses and central city office buildings (Figure 9.) will continue to have

Figure 12. Current Commercial Development Trends Driving Projects



Source: Development Prospects: PwC/ULI 2017.

36 www.energydataweb.com/cpucfiles/pdadocs/904/california_zne_technical_feasibility_report_final.pdf

37 *Allen Matkins/UCLA Anderson, Forecast California Commercial Real Estate Survey and Index, Fall 2017*

excellent development prospects, relative to other building types, in the coming years. Regional malls throughout the country are the least likely to be newly developed, but, are likely candidates for renovation and repurpose. Eight California areas, Orange County, San Francisco, San Jose, Los Angeles, San Diego, Oakland, Inland Empire, and Sacramento, are considered high growth markets, with Oakland, San Jose, and Los Angeles in the top 20 commercial real estate markets nationally.

Size Matters

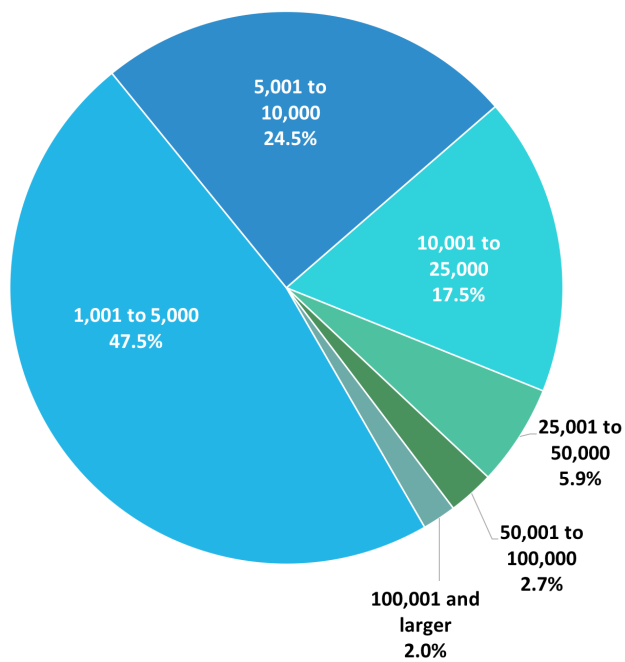
Building size is another important element of the commercial building market. While the perception is that the commercial building market is dominated by large, high-rise downtown areas, there are far more small and medium commercial properties. In the Western U.S. nearly half of commercial buildings are between 1000 and 5000 square feet (almost residential in size) and about 95% of buildings are under 50,000 sf., the size of an average supermarket. These buildings are relatively simple from a design and construction perspective. The remaining 5% of larger buildings typically are the larger, more complex buildings including high rises of all types, hospitals, schools and colleges and a variety of other uses. However, this small number of larger building represent almost half of the total square footage of commercial buildings. Over 70% of commercial buildings are owner occupied (including local and state government).

Commercial Building Energy Use

According to the 2008 California Energy Use Survey database (CEUS), commercial buildings represent 54% of building energy usage in California and just over 19% of all energy use according to Energy Information Administration (EIA) in 2015. Multifamily buildings (includes 2-4 unit buildings) overall represent approximately 11% of all building energy use.[38] Addressing and lowering the energy and carbon footprint of commercial buildings in California is an essential part of meeting the State goals for SB 350, AB 32 and CAEESP goals.

Commercial building energy use intensity (EUI) vary significantly by size and end use. EUI is a useful metric to utilize as an absolute value that can serve as a baseline for energy consumption, and establish targets for reductions. Figure 12 illustrates the average EUI for different building uses and sizes. Restaurants have five times the

