
# Commercial Zero Net Energy Action Plan

DRAFT

California Public Utilities Commission

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# Acknowledgements

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## Action Plan Funding

The key initiatives in this Action Plan represent what stakeholders have prioritized as those that will result in direct or indirect energy savings to help achieve the state's energy policy goals. However, not all of these initiatives are mandated, nor do they all have the funding necessary for execution. Possible funding sources for these initiatives could come from investor-owned utility (IOU) programs, publicly owned utility (POU) programs, state and federal government programs, public-private partnerships and other potential sources.

# Table of Contents


*Photo Courtesy NBI: DPR ZNE 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**."[1]

In 2008, the 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, increase the level 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 market and numerous examples of both commercial and residential buildings.

At the same time, the market and state policy context have changed. In particular, the future for the electric grid now looks more to distributed energy resources (DER) that are interactive and located in areas with grid constraints, and the costs of solar generation and electricity storage have plummeted. The most critical change for this Plan is expanding the concept of ZNE beyond building scale to encompass multi-building projects, campuses and large-scale developments.

This Commercial ZNE Action Plan (CZAP) is designed to help catalyze the market and drive utilities, local government, developers, and property owners to more aggressively achieve ZNE levels of performance in their projects. The CZAP incorporates and addresses trends in the deployment of solar renewables and storage, electric grid modernization strategies, 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, including energy used for transportation.

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.

1 Diane Moss, "Net Zero Energy For Buildings: Advanced energy solutions are coming down in price, prompting more facility management leaders to pursue this clean energy goal", Facility Executive, August 14, 2017.

# Why ZNE is Important

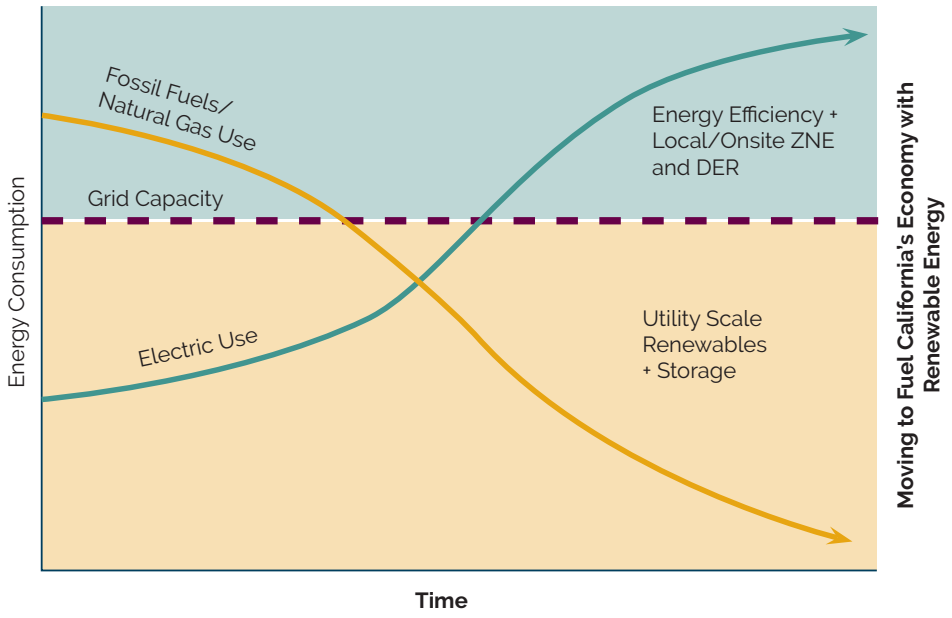
ZNE is a compelling advancement in the integration of building energy efficiency, renewable energy and control technologies that provide an easily understood, if not easily defined, concept – a project or building that produces as much (renewable) energy as it uses over the course of the year. California 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.

California has established ambitious goals for carbon reduction that will require a diverse and aggressive set of programs and initiatives to implement. ZNE projects are essential to these goals and an approach to decarbonizing the building sector. Many ZNE projects are 100% electric and employ a broad range of complimentary green building techniques that further reduce carbon emissions in the sector.

The potential for energy savings by achieving our ZNE goals is tremendous. The Energy Commission estimates that new ZNE commercial buildings will help to avoid the development of up to eight 500 MW power plants. Also, 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 SB 350's goal of increasing energy efficiency by 50% in existing buildings.

Another critical role for ZNE projects is the ability to become a managed resource for helping to optimize the grid. As Figure 1. illustrates conceptually below, there is a trend of increased electric loads (fuel switching, EVs, plug loads, etc.) over time 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. 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, 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 distributed energy resources will be more cost effective than having the current grid reach the needed future capacity.

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



# Evolving Understanding of the ZNE

The CZAP 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 CZAP has built on the lessons learned to date, new market research, and stakeholder input. 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 CZAP also frames ZNE differently. The CZAP also frames ZNE differently than the previous Action Plan. Historically, ZNE was defined at the building level, and by a simple formula. Start 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.

## The first change is scale.

While individual buildings still must be extremely efficient, expanding ZNE to multiple buildings or district-scale can improve costs, customer benefits 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.

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. It also reduces the costs of renewables. It 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. It also offers a future where local and state policy makers and planners can incorporate resiliency, water, waste, and transportation concerns at the same scale.

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

While storage and demand control can and will be incorporated in individual homes and buildings, there are benefits of scale at the district level both for customers (cost, convenience) and for the grid, such as fewer control points, operation directly as part of the grid, and better maintenance and reliability. Distributed storage is a game changer for the grid, especially as the grid further incorporates renewable energy production and electric vehicles and other electrification efforts continue to gain market share. Integrating storage with renewable energy as part of the CZAP provides more tools for both grid and building demand management.

## 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 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. ZNE buildings and communities can also island from the grid during major disruptive events or other emergencies to improve reliability and provide local resilience. 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.

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

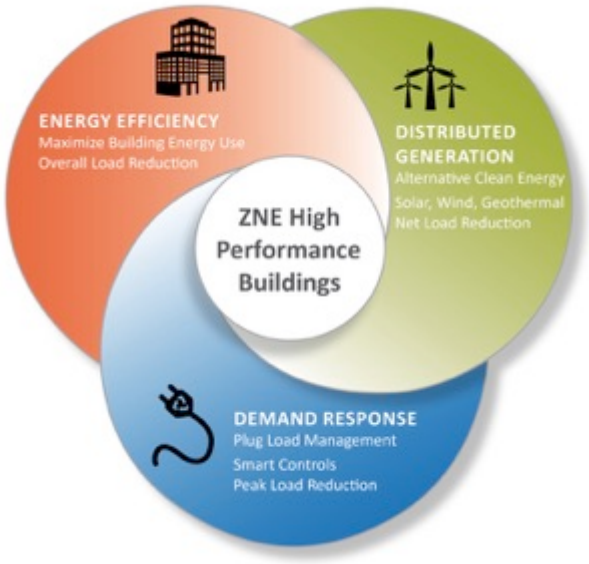
Few existing buildings operate at ZNE levels; this result is typically only accomplished through infrequently major renovations in the market. A better paradigm for achieving ZNE in existing buildings includes more emphasis on community-scale renewables. Community-scale reduces substantial barriers to ZNE for existing buildings, as many existing buildings have shading, limited open roof space, or structural issues that make on-site 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. But building owners and communities have additional reasons for designing, operating, and providing energy services in buildings and communities. They may care about meeting carbon commitments. They may care about resiliency and safety. They may care about local employment and economic development.

At both the building and community level, the CZAP strategies can help achieve better outcomes in terms of responsiveness and resiliency, 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.

**Figure 2. Illustrating Integrated Resource Management Approach and ZNE**




## The New Market Drivers

Below, is a summary of how new market drivers, some specific to California and some international in scope, are reshaping the commercial ZNE market and this Plan. Section II provides more detailed information on the broader commercial buildings market and trends, key decision makers, and economic factors.

### 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 may also be essential partners to large scale utilities, filling gaps and playing roles that are not as well suited for for-profit utilities.

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

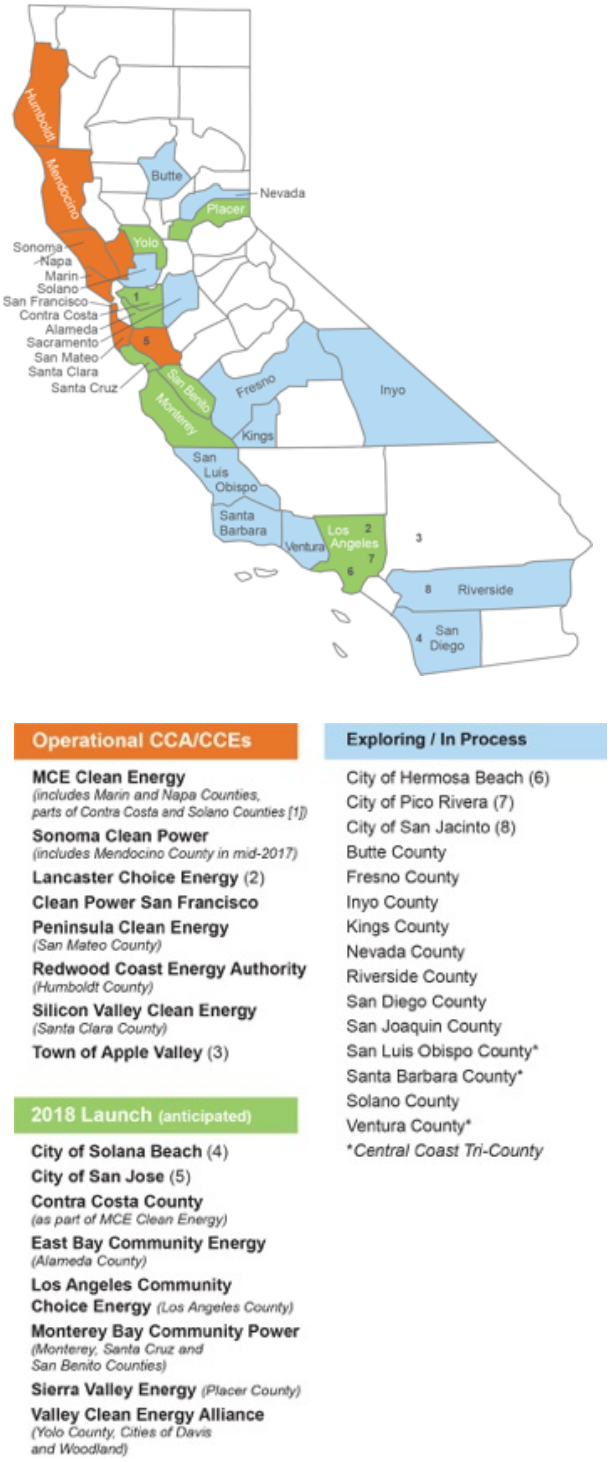
two-thirds of the State's population and receive ratepayer funding to administer energy efficiency programs and supporting activities. Proposed REN activities in filed CPUC Energy Efficiency Business Plans include a number of initiatives to promote ZNE for municipal government buildings and to establish 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.

