

SAM – ENERGY AND SUSTAINABILITY

ZERO NET ENERGY FOR NEW AND EXISTING STATE BUILDINGS

1815.31

(New 10/2017)

Purpose

This policy was outlined in Management Memo 17-04 and provides state agencies and building professionals with the requirements for meeting zero net energy (ZNE), as well as the direction, strategies and procedures that will help them achieve ZNE for new building design and construction, and build-to-suit leases, as well as existing state-owned buildings.

This policy is part of a series of directives to state agencies designed to implement the Governor's Executive Order (EO) B-18-12 on energy and resource conservation in state buildings.

Policy

[Executive Order B-18-12](#) requires the following actions to reduce the environmental impact of state facilities on climate change:

- All new State buildings and major renovations beginning design after 2025 shall be constructed as Zero Net Energy facilities.
- 50% of new facilities beginning design after 2020 shall be Zero Net Energy.
- State agencies shall also take measures toward achieving Zero Net Energy for 50% of the square footage of existing State-owned building area by 2025.

To facilitate achieving these goals the following shall apply:

- All new state buildings, major renovations, and build-to-suit leases beginning design after October 23, 2017, shall be designed and built following cost-effective energy efficiency strategies for achieving ZNE identified below.
- Departments shall work to improve energy efficiency in existing buildings in the most cost cost-effective manner to meet or exceed energy efficiency targets established in energy efficiency strategies for achieving ZNE identified below.
- Renewable energy generation shall be added to state facilities either onsite, and/or offsite to achieve EO B-18-12 targets by following renewable energy generation prioritization and strategies identified below.

Reporting Requirements

Energy use reporting is already required monthly into the ENERGY STAR Portfolio Manager database (see [SAM chapter 1815.4](#)). Departments shall also provide status on compliance with this policy in their department *Sustainability Road Map*.

Definition of Zero Net Energy (ZNE)

ZNE Source – *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.*

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Definition of Zero Net Energy (ZNE) (continued)

Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all fuel extraction, transmission, delivery, and production losses. By taking *all* energy use into account, the ZNE definition provides a complete assessment of energy used in buildings.

Definitions of other terms can be found in the Green California [Glossary](#).

Energy Measurement and Calculation

Measurement of source energy converts all energy sources into common units of *Source kBtu* using established conversion factors for each energy source. Energy use quantities are included in the Energy Star Portfolio Manager reporting¹. Source energy conversion factors shall be applied to energy metrics from all energy sources, including district energy and renewable energy and shall be based on national averages in ASHRAE Standard 105-2014². They are also included in a [ZNE Calculator](#) for State Buildings. Energy used for Zero Emission Vehicle charging or fueling is excluded from building total energy for ZNE calculations.

State agencies shall utilize the following strategies to achieve ZNE at state facilities whenever possible and cost-effective to ensure the highest output and efficiency possible, reduce long-term operating budgets and reduce or avoid any uneconomical over-generation of renewable energy:

1. **Energy Efficiency** – Ultra-low energy use through energy conservation, passive systems and whole-building integrated energy efficiency measures should always be the initial focus for each building pursuing ZNE.
 - a. **New Construction, Major Renovations and Build-to-Suit Leases** – All new projects shall exceed the applicable version of California code (California Code of Regulations, Title 24, Part 6), by fifteen percent or more. (This is already required by EO B-18-12 and identified in its [Green Building Action Plan](#))
 - Build-to-suit leases apply where the state will likely become the eventual owner of the building, and the state is the sole tenant.

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¹ State agency and facility energy use is posted on the [governor's green building website](#), and will eventually include energy efficiency metrics and ZNE data.

² ASHRAE Standard 105-2014, Table J2A. Primary Energy Conversion Factors for National Comparisons

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Energy Measurement and Calculation (continued)

- All new projects should design and construction facilities to maximize efficiency, and accommodate on-site renewable energy to the extent feasible and cost-effective, whether onsite renewables are installed with new project, or at a later date. This may include site orientation, massing, layout, landscape design, roof design and orientation, and mechanical/electrical room layouts. If onsite renewable energy is not possible, or feasible, other renewable energy generation strategies may be utilized (see Renewable Energy Generation categories below.)
 - Design and install conduits and chases for eventual wiring and plumbing required for connecting site and/or building renewable energy systems to mechanical/electrical rooms.
 - Departments with decision-making authority are responsible to implement energy efficiency measures into all new construction and major renovation projects, and meet energy efficiency targets, or exceed them to the extent cost effective. The Department of General Services (DGS) is responsible for implementing these measures into buildings for Departments without this authority.
 - All departments are responsible to conserve energy to the extent feasible, through procurement of energy-efficient office equipment, and other measures identified in [SAM Section 1805.3 – Standard Operating Efficiency Procedures](#).
 - A [ZNE Decision Making Matrix](#) for State Agencies helps identify measures and responsibilities of owners, tenants of new and existing state buildings pursuing ZNE.
- b. Existing Buildings** – Existing state buildings should strive to achieve high levels of energy efficiency before adding renewable energy to achieve ZNE. While state agencies are required to take measures toward achieving ZNE on 50 percent or more of their building area, they should work to achieve high energy efficiency levels in their entire portfolios to the extent cost effective.
- Energy efficiency for ZNE is to be measured using Source Energy Use Intensity (Source EUI), and uses the following units of measurement – **kBtu/sq. ft. Source** (thousand British thermal units per square foot of building area). This metric can currently be extracted from the Energy Star Portfolio Manager in a report, but can also be calculated using the [ZNE Calculator](#).