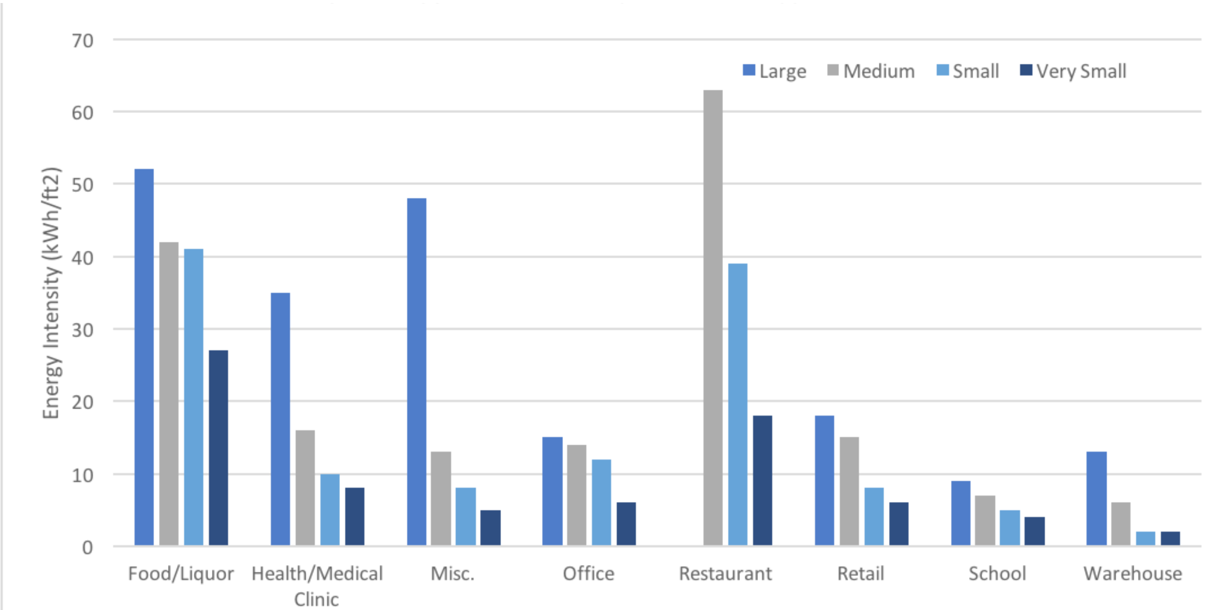
Figure 13. Number & Size of Buildings (sf) in Western US



Source: CBECS 2012

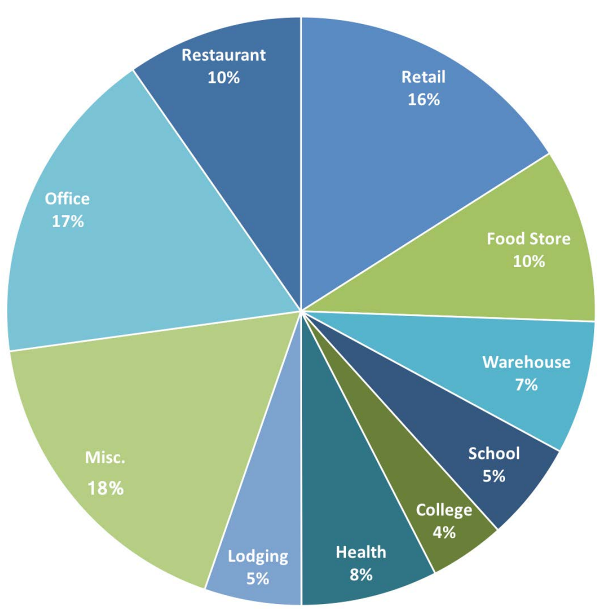
38 Ibid.

Figure 14. Average Energy Intensity by Business Type and Size



Source: California Commercial Saturation Survey Report, 2014.

Figure 15. Commercial Electrical Use by Building Type



Source: CEUS 2008

average EUI of a typical commercial building. Food stores and health care facilities have more than double the EUI of the typical building. Large offices, retail and the miscellaneous category as illustrated in Figure 11, constitute the highest overall electrical consumption. This data indicates areas for potential focus for initial ZNE programs.