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 are regulated similarly to a utility and 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 can fill the gaps in grid enabled power, improving local resilience in case of grid interruptions, 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.[2]

**Figure 3. CCAs Operating & In Development**




2 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 from a recent Sierra Club report indicates at least 11 cities in California, more than any other state, 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 are a diversity of approaches and definitions used for 100% renewable energy. The challenge for California is how, where and when the renewable power will be developed. Locally procured, renewable power is a goal for most of the participating cities, although some will rely extensively on existing hydro as part of the renewables. 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

**Figure 4. US Cities Committed to 100% Renewable Energy (Sierra Club)**

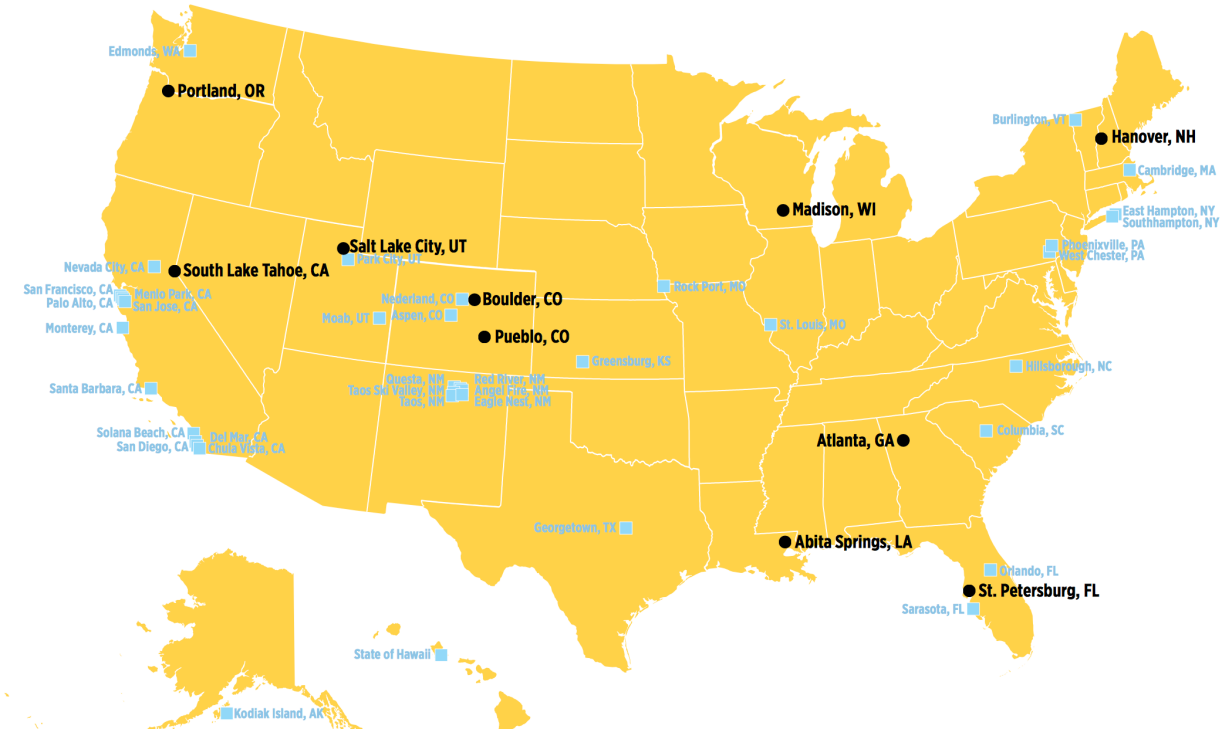
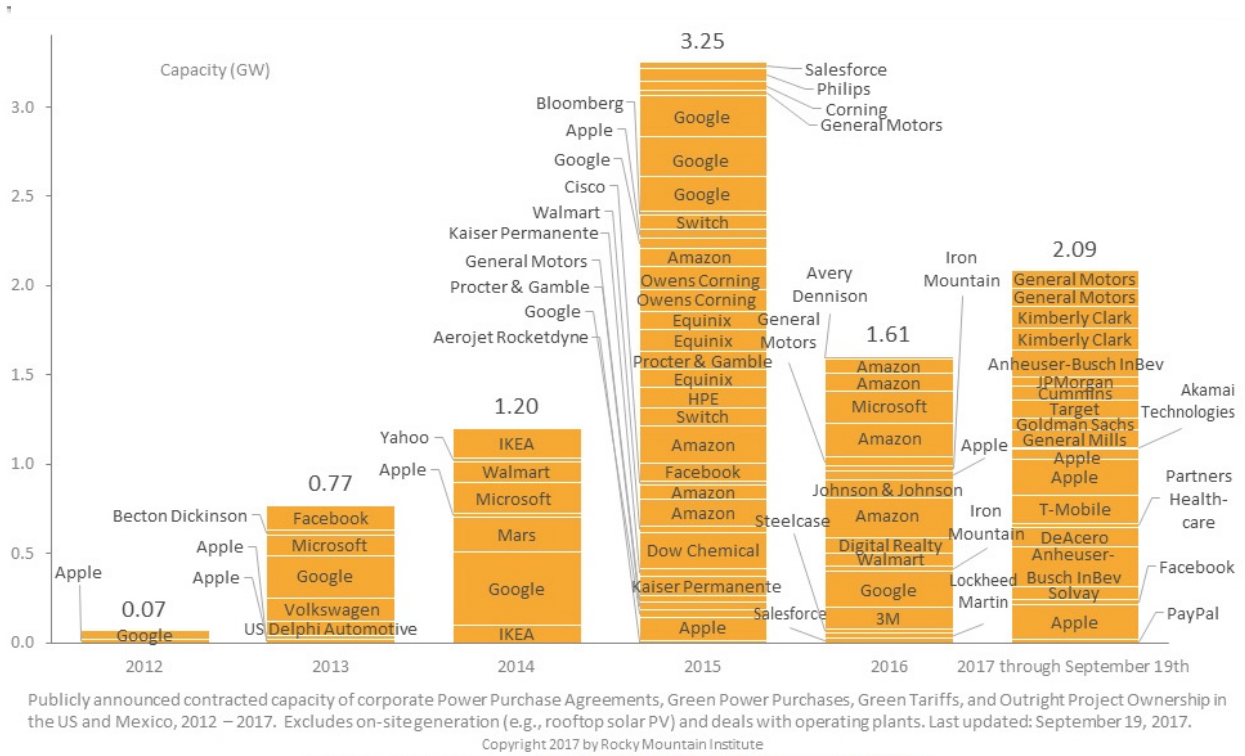


**Figure 5. Corporate Renewable Deals (2012-2017)**




Publicly announced contracted capacity of corporate Power Purchase Agreements, Green Power Purchases, Green Tariffs, and Outright Project Ownership in the US and Mexico, 2012 – 2017. Excludes on-site generation (e.g., rooftop solar PV) and deals with operating plants. Last updated: September 19, 2017.



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.[3]

## 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."*[4]

Another trend that has been evolving over the years is the decreasing cost of renewable energy. Many current reports indicate wind and solar[5] costs to be dropping steadily while energy production and consumption are increasing[6]. The conventional wisdom that renewable technologies depend on subsidies and that they are too costly to integrate into the grid has become anachronistic. The

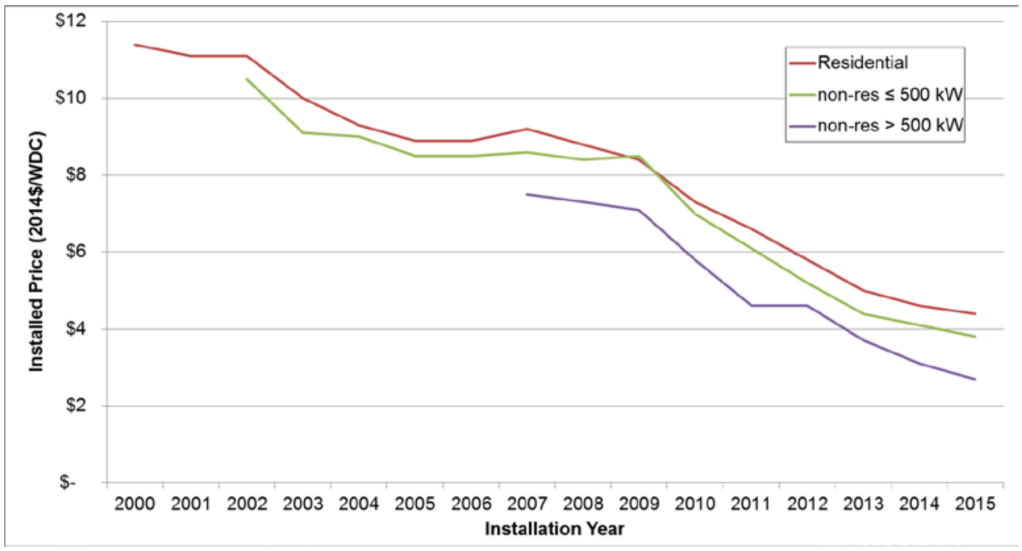
3 (Joint press release from Microsoft and PSE, June 13, 2017)
4 Stanton, Tom, et al, "The Ecology of Community Solar Gardening", National Regulatory Research Institute, August 2016.
5 NREL.gov, 11/1/2017, https://www.nrel.gov/docs/fy15osti/63604.pdf.
6 eia.gov. 11/1/2017, https://www.eia.gov/totalenergy/data/browser/?tbl=T10.01#/?f=M&start=200001.

Lawrence Berkeley National Laboratory in their report on solar energy states that the price of photovoltaic panels has dropped so much in fact that it is changing the way power plants are set up[7].

Moving away from just solar on rooftops, community solar projects, especially 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 utility scale (over 500kW) is approximately about $2.25/WDC. (See Figure 6) Community solar projects that are located near projects, reducing transmission and distribution costs, and using available space on parking lots and rooftops as well as unusable land can be a major resource for communities in building more resilient neighborhoods.

Energy Storage is also experiencing increased demand and substantial cost reductions as it becomes a tool to manage energy loads, provide increased reliability and resilience and a cost management tool. A recent analysis estimates storage costs dropping from 10% to 43% depending on the technology employed. While transmission costs from traditional energy resources remains far more cost effective especially for the residential sector, storage systems, especially at larger scales are becoming more and more cost effective.[8]

**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.

7 emp.lbl.gov, 11/1/2017, https://emp.lbl.gov/publications/utility-scale-solar-2015-empirical.

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

# Policy Drivers

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 CZAP and its goals. The following is a summary of the current legislation that impacts achieving zero net energy.

- 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.
- 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.
- 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) is working closely with stakeholders to develop 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 low performing buildings.
- AB 793 requires the utilities to install 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.
- Net Energy Metering (NEM) rules that dictate the rates that Solar and now storage users pay (or are paid based on excess generation) have incentivized the increase in rooftop solar and created extensive concerns related to unfair burden of costs for transmission and distribution costs to non-solar users. The CPUC in the NEM 2.0 proceedings will continued to evaluate and look at these rates including establishing time of use rates (TOU) beginning in 2019 (AB 327) that will help to balance loads and grid impacts. (Related Self Generation Incentive Program)
- 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 (R1311005). These plans provide an overview of all planned priorities and spending for the coming years, including establishing a number of ZNE programs.
- Local and regional planning related to land use planning, climate, sustainability, and resiliency.
- And more policies are being considered and developed from various agencies in California as represented in Figure 7. below.