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Energy Measurement and Calculation (continued)

- Energy efficiency targets for existing state buildings are derived from 2015 historic state-owned building energy data and some national data. These energy efficiency targets are established as the top quartile of energy use for each building type. For some building types (i.e. offices & other types) EUI targets are established for some specific state occupancies, as well. This accounts for variations from differences in occupancy, hours of use, equipment, etc.
- [Source EUI targets](#) for Existing State Buildings are all listed in the linked table and includes variations for each of the 16 California Climate Zones. These are soft EUI targets that state agencies should attempt to achieve for buildings or facilities pursuing ZNE. They are intended as a guide, as some circumstances may vary affecting the feasible achievability of some targets.
- Energy use reduction in existing buildings can be achieved through a variety of measures including:
 - Upgrading lighting systems and controls to more efficient systems
 - Upgrading heating, ventilation and air conditioning (HVAC) systems and/or controls for improved efficiency
 - Improving thermal performance of building envelope (insulation, glazing, roofing, etc.)
 - Reducing plug loads by improving efficiency of equipment and appliances used in building ([see SAM chapter 1805](#))
 - Energy conservation measures of occupants
 - Retro-commissioning and monitoring-based commissioning, as required and outlined by SAM Section 1815.3
 - The [DGS Energy Efficiency Retrofit Program](#) provides support for state departments on energy efficiency upgrades utilizing ESCo's, and other alternative financing options.
- A [ZNE Decision Making Matrix](#) for State Agencies helps identify measures and responsibilities of owners, tenants of new and existing state buildings pursuing ZNE.

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Renewable Energy Generation

In addition to achievement of energy efficiency targets, renewable energy must be generated and used to offset the annual energy use of the facilities achieving ZNE. Renewable energy generation should come from the following sources, as much as possible in the priority listed (a through d below), but can include a combination of the following approaches. In all cases Renewable Energy Credits (RECs) must be retired (not sold to other customers) for all renewable energy systems.

- a. **Building** – Generate and use renewable energy on-site to the extent possible and cost-effective.
 - This can utilize rooftops, or the building site (parking lot, adjacent land) for on-site renewable generation.
 - On-site systems can be purchased as part of projects, procured through Power Purchase Agreements (PPA's), or through other means. DGS provides assistance procuring PPA's through its [Clean Energy Generation Program](#).
 - It is strongly advised that all on-site renewable energy system procurement include services for operation and maintenance to assure that system operation and generation persists for the life of the equipment.
- b. **Campus** – Generate and use renewable energy within a multiple building campus to the extent possible.
 - This can utilize rooftops, or the building or campus site (parking lot, adjacent land, common areas) for on-site renewable generation.
 - Advantages of campus generation include that excess renewable energy generation, above the amount of the building(s) achieving ZNE can be used to offset other campus loads.
- c. **Portfolio** – Generate and use renewable energy within an owner's portfolio to the extent possible.
 - Multiple building sites by the same owner could be used and aggregated so that the combined on-site renewable energy could offset the combined building energy from the aggregated building sites. This could apply to the entire portfolio, or portions of the portfolio.
 - This approach would allow ZNE to be achieved for energy-efficient buildings within the portfolio where the capacity for on-site renewable energy is very restricted. While preferable, it is not required that renewable generation using the portfolio approach be in the same utility grid as the building achieving ZNE.