A 2014 report, the California Commercial Saturation Survey (CSS) indicates that there are 500 million sf of commercial businesses with solar PV installed. However, the energy usage of these buildings does not achieve EUIs indicative of ZNE[39]. The report further indicates that the larger the building, the more likely it is to have an Energy Management System (EMS) in place. 60% of large businesses, 22% of medium business, and 2% of small businesses had EMS in place. 15% of Schools have EMS. The ability to control a building's energy use, and monitor occupant behavior with the use of EMS is a critical need for ZNE buildings. These

39 Itron, Inc., CPUC, "California Commercial Saturation Survey Report," 2014.

statistics imply the need to work with small and medium business owners to install these controls, ultimately helping their properties be more energy efficient and able to perform at the levels necessary to achieve ZNE.

The CSS also evaluated the heating sources of commercial buildings. 39% of commercial buildings are fueled solely by gas, and 6% with electric and gas. 9% are not heated by systems on site, and are likely part of a district heating system. Reducing the carbon footprint of California's buildings will require deeply reducing our reliance on natural gas and moving towards electrification. The fact that such a large portion of California's commercial buildings are fueled by gas indicates that we need to understand the implications related to infrastructure modernization and how renewable policies will impact gas fueled buildings facilities and the required infrastructure. There may be opportunities to leverage the development of electric only projects to reduce or eliminate upgrades to aging gas infrastructure in certain areas or situations. Policies, codes, and incentives need to accurately reflect the social cost of carbon, current efficiency of gas and electric equipment, as well as appropriate baselines for calculating savings and costs.

Energy Management System

"Energy Management Systems (EMS) consist of a network that combines local distributed control with centralized coordination and management to monitor, control, and optimize the energy usage throughout a business facility. EMS can be used to control and monitor the energy use of appliances and equipment at a site including lighting, HVAC, water heating and process equipment. EMS systems can also be used to control systems during demand response events." Itron, Inc., CPUC, "California

RECOMMENDATIONS

To support ZNE level energy codes, the codes and standards processes must consider and address issues related to offsite renewables, changing technologies, district-scale projects, and maintenance, and behavior impacts for all of the different market sectors and building types. As indicated above, this is a complex sector and would benefit from differentiating based on building types, size, and markets.

The standard industry definition of ZNE is operational, requiring a facility/building to operate for a year at net zero. However, the code is based on modeled performance or "as designed" not actual operational performance. Currently there are no tools or mechanisms within the code to enforce or consider what operation of a building or behavior might be after a permit has been issued and the construction approved. These changes may expand energy code scope to support the transition to whole building performance rather than modeled performance. This performance verses modeled design consideration needs to be more fully evaluated within codes and standards.

One of the most significant challenges to California and other states is to be able to keep policies, codes, and programs up-to-date and relevant. Part of the focus of the Framework is to create an environment for commercial buildings that focus on an end result rather than on the way a project reaches that outcome. This performance approach recognizes the dynamic character of the market and the need to get out of the way of innovation while protecting the critical infrastructure and safety of the grid.

The industry and local government agencies involved in enforcing the codes need to be prepared for and open to managing the evolution to new approaches to building energy performance. Appliance standards also need to be updated and aligned with the ZNE goals, as allowed under Federal preemption rules.

Ultimately, building standards and code will provide a baseline for what buildings should achieve, not necessarily the ideal goal of ZNE. Therefore, while establishing ZNE-level standards and code is important, it should not be a replacement for pushing for higher levels of efficiency and innovations, which may not be possible within the realm of the building code.