# Zero Net Energy Definition

Defining ZNE has been one of the most complicated issues with stakeholders. Why does it matter how we define ZNE? 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:

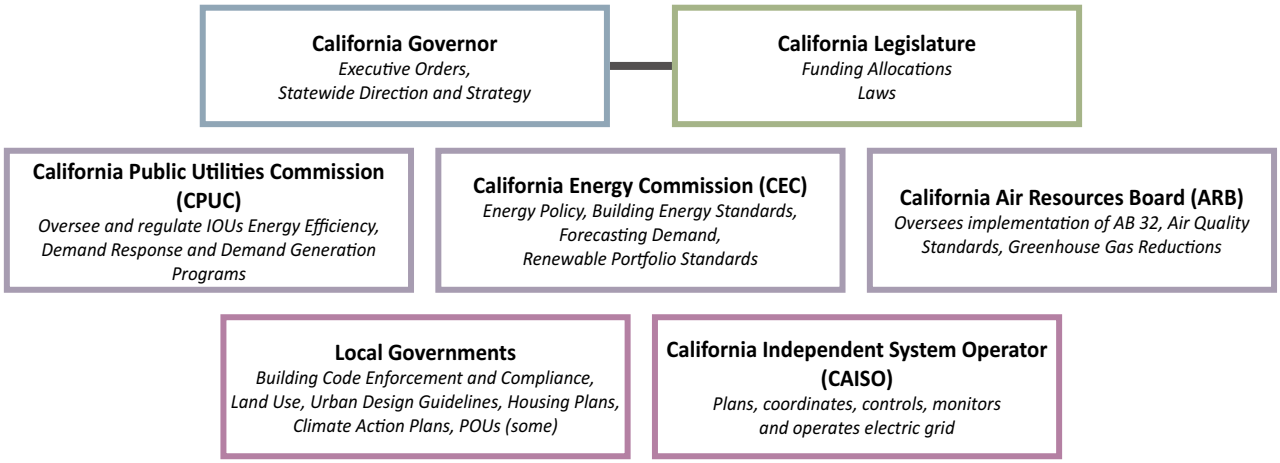
1. The development of the 2019 Building Code for new residential buildings and the Time Dependent Value (TDV) definition of ZNE; and

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.

For purposes of this Plan, we will use the DGS definitions, as they encompass new and existing buildings, as well as community-scale ZNE and portfolio based approaches to ZNE. (See sidebar)

**Figure 7. California's Lead Organizations and Agencies in Energy and ZNE Policies**



# 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.*

**DGS provides additional definitions on various approaches to 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 on-site renewable exported energy.

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

- A multiple building campus can be utilized as a boundary for on-site 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 on-site renewable energy is very restricted.
- This would also provide an outlet for on-site 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 on-site renewable exported energy.

1. Multiple building sites by the same owner could be used and aggregated so that the combined on-site renewable energy could off-site the combined building energy from the aggregated project sites. This could apply to the entire portfolio, or portions of the portfolio.
2. This approach would allow ZNE to be achieved for energy efficient buildings within the portfolio where the capacity for on-site renewable energy is very restricted.
3. This would also provide an outlet for on-site 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 on-site renewable exported energy.

1. 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 on-site 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[1] (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

*Photo Courtesy NBI: San Francisco ZNE Exploratorium*

# II. Market and Trends

# Understanding the Market

*"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 Update, page 7.

This section provides an overview of the Commercial building sector market in California. Key characteristics and trends that are relevant to the readiness and potential for ZNE are highlighted for new buildings and major renovations of existing buildings, as well as campus, corporate, and community approaches that involve multiple buildings in a single project.

This analysis indicates, that many of the elements to achieve ZNE in the commercial buildings market are in play and growing in strength. There is a clear move towards green building development, 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 resiliency and climate reduction strategies for communities. In a bold move, Moody's Investor Services, the bond rating firm, indicated in a November 2017 report that 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.

The Market Context and Trends is broken into several areas. These are:

- ZNE Commercial Buildings
- California's Commercial Buildings Market
- Decision Makers
- Power Supply, Grid and Infrastructure

## ZNE Commercial Buildings

Zero energy buildings (ZEBs) 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. Zero energy 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 zero net energy 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. A 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 191 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[9] (CBECS) building. (See Figure 8.)

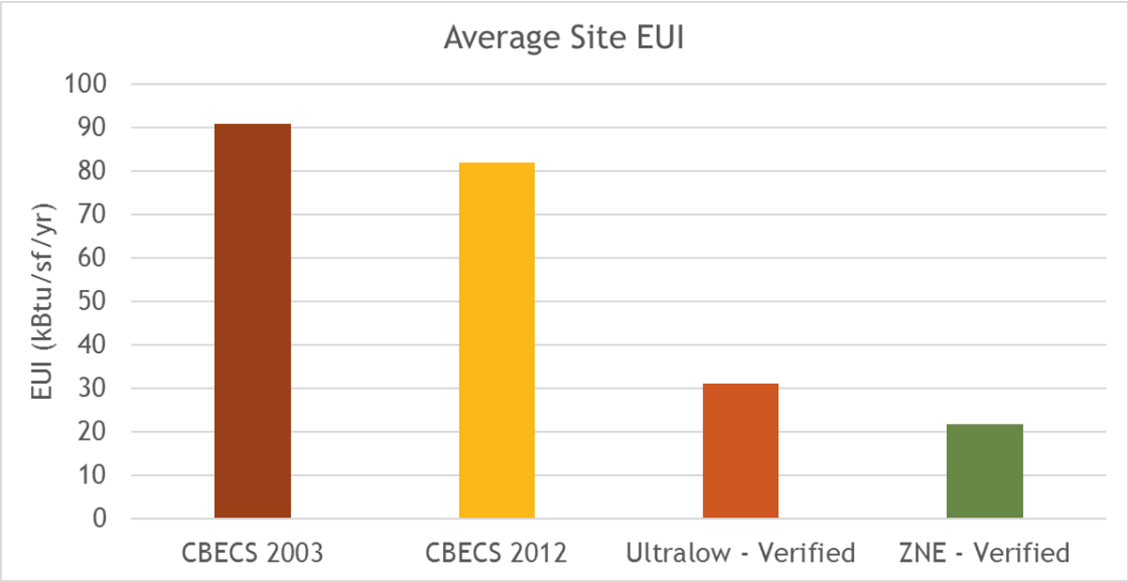
## Energy Use Intensity (EUI)

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:

**Figure 8. Energy Use Intensity (EUI) of ZNE buildings compared to a CBECS standard building. (NBI 2016)**




9 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.

1. ZNE buildings are technically feasible for nearly every building type (hospitals and high-rise buildings are more challenging).
2. 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.[10]
3. Cost is a complex issue for integrated building projects. However, a variety of ZEBs 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.
4. The Energy Commission is poised to approve a 2019 building standard under Title 24, Part 6 for residential building energy efficiency, which will for all intents and purposes require ZNE for all new residential buildings or high performance.
5. 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.
6. 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.

# Commercial Buildings 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.[11] The following information builds from data in the 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[12] 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
- Miscellaneous buildings (includes churches, gas stations, prisons, entertainment and movie venues, etc.)

Multifamily buildings over 4 units are also included as part of this Plan. They 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

10 ARUP, "The Technical Feasibility of Zero Net Energy Buildings in California," for PG&E, December 2012.
11 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.
12 Itron, Inc., California Energy Commission, "California Commercial End-Use Survey", March 2006, Page 8.

California and represent the fastest growing market segment.

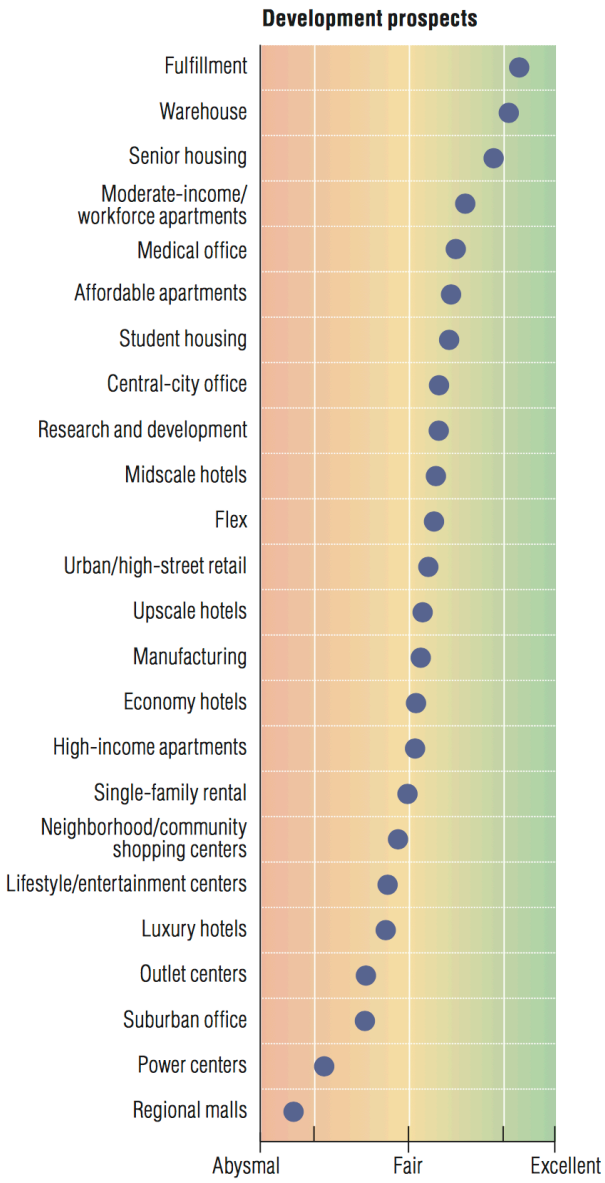
## Future Construction Trends

Forecasting future construction and the potential market for ZNE Commercial beyond a year or two is challenging due to changing economics, demand and trends in demographics and needs. Data from the Energy Commission and the Arup report[13] 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 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[14] 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 for various audiences, medical offices, warehouses and central city office buildings (Figure 9.) will continue to have excellent development prospects in the coming years. Regional malls throughout the country are the least likely to be developed, however, due to the extensive number of existing, poor performing malls, they 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.

**Figure 9. Current Commercial Development Trends**




*Source: Development Prospects (PwC/ULI 2017)*

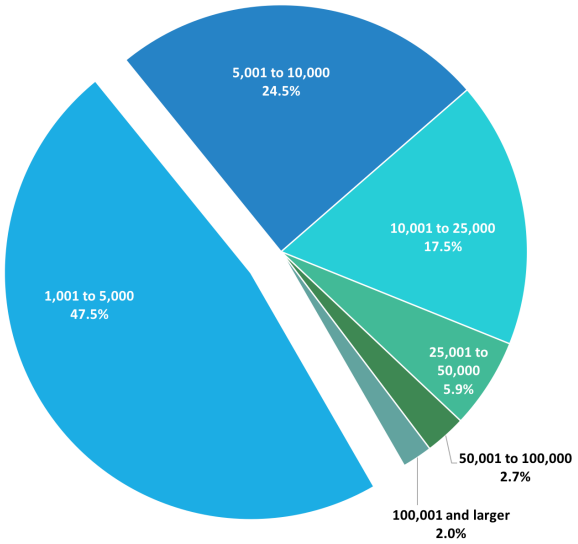
13www.energydataweb.com/cpucfiles/pdadocs/904/california_zne_technical_feasibility_report_final.pdf

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

## Size Matters

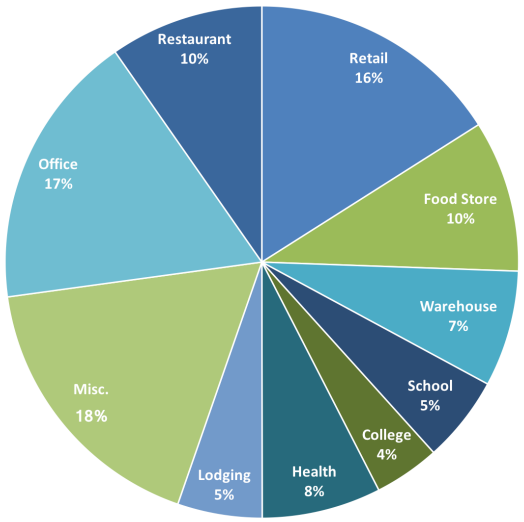
Building size is another important element of the commercial building market. While the perception is that the commercial building market is dominated by large, high-rise downtown areas, there are far more small and medium commercial properties. In the Western U.S. nearly half of commercial buildings 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).

**Figure 10. Number and Size of Buildings (sf) in Western U.S.**




*Source: CBECS 2012*

**Figure 11. Commercial Electrical Use by Building Type**




*Source: CEUS 2008*

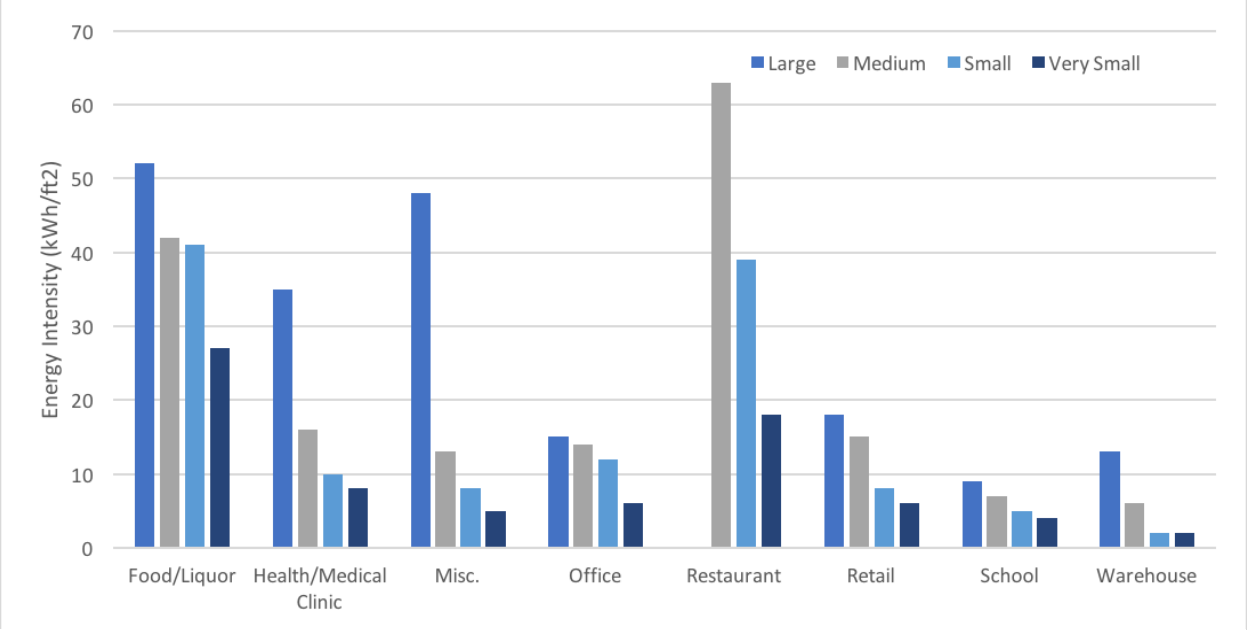
## Commercial Building Energy Use

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.[15] 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 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 average EUI of a typical commercial building and, Food Stores and Health Care facilities 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

15 Ibid.

**Figure 12. Avg. Energy Intensities by Business Type and Size**



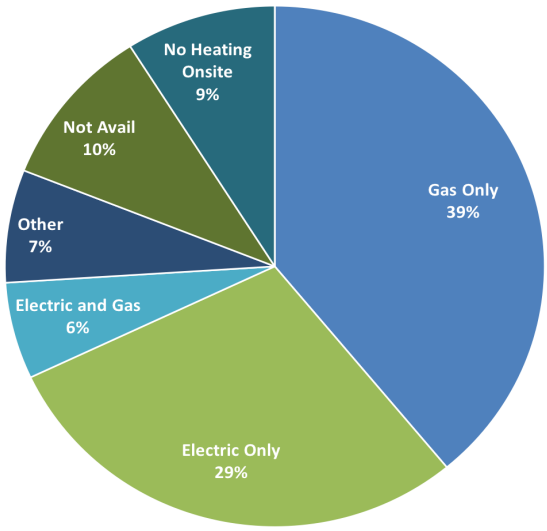

*Source: California Commercial Saturation Survey Report, 2014*

electrical consumption. This data indicates areas for potential focus for initial ZNE programs.

A 2014 report, the California Commercial Saturation Survey (CSS) by Itron, indicates that there are 500 million square feet of commercial businesses with solar PV installed. However, the energy usage of these buildings does not achieve Energy Use Intensities indicative of ZNE[16]. 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 had EMS with just 22% of medium business and 2% of small businesses. 15% of Schools have EMS. This implies 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 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

**Figure 13. Distribution of Heating Fuel Type**




*Source: CSS 2014*

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

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.

# Decision-Makers

*"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."*

*By Coral Davenport and Adam Nagourney, New York Times, May 23, 2017*

The ultimate success of Zero Net Energy 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 manager behavior to make sure the building operates at ZNE levels; as well as local government agencies who can approve and facilitate ZNE developments. It is essential to the CZAP'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

**Figure 14. Factors Influencing Design and Construction Decisions**

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

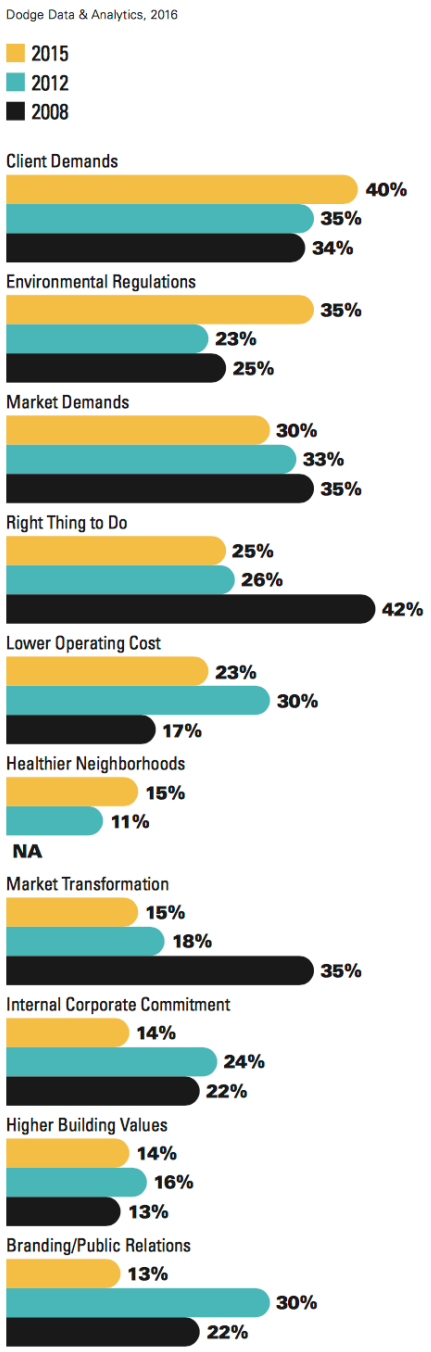
*Source: Dodge Data and Analytics, "The Drive Toward Healthier Buildings 2016"*

energy security and resiliency are very or extremely important for their future energy investments.[17]

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[18] 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 projects but only 30% of their total projects are actual considered green. This insight illustrates the difference between what people say they 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.

**Figure 15. Triggers Driving Future Green Building Activity by Year**




*Source: Dodge Data & Analytics, World Green Building Trends 2016.*

17 Johnson Controls 2017 Indicator Survey, http://www.johnsoncontrols.com/media-center/news.

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

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.[19]

Another Dodge report, "The Drive Toward Healthier Buildings 2016" details critical trends that are driving owners to develop heathier buildings, which aligns very closely to the measures required for ZNE buildings, including enhanced air quality, thermal comfort, and better lighting. In Figure 14., the various drivers for owners, architects, contractors are articulated. 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, but only 68% of architects and 63% of builders.

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

# Local Government

Government regulations are second to owner demands in driving green building and ZNE development and as such a critical player in reaching ZNE goals. (Figure 15.) What more, local governments direct land use planning via general plans and specific plans and can 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.

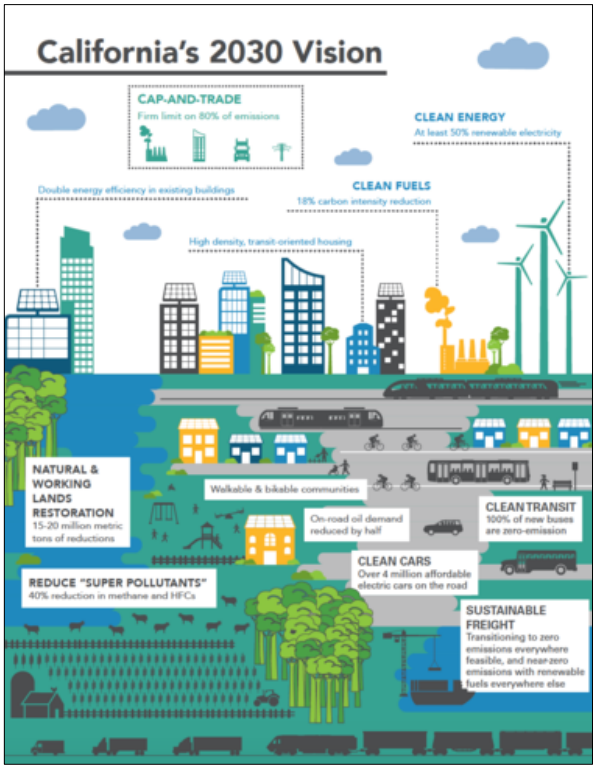



*Photo Vision from California Air Resources Board*

## Climate Action and Resiliency Planning

Based on AB 32/SB 32, local governments have developed local climate action plans for most of the jurisdictions in California. 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, urban design guidelines, transportation networks and dictating the mix and location of building types and uses. They rarely

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

consider energy or the potential for renewables in these Plans (the State Office of Planning and Research tracks the various elements in general plans and has identified approximately 11 jurisdictions with some level of energy element – mostly dedicated to energy efficiency for buildings). That 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. This includes 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 cities of Santa Monica, 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.