DRIVER 6. KEY TACTIC AREAS

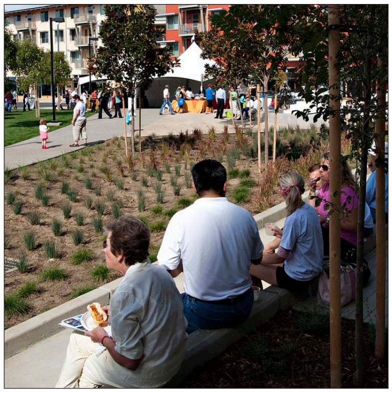
Tactic	Lead	Partner
6.1 Statewide Code Pathway		
• Adopt a definition of ZNE that allows purchase or lease of offsite renewable energy resources to better enable ZNE to be achieved for a broad variety of building types and/or on constrained sites. This should include a limit on the distance of renewable location to the project as well as a time-differentiation.	CEC	PAs
• Develop a pathway for state energy codes to reach ZNE for all building types by 2030 and define a pathway for challenging buildings, such as hospitals, and restaurants to be ZNE by 2030.	CEC	PAs
• Support advancement of building code and product standards including outcome based options.	CEC, IOUs	PAs
• Pursue code at ZNE performance level for all building types, and address the need for decarbonization to achieve climate change goals.	CEC	PAs
6.2 Reach Codes		
• Adopt reach codes at the local development level to demonstrate the viability of statewide ZNE codes.	Local Gov.	PAs
• Develop code compliance trade-offs for existing buildings to enable innovation within defined ZNE districts.	CEC	RENs and local govt
• Coordinate reach energy codes to complement other local government laws or regulations in support of EVs, water reductions, and zoning, as well as master plan and sustainability goals.	RENs	
6.3 Building Department Engagement and Capacity Building		
• Local building department officials are engaged and prepared to review and permit ZNE buildings and ZNE District Projects.	CEC	RENs
• Local incentives, such as density bonuses and accelerated review processes, are available to encourage adoption of ZNE goals.	Local Gov.	RENs
• Develop and provide software modeling to assist building departments.	CEC	

DRIVER 6. SUCCESS INDICATORS

- Improvements in overall modeled building energy performance towards ZNE in each code development cycle.
- Identification and codification of ZNE performance for targeted market segments prior to 2030.
- Movement towards outcome-based codes that can better incorporate the full range of energy efficiency options.
- Reach codes support an integrated path to ZNE in advance of statewide code.
- Well designed and routine training is provided to building department staff to support code administration.
- Code compliance training and support.

Photo: Courtesy UC Davis, West Davis ZNE Community Square, Davis, CA

III. Discussion Tool



Changing the Conversation

"It's not possible to prove analytically that a new idea is a good one in advance. If an idea is new there is no data about how it will interact with the world."

– Roger Martin, Institute Director, Martin Prosperity Institute

There are a number of different ways to achieve ZNE. Each path, as this Plan has described, has various benefits to the grid, to meeting our energy goals, and to customers. The focus of this section to assist in building awareness of options and expand the conversation for local government, developers and large property owners specifically to introduce a new set of ideas that push beyond building-scale and extends the ability to achieve ZNE levels of performance in a wide variety of situations.

The following provides a methodology and framework for the reader to explore alternatives to rooftop-only solar with decision-makers, staff, and project teams.

Discussion Tool Introduction

The discussion tool is an initial step for property owners, local governments, and organizations interested in pursuing ZNE. It helps to reframe the options for achieving ZNE and how they connect to customer objectives. Property owners and organizations with larger, multi-building projects associated with a campus, portfolio or neighborhood/district will get the most useful information from the tool.

The online tool provided on the Plan's website (capath2zne.org) allows a user to rank their objectives in pursuing a ZNE project and the tool will provide three options to explore further. Below are details that inform the tool and resources to inform discussion and ranking of objectives.

This is the first phase of the tool and the intent is to work with stakeholders to enhance and refine it over the coming year. (Feedback and insights on how to improve it are welcomed.) In addition, it is clear that specifics related to costs for different options are critical to ultimate decision making. The CPUC is working with partners to develop additional resources including tools for determining costs and locational value for ZNE projects. The extended tool will be available in 2018 or early 2019.

Photo: Google Headquarters

Paths to ZNE

The following "Paths to ZNE" are general examples of potential approaches to ZNE projects. Aligning objectives to these paths will help to focus how to best reach ZNE goals. Often stakeholders ask for examples and specific details on these concepts. While there is a growing body of examples (see the next section on ZNE Project Examples) of these approaches, this is new and there are limited completed case studies.

1. Building Scale (Onsite Solar Only)

ZNE is achieved onsite for a single building, as defined by producing as much energy as it uses over a year.

Grid friendliness: Low - inability to serve load onsite outside of solar generation hours. May reduce summer distribution peaks. Limited reduction of transmission and distribution.