# Financial Market

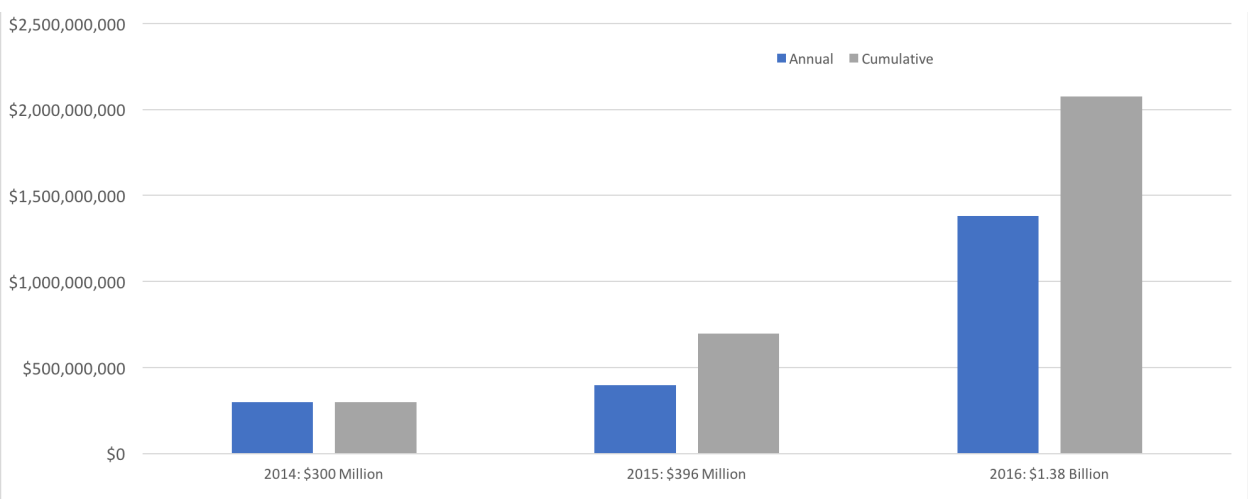
*"In 2016, green bonds became a significant and growing component of the overall bond market, with $93 billion in new bonds issued. Investor interest in these bonds has been driven by a growing pool of investors looking for low-risk instruments that meet environmental and social criteria."*

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

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. This 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 downgrading communities bond rating if they are not activity addressing the impacts of climate change. This 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, there were $11 billion[20] in green bonds issued in the United States. This market is expected to grow to $200 billion in 2018.[21] In Q3 2014 the state of California issued its first green bond and in 2016, agencies in the state issued over $1.38 billion in labeled green bonds, growing over a $1 billion as illustrated in Figure 14 [22]. Another area of growth is in Socially Responsible Investments (SRI) which

**Figure 16. California Green Muni Bond Issuances: Annual and Cumulative**




*Source: CalGreen Finance, "California Green Muni Bonds"*

20 climatebonds.net, 10/29/2017, (https://www.climatebonds.net/market/explaining-green-bonds)
21 PwC and Urban Land Institute, "Emerging Trends in Real Estate® 2018," Washington, DC, 2017, page 35.
22 calgreenfinance.com, 10/29/2017; (http://www.calgreenfinance.com/2017/01/california-green-muni-bonds-top-13.html)

equaled $8.7 trillion in the United States in 2016. These activities are fueled by investors looking for a triple-bottom line investment, those looking to hedge their bets on industries that face risks due to climate change[23]. 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**.[24]

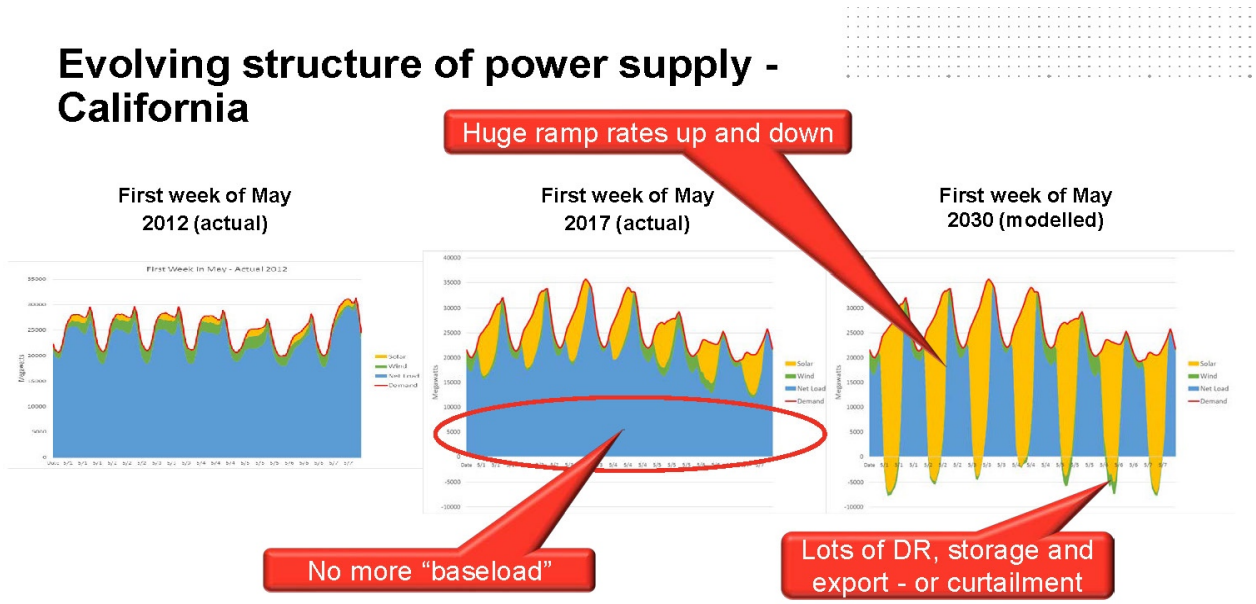
In California, a relatively underused financing mechanism called the Enhanced Infrastructure Financing District (EIFD) defined in SB 638/AB 313, allows infrastructure improvements, including renewables and energy efficiency, through a tax increment financing mechanism at the district or neighborhood 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.

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

24 Wall Street Journal, 2015.

**Figure 17. 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*

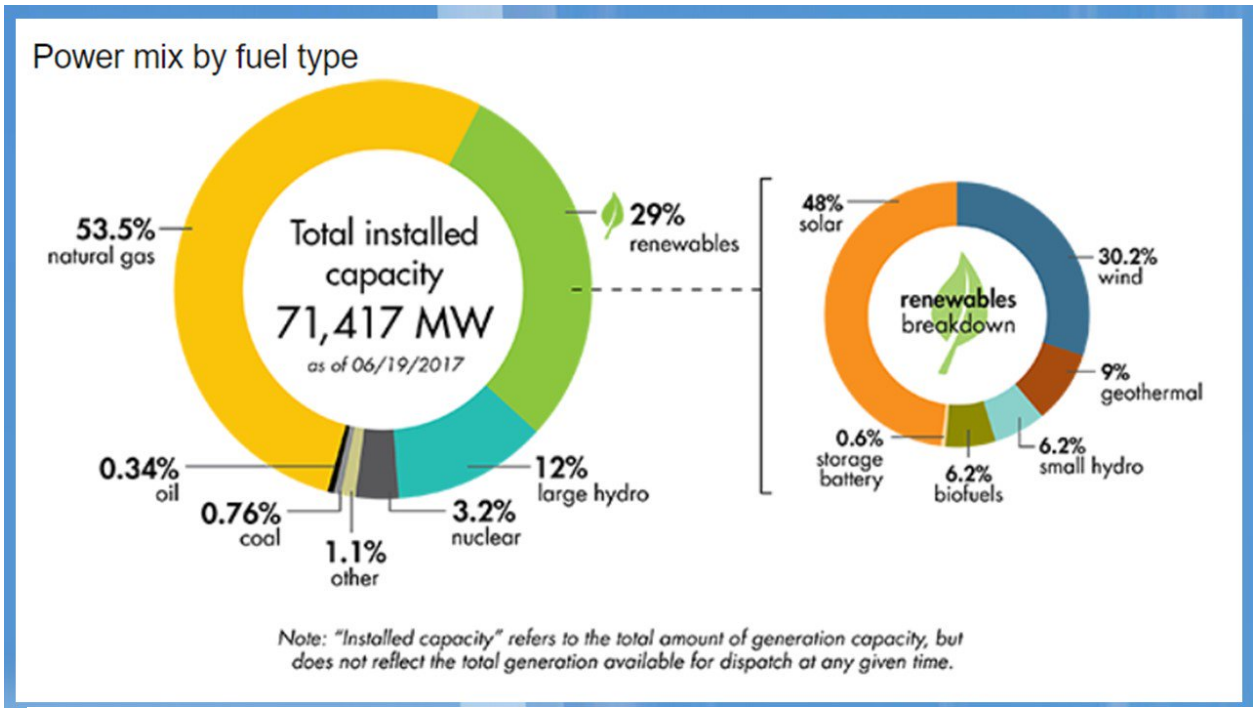
# Power Supply, Grid and Infrastructure

*"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."*
*- The Ecology of Community Solar Gardening, National Regulatory Research Institute*

To date, Zero Net Energy programs and efforts has 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. 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.

As Figure 17. illustrates, California's power supply has become more volatile and with the substantial increase in solar renewable power has resulted in excess power generation or curtailment. Due to the increase in renewables, the power stand by - 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: the massive natural gas leak at Aliso Canyon and the likelihood for many more leaks throughout the natural gas system; the closure of two nuclear power plants; and the increase risk of excessive droughts and reduced power from hydroelectric plants. The end result is that California needs a greater diversity of

**Figure 18. California's Power Mix by Fuel Type**




*Source: Utility Dive, CAISO Symposium, October 2017*

power supplies, that are clean, renewable and flexible[25].

ZNE projects, if redefined to incorporate distribute 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, reduce the need for new electricity generation and new transmission in achieving the state's energy goals while minimizing costs to ratepayers.[26] ZNE as an integrated resource can be an effective tool to achieve this goal.

## 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."*[27]

Another trend that has been evolving over the years is the decreasing cost of renewable energy. Many current reports indicate wind and solar[28] costs to be dropping steadily while energy production and consumption are increasing[29]. The conventional wisdom that renewable technologies depend on subsidies and that they are too costly to

25 Energy Commission, "Integrated Energy Policy Report 2017."
26 California Legislative Information, 11/28/2017, https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB338.
27 Stanton, Tom, et al, "The Ecology of Community Solar Gardening", National Regulatory Research Institute, August 2016.
28 NREL.gov, 11/1/2017, https://www.nrel.gov/docs/fy15osti/63604.pdf.
29 eia.gov. 11/1/2017, https://www.eia.gov/totalenergy/data/browser/?tbl=T10.01#/?f=M&start=200001.

integrate into the grid has become anachronistic. The Lawrence Berkeley National Laboratory in their report on solar energy that the price of photovoltaic panels has dropped so much in fact that it is changing the way power plants are set up[30].

Moving away from just solar on rooftops, community solar projects, especially 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 utility scale (over 500kW) is approximately about $2.25/WDC. (See Figure 19) Community solar projects that are located near projects, reducing transmission and distribution costs, and using available space on parking lots and rooftops as well as unusable land can be a major resource for communities in building more resilient neighborhoods.

Energy Storage is also experiencing increased demand and substantial cost reductions as it becomes a tool to manage energy loads, provide increased reliability and resilience and a cost management tool. A recent analysis estimates storage costs dropping from 10% to 43% depending on the technology employed. While transmission costs from traditional energy resources remains far more cost effective especially for the residential sector, storage systems, especially at larger scales are becoming more and more cost effective.[31]

### Distributed Energy Resources (DERs)

"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 (AEE)*

30 emp.lbl.gov, 11/1/2017, https://emp.lbl.gov/publications/utility-scale-solar-2015-empirical.

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


*Photo Courtesy NBI: Alameda County ZNE Library*

# III. 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. As detailed above, corporations and local governments are adopting goals of 100% renewable energy, which while defined a somewhat differently in the details, 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 that support better utilization of the existing grid rather than additional grid expansions. There are three primary components of this "grid friendliness":

## Locational Value

Build new solar arrays in geographical areas where the power generated can be more beneficial to grid operations, rather than requiring significant new grid investments, including transmission and distribution lines.