2. Building Scale (Solar + Storage Onsite)

ZNE is achieved onsite with storage capabilities, including the ability to reduce solar generation/ size of arrays and cover substantial percentage of non-solar generation times with storage.

Grid friendliness: Medium - depends on the storage capacity and ability to flatten load shapes. Storage recharge in off peak times may be with non-renewable power - not desirable.

3. Community-Scale Solar (Local)

Local community scale solar serving multiple buildings. May be directly connected to building loads or nearby.

Grid friendliness: Low - depending on location relative to generation/distribution peak requirements, and whether solar distributed, serves a locational and time value.

Grid-Friendly ZNE

The following, adapted from the CEC Advance Energy Community criteria, defines what a ZNE grid-friendly project should achieve and assists in explaining why some approaches to ZNE are more desirable than others.

- Minimize the need for new energy infrastructure costs such as transmission and distribution upgrades or fossil fuel power plants.
- Provide energy savings by achieving high levels of energy efficiency and maintaining zero net energy status (accounting for behavior and increasing loads from vehicle and appliance electrification).
- Support grid reliability and resilience by incorporating technologies such as energy storage and smart inverters.
- Provide easier grid integration and alignment with the California Public Utilities Commission's (CPUC) Integrated Resource Plan (IRP), and the California Independent System Operator's local capacity requirements process.
- Provide affordable access to renewable energy generation, energy efficiency upgrades, water efficiency, and technologies that reduce electricity consumption for all electric ratepayers.
- Make use of smart-grid technologies in the project and when applicable throughout the community.
- Align with other state energy and environmental policy goals at the community level such as the Sustainable Communities and Environmental Protection Act (Senate Bill 375, Steinberg, Chapter 728, Statutes of 2008).

4. Community Solar Plus Storage (Local)

Similar to #3, with the addition of community scale storage and enhanced controls for demand response and load management.

Grid friendliness: High - can help manage loads and power requirements within a local area. Particularly useful when it supports locational benefits.

5. District ZNE/Grid Connected Microgrid (Onsite)

Multi-faceted distributed energy system onsite, connected to the grid normally, but a level of self-reliance during events. May include CHP/ district system.

Grid friendliness: High - can help manage loads and power requirements within a local area and improve reliability to connected loads.

6. Utility Scale Renewables (Offsite, not local)

ZNE is achieved by utility owned/contracted power or by a third party PPA and wheeled through the grid.

Grid friendliness: Medium - Requires transmission and distribution system, potential upstream environmental impacts, and reduces resilience. Locational value and increased reliability may not be considerations.

Photo: Renewable Energy Source - Wind Trees

Customer Objectives and Discussion Questions

The following are the "Customer Objective" categories that are designed to help determine what is important to ZNE projects. Additional questions have been added under each to spur conversation and to hone in on the relative importance of that objective. These can help to frame any ZNE project but are intended to align with the online tool and be rated on a scale of 0 – 10, with 0 being not important, 5 being neutral and 10 being extremely important.

Develop Your Project Description

Before beginning this process, first develop a fairly well-developed project description that addresses the following at a minimum:

- Is the project a single building under 50,000 sq. ft., a single building over 50,000 sq. ft., a combination of multiple similar buildings, or a larger/complex district, campus or community project?
- Do you have land and/or sufficient rooftop area for the needed renewable energy array at the project site?
- Who are the utility providers in the area? Are there incentives or other programs that you are eligible for?
- Are you located within an active or soon to be established CCA?

Sustainability

The ZNE project reduces environmental footprint by providing onsite (or nearby) energy supply; reduces or eliminates use of fossil fuels/ natural gas; supports sustainable transportation choices, Local Climate Action Plan, and green building practices.

- Is there a Local Climate Action Plan or Sustainability Plan that this project will address?
- Does the General Plan address sustainability?
- What will the impact of this project be on sustainability goals?
- Will this project be a model of sustainability for the city or region?

Resilience

The project should increase the ability to withstand and recover from adverse event to function during larger grid outages and mitigate effects of disruptive events on local communities.