## Electricity Storage

Include storage in renewable DERs to dramatically change the demand profile to the grid, and allow the existing grid to spread additional kWhs across the day, ideally lowering consumer costs.

## Grid Integrated Control

Manage ZNE renewable energy generation and storage capability as part of the grid, rather than just one or more buildings.

Additional considerations include:

- Promote demand shifting and/or control within facilities to reduce loads. This could include measures like ice storage and off-peak water heating within buildings, which are lower cost than electricity storage.
- Encourage tilting axis solar arrays to change the generation profile.
- Incorporate EV charging infrastructure as part of DERs, which could support workplace and public charging during peak generation hours.

Larger commercial buildings can also benefit from this approach. The largest five percent of commercial buildings account for 50% of all of the square footage of commercial buildings, and nearly as much energy use.

The investment by corporations and communities (and their third-party partners) in renewable energy needs to be encouraged to incorporate a high level of grid friendliness. Given that the movement is new, a first step is market education, so that local government, corporations, and communities understand how to optimize their investment from a grid perspective, potentially while considering other benefits, such as resiliency or social benefits. A second step is providing incentives to renewable energy investments that meet clear criteria, based on the value to the grid of location, storage, and control. All of this while continuing to incentivize the development of high performing, easily controlled, energy efficiency buildings that can be used as a dynamic resource to the grid.

The drivers below first focus on getting new construction and major renovation[32] 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, and working with them to improve critical decisions around the investment.

# New Goal and New Focus

The revised goal, "Beginning in 2030, all new commercial buildings and major renovations of existing buildings achieve zero net energy performance (on-site or off-site renewables) and support grid optimization," differentiates from 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 provides for renewables to be provided **on-site or off-site** (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 a reasonable amount of renewables.

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

Ultimately, the Action Plan, as laid out in this section 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.

32 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.

# Action Plan Vision Framework

## GOAL

Beginning in 2030, all new commercial buildings and major renovations of existing buildings 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

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 and programs oriented to specific markets such as campuses and state buildings, should be designed to meet ZNE goals and enable ZNE projects and pilots, not just improve energy efficiency. **This funding and 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 training related to ZNE.

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. 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.

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. Additional issues related to community solar programs, net energy metering, rates and the like need to be addressed to remove unintended consequences of older policies.

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. The programs support multi-building ZNE districts as pilots in larger developments to further reduce costs and improve grid integration. The following have been identified as the initial targets.

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

Another critical area for 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 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.

In 2017, all program administrators (PAs) were required to submit Business Plans for the next ten years, identifying key strategies and program concepts 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. As currently written, the Business Plans do not reflect the goals and needs identified in this CZAP. There is an opportunity to align these efforts in the development of the Implementation Plans moving forward if so directed by the CPUC.

## Driver 1. Key Tactic Areas

| Tactic | Lead | Partner |
|---|---|---|
| **1.1 IOU 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. | IOUs | RENs/ CCAs |
| ○ 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 |
| • Provide technical assistance services to customers to support the integration of new technologies and design strategies. | IOUs | CCAs |
| • Provide additional incentives and/or rate structures that recognize locational value of specific projects. | IOUs | RENs |
| • Establish programs and funding for technical planning of ZNE projects. | | |
| ○ Align with local government and institutional facility planning. | | |
| • Leverage the Implementation Planning process to ensure there is alignment with CZAP's goals and strategies, and proposed ZNE programs and budgets. | CPUC | |

| Tactic | Lead | Partner |
|---|---|---|
| **1.2 Ongoing Building Performance Programs** | | |
| • Ensure that system and building level performance data are routinely captured and reported by advanced control systems and/or smart meters. | IOUs | |
| • Create training and technical assistance programs for building operators and remote contractors to diagnose problems and maintain system and building performance levels. | IOUs | Manufacturers |
| • Establish incentive structures to reward property owners that maintain and enhance building energy performance.<br>  ○ Explore Pay-for-Performance programs for Commercial ZNE. | IOUs | |
| **1.3 Pilot Programs** | | |
| • Develop pilot programs to support ZNE performance by demonstrating new approaches, including projects that incorporate multiple buildings. | IOUs | |
| • Develop demonstrations of grid integration at the campus and community scale. (Connected to Driver 4) | IOUs | CCAs/RENs |
| • Document and share lessons learned from pilot efforts to inform future market activity. | RENs | IOUs |
| • Develop programs that extend beyond energy efficiency and link to DERs, DRP, and other IOU efforts. | IOUs | 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. | CPUC | |
| • Coordinate and facilitate the ability of local governments to establish locational value of ZNE projects. | CPUC | RENs/IOUs/ LGP |
| • Encourage and support coordination and partnerships between IOUs, RENs, and CCAs to establish innovative approaches to achieving goals. | CPUC | |
| **1.5 ZNE Industry Training and Education** | | |
| • PA Programs, IOU Workforce Education and Training, and other providers coordinate to offer a full spectrum of educational degrees, certificates and career training.<br>  ○ Focus efforts on architects, engineers, large builders, development community, planners, and project managers.<br>  ○ Education should include integrated design, advanced mechanical systems, advanced controls, passive systems, renewable energy and building-grid integration.<br>  ○ 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

1. Program Administrator Implementation Plans support and align with CZAP's goals and strategies.
2. 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.
3. Program dollars dedicated and spent for ZNE and ZNE-Ready projects increase annually.
4. Buildings served by the program are designed and operated to control loads and generation to support and enhance grid operations, including on-site energy storage.
5. Establishment of a program mechanism to measure and reward energy performance after one year of occupancy that incorporates energy loads not regulated by building energy codes.
6. Multi-building scale ZNE-scale pilots are undertaken and documented.
7. Industry-supported ZNE education is available across 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 use 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 utilities 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 Systems 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 their activities for the program.

**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 utilities provide assistance to the California Energy Commission to update the appliance and buildings codes. They 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:** The Emerging Technologies Program (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:** Energy Division oversees workforce education and training programs implemented by the investor-owned utilities. These 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 good 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. Further, 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 as well as mixed 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 most laypeople. Issues related to grid optimization, energy pricing, storage options, cost tradeoffs, and conventional thinking about the benefits of solar on roofs can confuse 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. Further, it is critical to develop simple to understand and use tools to help them make decisions that are right for the market, for the grid, and for carbon reduction goals.

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

### 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 component of growing the market.

- 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 commitment and recognition programs to help encourage the development of ZNE projects.
- 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.

## 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.<br>○ Provide information about ZNE benefits from property owner and business perspective.<br>○ Provide information about financial and structural/operational options that support incorporation of grid-friendly ZNE within development plans.<br>○ Develop and promote specific case studies that represent best practices within the owner communities.<br>○ 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 |
| **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/resiliency. | EPIC/ IOUs | RENs/CCAs |
| • Develop ZNE commitment campaigns targeted to corporate leaders.<br>○ Institutional, corporate, and commercial real estate.<br>○ ZNE higher education campuses and communities. | EPIC/ IOUs | RENs/CCAs |
| • Support and recognize leadership within commercial building professions, planning, and implementation. | WE&T - TBD | |

| Tactic | Lead | Partner |
|---|---|---|
| **2.3 Decision-Making Tools**<br>• 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.<br>  ○ Provide proof-of-concept and business case information.<br>  ○ Provide economic analysis of utility incentives and rate benefits based on locational value.<br>  ○ Engage the financial community to better understand costs and benefits.<br>  ○ Provide data that can support the improved valuation of low-carbon buildings. | TBD | Advocacy Groups |
| • Create and launch a ZNE discussion/decision-making tool to help facilitate informed decision-making and awareness of key issues and benefits. | CPUC | |
| • Support the development and deployment of high-level modeling and visualization tools to help communities make informed decisions at a larger than building scale. | IOUs/ET | |

## Driver 2. Success Indicators

1. Increase in market awareness and demand for ZNE projects.
2. Building owners, both public and private, increasingly pursue projects that utilize renewable energy to meet all energy requirements as part of their overall development strategy.
3. A commitment campaign is launched, including communications development, media strategy, and key partners.
4. Increased commitments to ZNE or 100% renewables at the community, corporate, and campus levels.
5. 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.
6. There is a library of resources that provide best practices, case studies, and governance/financial models for ZNE projects at all scales.
7. Financing mechanisms and property appraisals reflect the value of ZNE performance-level projects.

# Driver 3. Local Government Capacity & Readiness to Implement

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

## 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, and development entitlement process.

### Driver 3. Overview

Local governments as indicated in the market analysis is at the center of the ability of the State to achieve the aggressive climate goals. To that end, local governments need to be supported, encouraged, and recognized as leaders in enabling innovation and making sure there are the right conditions to pursue ZNE projects. Maximizing the potential of local governments includes leveraging RENs, CCAs, state and regional government efforts.

### 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 that can accommodate and support the economies of scale possible at the district level. In addition, policies need to provide sufficient signals to the market at the state level including appropriate fees and tariff including updating the NEM rules to support a robust market that can be self-sustaining and reduce impacts to non-participants.

### Governance

There is a need to identify, or in some cases 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 if they require long-term engagement. RENs on the other hand, as extensions of local government, can be 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 power provider, and governance body for a large project.

## Driver 3. Key Tactic Areas

| Tactic | Lead | Partner |
|---|---|---|
| **3.1 Local Government Enabling Policies**<br>• Develop Model Policy Guidance for local governments.<br>  ○ ZNE Commercial Policies.<br>  ○ 100% Renewables Policies.<br>  ○ Support development of Reach Codes.<br>• 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. | RENs<br><br><br>CPUC | IOUs, CEC/ Advocacy Groups<br><br>OPR |
| **3.2 Local Government Education**<br>• Provide supportive ZNE education, training, and technical assistance to local governments.<br>  ○ Provide tools, education, and training for municipalities (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.<br>  ○ 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 Enabling State Policy and Legislation**<br>• Conduct a policy/legislation needs assessment to identify gaps, conflicts, and approaches to support ZNE projects.<br>  ○ 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.<br>  ○ Update and improve community solar and community storage policies to enable ZNE District programs.<br>• Continue to support, direct, and fund RENs and CCA's to support grid-friendly ZNE at the regional and local level. | CPUC<br><br><br><br>CPUC | CEC/ Governor's Office |

## Driver 3. Success Indicators

1. Local governments adopt ZNE Commercial policies in advance of 2030 to support and provide a foundation for future codes.
2. Local government land use planning, zoning, and building departments understand and support ZNE design and construction needs.
3. State, regional and local policy forums consider ZNE goals and discuss related policies and programs.
4. The CPUC is actively working with stakeholders and the State to address and minimize identified barriers to grid-friendly ZNE.
5. The State Office of Planning and Research (OPR) supports and provides guidance for the development of ZNE districts in Specific Plan and General Plan guidelines by 2019.
6. CCAs and RENs are funded and leveraged as links 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 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 resiliency. Campus and district-scale projects can take advantage of a variety of ownership and financing mechanisms, which can reduce both first costs and potentially, long-term costs.

Incorporating storage in district-scale projects can provide options to improve demand management and grid interaction while also enhancing grid resiliency 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 that can also integrate water, waste, and transportation outcomes

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.