- Do the Local Hazard Mitigation Plan or General Plan Safety Element goals and strategies (as mandated by SB 379) support this type of development?
- Are there goals for climate adaptation?
- Is resilience during power disruptions a priority?
- Does this project need to maintain electricity in emergency situations, such as emergency responders, on-going patient care, or other critical operational elements related to data/research/communications?
- For how long, and at what level, is emergency electricity needed? A few hours, two or three days, indefinitely? What level of back up power is needed?
- Is there a plan to install a fossil fueled generator as part of resilience?
- Will this project reduce risks in emergency situations?

Carbon Zero/Neutral Development

This project should not create new greenhouse gas emissions or all GHGs should be 100% offset. This assumes if a project relies on grid power, that there are some associated GHG emissions.

- Is it a goal to have 100% renewable or clean power?
- Is this project trying to achieve electrification (i.e. no fossil fuels used on site, and 100% renewable electricity)?

Photo: Community-Scale Solar Plus Storage

- Is it a goal to integrate electric vehicle (EVs) charging into the project?

Infrastructure Modernization

The project should improve other infrastructure not associated with the building - water, sewer, fiber network, etc., as well as the ability to leverage new or existing district-scale systems land, may provide needed new services to an area.

- Will this project include other infrastructure improvements such as water, sewer, transportation or landscape systems?
- Will the project be able to leverage these improvements and increase overall benefits?
- Are there major infrastructure upgrades required in the project area?
- Are there additional funding sources that can be leveraged from other infrastructure efforts?

Local Energy Supply

The project should reduce or eliminate energy imports into a community and increase control by local government/partners (particularly CCAs and RENs).

- Is it a goal or a requirement of your organization to have local control of your energy supply (verses utility)?
- Is the CCA a potential partner?
- Does the organization have the ability to become a utility for the project and negotiate power purchase agreements?

Certification

This project should contribute to eligibility to achieve high performance certifications such as U.S. Green Building Council's LEED Platinum, International Living Future Institute (ILFI) Living Buildings, and EcoDistrict.

- Is it a goal to certify the project?
- What kind of certification?
- What does this project need to achieve in terms of energy provision to make sure to get the certification?

Photo: DPR Offices

Monetization of Energy

The project should enable the energy system to be leveraged for revenue generation, and offset costs.

- Should this project help to establish an energy system and infrastructure that can be a revenue source?
- Is there a organizational structure to operate and manage such a system?
- Is economic development a driver for the project?
- Is the organization eligible or organized so it can monetize its energy (PPA/CCA other)?

Economic Development

The project should have potential to improve branding, attraction to the project. Project contributes to the local economy through job creation, the development of sustainable infrastructure, and may support developer objectives.

- Will a project improve the image or brand of a organization?
- Will this project spur job creation or help the surrounding neighborhood?

Asset Control/Management

The project should increase control of the management and operations of physical assets related to energy systems and investments.

- Is it a goal to control and own the energy infrastructure as part of this project?
- Are there financial resources available to purchase, install and manage the solar array?
- Are external financing/managements, or alternative financing structure, such as a lease or a project share, better options?

Photo: Carport Solar

Ease of Access/Entitlement

The project should have the ability to receive incentives to streamline development or reduce barriers to implementation or get entitlements.

- • Will entitlement incentives or stream-lining be important for a project to succeed?
- • Have local developers indicated the need for incentives to meet environmental goals?

Architecture Flexibility

The project should reduce the need for roof space/architectural changes for solar arrays on building siting and building design and provides more design flexibility/innovation.

- Does the project's architectural design have the flexibility for various roof designs, or can it be designed to accommodate solar PV?
- Is there sufficient land for community scale solar and storage?
- Are there shading or tree issues that would limit the space for solar panels?
- What do developers or potential tenants think?
- Do surrounding buildings dictate a style or look that would preclude solar on the roof?

Optimize Electricity Rates

The project should enhance the ability to manage and distribute energy loads across different buildings and/or uses, flatten energy demand peaks and reduce costs.