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 in 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 may be 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 related work in California and around the country. | 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 |
| • Better define the specific benefits of locational value for community-scale projects to the grid, including incentives available to reduce grid constraints. | IOUs | CPUC |
| • Identify funding from EPIC and other state and local resources to help fund pilot and demonstration programs. | CEC | |
| • Develop DER/ZNE pilot and demonstration programs. | IOUs | EPIC |
| • Establish a portfolio of options to finance district-scale projects.<br>o DGS public-public partnerships.<br>o Expansion and support for enhanced infrastructure finance districts (EIFD).<br>o Explore and develop Existing building financing mechanisms that benefits from district-scale renewables and energy systems. | State/ CPUC | |
| **4.3 Align IOU and PA and District Efforts** | | |
| • Ensure that pilot utility DER programs align and support district-scale projects. | 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 renovated 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

1. Establishment of initial ZNE districts guidance, support and incentives for pilot programs by January 2019.
2. Establishment of the value of integrated distributed resource to the grid.
3. Increased annual growth in ZNE districts with integrated storage.
4. Demand load curves are flattened and better managed in areas with ZNE districts and buildings.
5. ZNE districts become a central strategy in local resiliency and economic development planning.
6. Distributed Resource Plans (DRP) utilize ZNE districts as a tool for meeting goals.
7. Development of enhanced ZNE district support resources.
8. There are a variety of accessible financing and funding tools and resources for ZNE projects.
9. A mechanism exists to fund deep energy retrofits or renovation of existing buildings that can include ZNE level of performance.
10. 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 with ZNE are core components of making the transition to routine practice and ultimately to building codes and standards.

Research and development need to include assessing the value, costs, 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.

Beyond design and construction, research is needed to improve the occupant interface and support whole building performance and behavior over time.

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

## Driver 5. Key Tactic Areas

| Tactic | Lead | Partner |
|---|---|---|
| **5.1 Building Performance**<br>• Conduct research and development of building-related systems including advanced controls systems, passive system approaches and storage integration to better control demand.<br>  ○ Support improved efficiency in appliances/plug loads.<br>  ○ Research mechanisms to provide feedback on building performance and maintain building performance over time.<br>  ○ Support development of innovative products and technologies that reduce costs, and implementation barriers.<br>  ○ Focus on new and cost-effective ways to upgrade and improve energy efficiency and ability of existing buildings to achieve ZNE performance levels. | IOU<br>ET/<br>CEC | Manufact. |
| **5.2. Planning and Modeling Tools**<br>• Improve land use and energy planning and modeling tools for grid integration of distributed resources.<br>  ○ Enhance modeling for ZNE of advanced building systems and grid integration.<br>  ○ Develop new tools to analyze grid needs at a community level.<br>  ○ Explore building scale distributed resource tools (storage, alternatives to PV, EV).<br>  ○ Improve the ability to more fully visualize, integrate and manage electric transportation options and alternative energy integration at the campus and community scale. | CEC | Nat'l Lab/<br>Private<br>firms |
| **5.3 District-Scale Systems**<br>• Develop and utilize energy analytical tools to understand and manage ZEDs.<br>• Develop new ways to integrate water and waste into ZEDs, and create new energy sources.<br>  ○ Create innovative approaches to balance transportation, EV, and storage needs. | CEC<br>Local<br>Govt | Local Govt<br>RENs |
| **5.4 Research Partnerships**<br>• Coordinate and engage with DOE and National Labs.<br>• Leverage lessons learned from district energy systems and stormwater to fiber optics and transportation systems. | IOU<br>ET/<br>CEC | |

## Driver 5. Success Indicators

1. ZNE cost-effectiveness is improved across all building types and is within 5% of standard building practices for 90% of buildings in 2030.
2. Number of demonstration projects illustrating new ZNE-ready technologies at both the building and district level. (Or number of committed manufacturers working with EPIC and ETP to develop new technologies & strategies.)
3. 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 commercial buildings by 2030, allowing renewables to be provided locally or on site.

### Driver 6. Overview

California has had a very active and effective energy code process for many years. IOUs work to prove emerging technologies and help 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 providing documentation on costs and practicality. The CEC will ultimately evaluate the cost effectiveness and feasibility of making ZNE code for all commercial building types.

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. These changes may expand energy code scope to support the transition to whole building performance rather than modeled performance. The industry and local government agencies involved in enforcing the codes need to be prepared 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.

Ultimately, the building code will provide a baseline for what buildings should achieve, not necessarily the ideal goal. Therefore, while establishing ZNE-level 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 development of 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. | CEC | |
| • Develop a pathway for state energy codes to reach ZNE for almost all building types by 2030. | CEC | |
| • Support advancement of building code and product standards. | CEC | |
| • Pursue code at ZNE performance level for all building types; and low carbon for large/complex buildings. | CEC | |
| **6.2 Reach Codes** | | |
| • Adopt reach codes at the local development level to demonstrate the viability of statewide ZNE codes. | Local Gov | |
| • Support advancement of building code and product standards. | RENs | |
| • 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 |

## 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.
- Development of code compliance trade-offs to enable innovation within defined ZNE districts.
- 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.

# IV. 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 is not to prescribe a particular path, but to expand the conversation and provide 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. The goal is to spark innovative ideas and projects that maximize the benefits of ZNE.

## Using the Discussion Tool

The discussion tool is an initial step for property owners, local governments, and organizations interested in pursuing ZNE. It helps to reframe what are 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 your discussion and ranking of your objectives.

1. Defining a Grid-friendly Project

2. Paths to ZNE

3. Customer Objectives and Discussion Questions

This is the first phase of the Tool and the goal is to work with stakeholders over the coming year to enhance and refine it over the coming year. (We welcome feedback and insights on how to improve it.) In addition, we recognize that understanding the details related to costs 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. This extended tool will be available in 2018 or early 2019.

*Photo: International Brotherhood of Electric Workers of San Leandro ZNE Center*

# Defining a Grid-Friendly Project

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 resiliency 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).

# Paths to ZNE

The following "Paths to ZNE" are general examples of potential approaches to ZNE projects. Aligning your 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, there are limited completed case studies.


*J. Craig Venter Center, UCSD*

## 1. Building Scale (On-site Solar Only)

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

**Grid friendliness:** Low - inability to serve load on-site outside of solar generation hours. May reduce summer distribution peaks. Does not reduce transmission and distribution.

## 2. Building Scale (Solar + Storage On-site)

ZNE is achieved on-site with storage capabilities, includes 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.

*Photo: Google Headquarters*

## 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. How is solar distributed, does it serve a locational and time value?

*Photo Mountain. View Los Altos High School District – Solar + Storage*

## 4. Community Solar Plus Storage (Local)

As above 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.

Particular useful when it supports locational benefits.

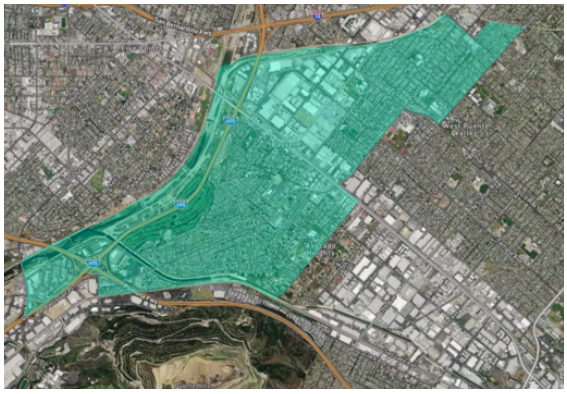


*Photo Avocado Heights, Los Angeles EPIC, AEC District Planning*

## 5. District ZNE/Grid Connected Microgrid (On-site)

Multi-faceted distributed energy system on-site, 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.

*Photo. Solar Farm in Southern California*

## 6. Utility Scale Renewables (Off-site, 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 resiliency. Locational value and increased reliability may not be considerations.

# Customer Objectives and Discussion Questions

The following are the "Customer Objective" categories that are designed to help determine what is important to your ZNE project. Additional questions have been added under each to spur additional conversation and to hone in on the relative importance of that objective. These can help to frame any ZNE project, but also 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 you begin this process, you should 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 is your utility provider? Are there incentives or other programs that you are eligible for?
- Are you located with an active or soon to be established CCA?

## Sustainability

Reduces environmental footprint by providing on-site (or nearby) energy supply; reduction or elimination of fossil fuels/natural gas; supports sustainable transportation choices, Local Climate Action Plan, and green building practices.

- Does your organization have a Local Climate Action Plan or Sustainability Plan that this project will address?
- What will the impact of this project be on your sustainability goals?
- Will your project be a model of sustainability for your City or region?

## Resiliency

Increase ability to withstand and recover from adverse events, in particular to function during larger grid outages; mitigate effects of disruptive events on local communities.

- Does your organization have goals for climate adaptation?
- Is resiliency during power disruptions a priority for your project or organization?
- Does this project need to maintain electricity in emergency situations, such as first 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? Some backup power is needed, full back up power is needed?
- Do you plan to install, or do you have, a fossil fueled generator as part of resiliency?
- Will your project reduce risks in emergency situations?

## Carbon Zero/Neutral Development

Creates no new greenhouse gas emissions or GHG are 100% offset. Assumes if a project relies on grid power, that there are some associated GHG emissions.

- Is your goal to have 100% renewable or clean energy?
- Is this project trying to achieve electrification (i.e. no fossil fuels used on site, and 100% renewable electricity)?
- Are you looking to integrate electric vehicle (EVs) charging into the project?

## Infrastructure Modernization

Project will improve other infrastructure not associated with the building - water, sewer, fiber network, etc.; ability to leverage new or existing district-scale systems, 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

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)?
- Can you partner with a CCA?

## Certification

Contributes 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.

- Does your organization want your project to be certified?
- What certification are you interested in?
- What does this project need to achieve in terms of energy provision to make sure you get the certification?

## Monetization of Energy

Enable energy system to be leveraged for revenue generation; offset of costs.

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

## Economic Development

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

## Asset Control/Management

Increase control of the management and operations of physical assets related to energy systems and investments.

- Is it important to your organization that you control and own the energy infrastructure as part of this project?
- Do you have the financial resources to purchase, install and manage the solar array, are you looking for external financing/managements, or are you interested in an alternative financing structure such as a lease or a project share?

## Ease of Access/Entitlement

Ability to receive incentives to streamline development or reduce barriers to implementation or get entitlements.

- Will entitlement incentives or streamlining be important for your project to succeed?

## Architecture Flexibility

Reduces the need for roof space/architectural changes for solar arrays on building siting and building design, and provides more design flexibility/innovation.

- Are you interested in architectural design that has the flexibility for various roof designs, or can it be designed to accommodate solar PV?
- Do you have sufficient land for community scale solar and storage?
- Are there shading or tree issues that would limit the space you have for solar panels?

## Optimize Electricity Rates

Enhanced ability to manage and distribute energy loads across different buildings and/or uses, flatten energy demand peaks and reduces costs to customer.

- Is it a goal to carefully manage electric loads to reduce demand charges?
- Are you planning 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 cost increase for a solution.

- How will you calculate your project costs?
- Will you consider the benefits of lower operating costs when balancing your capital costs (aka total cost of ownership)?
- Will you incorporate costs/benefits such carbon into your project?

## Financing Options

Ability to leverage other Government and/or private industry partnerships for funding, financing and/or other resources.

- Will the size of your project help financing options?
- Are there local programs or incentives that could help finance your project?
- Can you leverage other infrastructure investments into your project to create an economy of scale?
- Is the project within a special tax district?
- Can you utilize the Enhanced Infrastructure Financing District tool (EIFD)?

## Level of Effort

Incremental increase in time, resources and effort to implement.

- What are your organization's goals for the length of the project and the level of effort?
- Do you have the 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.

- Are you planning to be the owner and tenant of the project? Or are you a developer that may not need to consider operations?
- Is lowering your operating costs a goal?

## Environmental Justice

Provides a benefit to disadvantaged communities, increases affordability and access to renewable energy, and helps to lower bills.

- Will or do you want this project to help disadvantaged communities?
- How can you optimize those benefits if it is a goal?
- Will the addition of community solar and storage help?
- Will working with disadvantaged communities help ensure support of the project?

# ZNE Projects Examples

The development of ZNE projects, 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.

## Commercial and Residential Developments

There are numerous examples of leading builders, architects and developers incorporating low- and zero energy features, with hundreds of commercial building examples and thousands of residential buildings that have achieved zero energy performance in California. The "Net Zero Energy Building Report" (Navigant Consulting, 2016) estimate that the North American **market for Zero Energy Buildings will grow at an annual rate of 38%, increasing in size to $127 billion in 2035.** The report lists perceived and real costs and lack of awareness and education as the primary challenges to growing the market.

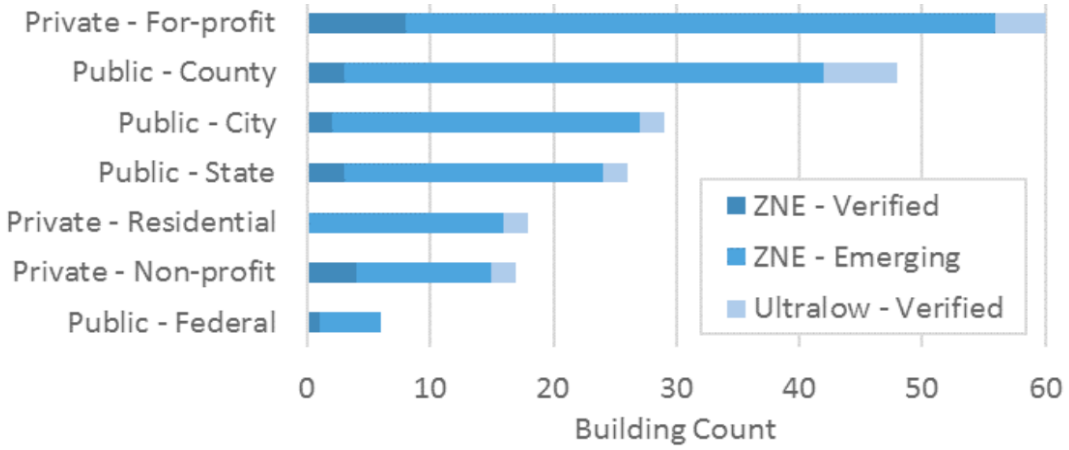
California has led the nation in ZNE commercial construction since formal tracking began in 2011. The New Buildings Institute's most recent list of California ZNE buildings includes 204 ZNE projects either completed or under construction. ZNE commercial buildings and campuses have now reached approximately 14 million square feet in California, including the University of California Merced campus project. Private buildings account for approximately 40% of the buildings with a wide variety of office buildings, multifamily dwellings and corporate/retail buildings. Public buildings represent over 50% and including K-12 schools, universities, and local state and national government projects.

## University and College ZNE Initiatives

Universities and colleges are also working on towards reducing their carbon footprints and using ZNE initiatives as one of the tools. An important example is the University of California has committed to become carbon neutral by 2025 through their "Carbon Neutrality Initiative". Specific projects included are utilizing ZNE as an element to achieve their goals and include the following:

- UC San Diego now generates about 85% of its electricity using an ultra-clean and efficient cogeneration plant, the world's largest commercial fuel cell and solar panels.
- UC Davis has built a net-zero community on its 130-acre West Village campus that provides housing for approximately 3,000 people in 662 apartments and 343 single-family homes.

**Figure 19. California Commercial ZNE Buildings by Building Ownership (n= 204)**




*Source: New Buildings Institute, 2017*

- UC Irvine has 3.7 MW of solar throughout the campus.
- UC Merced, the newest addition to the UC system, has implemented their comprehensive Triple Zero Commitment which aims for zero net energy use, the creation of zero net landfill waste and climate neutrality on campus by 2020 while nearly doubling the campus's physical capacity by that same year.

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 CSU's 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 their campus during peak demand. They are also planning 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.

Over $165 million in funding has been provided for community college projects statewide including energy efficiency and solar arrays.[33] 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 reallocating 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. Two school districts: Oakland Unified School District and San Diego School

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

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

District have recently been recognized as early leaders with their commitment to ZNE.

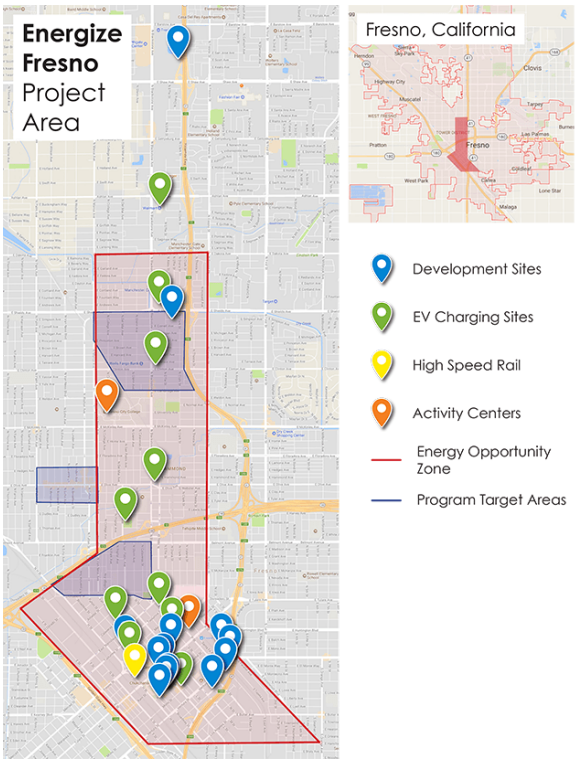
## District-Scale Advanced Energy Communities and ZNE Districts

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. ZNE buildings have demonstrated how to link deep efficiency with renewables and advanced building operation to achieve remarkable energy performance. District-scale ZNE efforts have the ability to address and encompass existing buildings in a district by sharing renewable power, 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.

### EPIC Advance Energy Communities

In 2016, the Energy Commission awarded approximately $16 million dollars to 13 grantees for "Accelerating the Deployment of Advanced Energy Communities." This Phase I solicitation focuses on researching barriers and opportunities, designing a strategic framework and an energy master plan, and developing models and tools for target pilot communities. Teams comprised of building developers, local governments, technology developers, researchers, utilities, and other project partners will spend 18 months developing innovative and replicable plans for Advanced Energy Communities. Projects will be eligible for Phase II funding to implement specific projects in the pilot communities, most of which aim to develop micro-grids or advance zero net energy implementation.

**Figure 20. EPIC Advance Energy Community: Energize Fresno District**




- Santa Monica Advanced Energy City Yards District, City of Santa Monica
- Integrated Community Resource Marketplace: Energize Fresno, Local Government Commission
- Berkeley Energy Assurance Transformation (BEAT) Project, City of Berkeley
- Peninsula Advanced Energy Community (PAEC), Natural Capitalism Solutions
- Huntington Beach Advanced Energy Community Blueprint, University of California Irvine
- Accelerating AEC Deployment Around Existing Buildings in Disadvantaged Communities, University of California Los Angeles
- Zero Net Energy Farms, Biodico, Inc.
- EnSEED (Encanto Social-Economic and Environmental Education Development), Groundwork San Diego, Chollas Creek

- The Oakland EcoBlock – A ZNE, Low Water Use Retrofit Project, University of California, Berkeley
- ZipPower San Leandro, Olidata Smart Cities
- Advanced Renewable Energy Community for Disadvantaged California Community, Charge Bliss, City of Carson
- Richmond Advance Energy Community Project, The Zero Net Energy Alliance
- Lancaster Advanced Energy Community Project, The Zero Net Energy Alliance

## EcoDistricts

EcoDistrict certification process focuses on the development of a roadmap to establish an advance sustainable and equitable community. The EcoDistrict protocol requires projects to emphasize three key tenets: equity, resilience, and climate protection. While zero net energy is not a requirement, it is an essential tool to achieve many of the protocol's goals, dependent on the city or project. There are 11 communities in 10 cities across North America that have committed to this certification[34].

The City of San Francisco is currently developing five EcoDistricts[35] within the city that include acquiring upgrading infrastructure, creating greener public housing and private buildings, and transit infrastructure. The City of Los Angeles is developing a similar effort, the Crenshaw Corridor. Project goals include the development of two mixed-use facilities with solar; and a new affordable senior housing project.

## 2030 Districts

2030 Districts are public/private partnerships in urban areas organized by the nonprofit organization, Architecture 2030. Through benchmarking, strategic development and implementing best practices, the organization is working in 15 cites including San Francisco and Los Angeles, to adopt aggressive energy performance targets. Through the "2030 Challenge for Planning" they work to renovate existing buildings to a 70% reduction in energy use relative to typical buildings. The goal is that all new building and major renovations are to be carbon neutral by 2030.

## 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.[36]

The following examples of microgrids serve different purposes, but illustrate how effective organization of renewables with DER optimize energy usage and generation to achieve resilience, reliability and sustainability:[37]

- **Santa Rita Jail:** The Santa Rita Jail is an excellent demonstration of a microgrid and includes approximately 1.5 MW of PV, a 1.0 MW molten carbonate fuel cell, back-up diesel generators and a 2 MW Lithium-Ion battery and functions either grid connected or islanded[38].
- **City of Berkeley Parking Garage**: The City of Berkeley is completing construction of a 720-space parking garage microgrid[39]. The microgrid is designed to power the structure and can be used as clean backup energy to neighboring key buildings, such as City Hall and the Public Safety Building.

34 Ecodistricts.org, 11/7/2017, (https://ecodistricts.org/district-registry/)
35 sf-planning.org, 11/7/2017, sf-planning.org/sustainable-development.
36 microgridinstitute.org, 11/7/2017, www.microgridinstitute.org/about-microgrids.html.
37 microgridinstitute.org, 11/7/2017, http://www.microgridinstitute.org/uploads/1/8/9/9/18995065/microgrid_institute_-_naseo_presentation_v2.4.pdf.
38 building-microgrid.lbl.gov, 11/7/2017, https://building-microgrid.lbl.gov/santa-rita-jail.
39 cityofberkeley.info, 11/7/2017, https://www.cityofberkeley.info/City_Manager/Press_Releases/2016/2016-07-12_Microgrid_for_a_Resilient_Berkeley.aspx.

- **College of Marin/Tesla Demonstration:** In an effort to kick-start demand for its Powerpack energy storage solution, Tesla Energy is initiating pilot projects that demonstrate the value of energy storage to potential customers in the commercial space. One of the first of these pilots, a 4-MW storage project at California's College of Marin.[40]

40 marinij.com, 11/7/2017, http://www.marinij.com/article/NO/20160515/NEWS/160519871.

# Glossary of Terms

# Glossary of 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**: 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)**: A non-utility based energy source, typically from a renewable source such as rooftop PV or community solar. A ZNE building or district can and should be consider a DER. DER are smaller power **sources** that can be aggregated to provide power necessary to meet regular demand. As the electricity grid continues to modernize, DER such as storage and advanced renewable technologies can help facilitate the transition to a smarter 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.

**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-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.

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

**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.