- Is it a goal to carefully manage electric loads to reduce demand charges?
- Is it a plan to implement specific demand reduction measures such as off-peak ice for cooling?
- If the project covers several buildings, is there a capability to manage electricity demand among several users?

Capital Costs

The incremental capital costs increase for a solution.

- How will the project costs be calculated?
- Are the benefits of lower operating costs when balancing capital costs (aka total cost of ownership) being considered?
- Will the project incorporate costs/benefits such as carbon?

Financing Options

The project should leverage other government and/or private industry partnerships for funding, financing and/or other resources.

- Will the size of the project help financing options?
- Are there local programs or incentives that could help finance the project?
- Can leveraging other infrastructure invest-ments into the project create an economy of scale?
- Is the project within a special tax district?

Photo: EcoCenter at Heron's Head Park, San Francisco

- Will the project be able to utilize the Enhanced Infrastructure Financing District tool (EIFD)?
- Could larger scale developments benefit the bottom line and feasibility of the effort?

Level of Effort

Time, resources and effort will be barriers to the implementation of the project.

- What are the goals for the length of the project and the level of effort?
- Is there capacity and resources to embark on more complex projects that may have greater benefits but could be more intense to manage?

Operation Costs

Incremental costs and resources for operations.

- Is it a plan to be the owner and tenant of the project? Or a developer that may not need to consider operations?
- Is lowering operating costs a goal?
- How much does utility cost?
- Can savings in operating costs be used to offset capital costs?

Environmental Justice

The project should provide a benefit to disadvantaged communities, increases affordability and access to renewable energy, and helps to lower bills.

- Will or should this project help disadvantaged communities?
- If it is a goal, how will benefits be optimized?
- Will the addition of community solar and storage help?
- Will working with disadvantaged communities help ensure support of the project?

Photo by Chad Ziemendorf: International Brotherhood of Electrical Workers ZNE Center, San Leandro, CA

Glossary

Glossary of Terms

(Includes terms adapted and reproduced in part from the Microgrids Institute Glossary of Terms)

Balancing: Active efforts to match energy supply and demand to maintain stable system operations. Both microgrids and large-scale utility grids perform balancing operations.

Campus: Educational, institutional, corporate or other kind of single owner development with multiple buildings.

Campus microgrid: A microgrid serving assets within the perimeter of a discrete campus -- e.g., a university, corporate, or government campus, a prison, or a military base. Campus microgrids generally do not cross public rights of way or incorporate public utility infrastructure.

Commitment (Corporate Commitment): The term here means that an organization has made a formal declaration in support and adoption of a path to Zero Net Energy. It is more than a signature and more likely a Board Resolution, strategy in a plan or similar formal item.

Community-scale: Community scale, as it is already commonly considered, refers to the provision of a community scale renewable source that may be located near, adjacent or within a district. It indicates a sizing of renewables that is larger than for a single building, but does not reach a larger utility scale serving many customers in a large geographic area.

Combined heat and power (CHP) (a.k.a., "cogeneration," "trigeneration" or "waste heat to power"): CHP systems supply both electricity and thermal energy, and can comprise the generation foundation of an efficient and economical microgrid.

Demand response (DR): Energy loads capable of being reduced, deferred, or curtailed in response to signals regarding such conditions as energy prices or system constraints.

District-scale: District scale refers to any natural cohort of buildings due to ownership, topography, location, financial structure (lighting and landscaping or BID) or use. This may include a campus (educational or corporate); downtown or business district; strip commercial; single block or similar. A district may include new and existing buildings and will aggregate energy production and use over all of the buildings to achieve zero net energy. It is assumed that a successful district would incorporate storage, electric charging and transportation considerations as well as consider water and waste efficiency.

Distributed Energy Resource (DER): DERs are physical and virtual assets that are deployed across the distribution grid, typically close to load, and usually behind the meter, which can be used individually or in aggregate to provide value to the grid, individual customers, or both. A particular industry interest seems to be centered on DERs — such as solar, storage, energy efficiency, and demand management — that can be aggregated to provide services to the electric grid.

Distributed generation (DG): A small power plant located near an end-use customer, often interconnected with the low-voltage utility distribution grid (versus the high-voltage transmission system).

District energy system (a.k.a. district heating and cooling): A local system that provides thermal energy for multiple facilities -- usually heating and domestic hot water, and sometimes thermal processes and cooling. District energy strategies can produce substantial energy savings and emissions reductions, as well as greater local resilience.

Energy Improvement District (EID): A vehicle used by local and state governments to promote planning, development, and funding activities supporting energy infrastructure improvements in a defined geographic area or community. Community leaders are considering microgrids as part of energy improvement district planning.

Energy management system (EMS): Software and hardware for balancing energy supply (including storage) and demand to maintain stable operations.

Energy service company (ESCO): A non-utility entity that provides retail, commercial, or industrial energy services.

Energy Use Intensity (EUI): EUI provides a standard measurement for the amount of energy that is used on a per square footage basis. This "energy intensity" changes with the number and kind of building users –or intensity of use. EUI is calculated by dividing the total energy consumed by a building in one year (measured in kBtu) by the total gross floor area of the building.

EPIC: The Electric Program Investment Charge (EPIC) Program was created by the California Public Utilities Commission (CPUC) in December 2011 to support investments in clean energy technologies that provide benefits to the electricity ratepayers of Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E), and Southern California Edison Company (SCE). The EPIC program funds clean energy research, demonstration and deployment projects that support California's energy policy goals and promote greater electricity reliability, lower costs, and increased safety. The Energy Commission through EPIC will fill critical funding gaps within the energy innovation pipeline to advance technologies, tools, and strategies of near zero-net-energy residential homes and commercial buildings, high-efficient businesses, low-carbon localized generation, sustainable bioenergy systems, electrification of the transportation system, and a resilient grid that is supported by a highly flexible and robust distribution and transmission infrastructure. These smarter, safer energy advancements provide ratepayers with better electricity services, reduce air pollution, foster economic development, and help achieve the State's policy goals at the lowest possible cost.

Grid-friendly: The term refers to a project that enhances and is an asset to the operation of the electrical grid. In particular, it achieves the criteria outlined in the Framework on page viii.

Grid-harmonization strategy (GHS): GHSs are strategies that maximize self-utilization of the PV array output and minimize exports back to the grid; examples of GHS include but are not limited to battery storage, demand response, thermal storage, and for some homeowners, EV grid integration.

Major renovation: For purposes of this effort "major renovation" means the remodel requires (a) The total cost of the renovation relating to the building envelope or the technical building systems is higher than 25% of the value of the building, excluding the value of the land upon which the building is situated; or (b) More than 25% of the surface of the building envelope undergoes renovation.

Microgrid: A small energy system capable of balancing captive supply and demand resources to maintain stable service within a defined boundary. There's no universally accepted minimum or maximum size for a microgrid.

Nanogrid: A microgrid serving a single building or asset, such as a commercial, industrial, or residential facility, or serving a dedicated system, such as a water treatment or pumping station.

Photovoltaics (PV): Solar-electric energy cells in any of numerous forms and configurations.

Program Administrator (PA): Refers to companies or organizations who receive ratepayer funding for energy efficiency programs via the CPUC, including the four investor owned utilities (IOUs), regional energy network (REN), or community choice aggregator (CCA).

Resilience: "Resilience of the energy sector refers to the capacity of the energy system or its components to cope with a hazardous event or trend, responding in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation." (International Energy Association (IEA))

Smart grid: A energy system characterized by two-way communications and distributed sensors, automation, and supervisory control systems.

Utility-Scale Solar: A ground-mounted solar project that is larger than 5MW, typically located remotely.

Virtual power plant (VPP): Aggregated power generating capacity that's provided by multiple, real DG facilities operating in different locations.

ZNE Project: Refers to either a building, a set of buildings, a campus, or neighborhood district.

ZNE Performance: Refers to any building or large-scale project that achieves deep energy efficiency with robust advance energy controls that with the addition of renewable energy source can achieve ZNE.

ZNE-Ready: The same as ZNE performance, but may not include the same level of controls.