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- This approach may require a cooperative agreement with the utility, and could also provide an outlet for excess renewable energy production during periods of the day when over-generation of electricity is likely, to avoid financial losses from selling back excess energy wholesale to utilities.
- d. **Community** – Generate renewable energy within the state for use at the facility, after other feasible options have been exhausted to the extent possible.
- This could be applied to allow long-term purchase agreements of state-generated, renewable energy, dedicated to providing energy for the building(s). Agreements should extend a minimum of 20 years, and must specify that the RECs are owned by the electricity customer and retired by the utility.
 - Some utilities may offer customers the opportunity to enter a long-term contract to purchase renewable energy from the utility for some portion of the energy used at the site. The contract must be for at least 20 years and must specify that RECs are owned by the electricity customer and will be retired by the utility.
 - Short-term RECs would not be allowed to be counted toward achievement of ZNE, while they are still effective to reduce GHG emissions.
- e. **Other renewable generation strategies to consider**
- **Share excess generation** – Whenever possible, excess generation should be utilized on-site through energy storage, with other buildings on campus, or through utility agreements with other buildings in portfolio.
 - **Install energy storage** – Utilize on-site energy storage (batteries, thermal, etc.) to shift energy use for peak load reduction, limit over-generation sent back to the grid, reduce demand charges, reduce energy costs by taking advantage of time-of-use (TOU) rates, and provide cloud cover and outage protection for the facility.
 - **PV array orientation** – To the extent possible, orient the PV arrays in way that maximizes alignment of the onsite generation with the onsite electrical load. This approach should be reviewed and adjusted over time to provide alignment with the needs of the utility grid.

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Renewable Energy Generation (Continued)

- **Use over-generated energy for EVSE charging** – Electric vehicle service equipment (EVSE) can utilize excess energy generated to charge electric vehicles. This will help reduce or avoid export of over-generated electricity, and help agencies meet zero-emission vehicle charging infrastructure goals. Energy used for electric vehicle charging does not count toward building energy use, nor does it need to be included in ZNE building calculations. However, electricity generated through on-site renewables that is used for EV charging can be used in ZNE calculations to offset non-EV-charging electricity and natural gas use at the site.
- **Renewable heating and cooling** (including ground source heat pumps or district heating), electrification, and other technologies to improve efficiency.
- **Mixed source of renewable energy** – Consider mixed sources of renewable energy from multiple sources, to mirror best grid optimization. For example, wind power also generates without sunlight, and during non-daylight hours.
- **Renewable heating and cooling** (including ground source heat pumps or district heating), electrification, and other technologies to improve efficiency.

Additional Energy Reference Policies

State departments should have implemented the practices incorporated into the [State Administrative Manual \(SAM\) Chapter 1800, *Sustainable Operations and Practices*](#), in the operation and maintenance of their facilities. Chapters that contain energy policies include:

- Standard Operating Procedures for Energy Management in State Buildings (Section 1805)
- Procedures for Energy Management in State Buildings During Electrical Emergencies (Section 1810)
- Energy Use Reduction for New, Existing and Leased Buildings (Section 1815)
- Energy Efficiency in Data Centers and Server Rooms (Section 1820)

[State of California Zero Net Energy Resources and Guides](#)

State of California Energy Efficiency Targets for Existing State Buildings Pursuing Zero Net Energy (ZNE)

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[State of California Zero Net Energy Resources and Guides](#) (continued)

- [Source EUI targets](#) – Table identifying energy efficiency (Energy Use Intensity) targets for existing state buildings to achieve or exceed when pursuing ZNE. Targets use Source EUI metrics that can be retrieved from Energy Star Portfolio Manager in a report, or calculated using_ZNE Calculator.
- [ZNE Calculator](#) – Spreadsheet calculator developed by California Department of General Services to calculate Source EUI, estimate renewable energy generation and/or photovoltaic array requirements, and to verify achievement of ZNE after 12 months of energy data is verified.
- [ZNE Decision Making Matrix for State Agencies](#) – Guideline for what decisions need to be made by owners, tenants, etc., for state ZNE buildings.

Information and Directories:

- [Getting to Zero Database](#) – Database of verified and emerging ZNE buildings. Agencies are encouraged to submit information on their buildings that have been built or upgraded to be ZNE, as well as after 12 months of energy data have verified achievement.

Guidelines and Resources:

- [New Buildings Institute Zero Net Energy Hub](#) – Website with resources and tools supporting ZNE, energy efficiency and other related efforts.
- [The Technical Feasibility of Zero Net Energy Buildings in California](#) – A ZNE technical report by ARUP for PG&E published December 2012.
- [The Road to ZNE: Mapping Pathways to ZNE Buildings in California](#) – A ZNE report by HMG for California Utilities, published December 2012.
- Net Zero Energy Design: A Guide for Commercial Architecture, Thomas Hootman, 2012
- Design Professional's Guide to Zero Net Energy Buildings, Charles Eley, 2016
- [How-To Guide for Energy-Performance-Based Procurement: An Integrated Approach for Whole Building High Performance Specifications in Commercial Buildings](#) – NREL, 2013
- [Introduction to Cost Control Strategies for Zero Energy Buildings: High-Performance Design and Construction on a Budget](#) – NREL, 2014
- [Cost Control Strategies for Zero Energy Buildings: High-Performance Design and Construction on a Budget](#) – NREL, 2014
- [An Energy-Performance-Based Design-Build Process: Strategies for Procuring High-Performance Buildings on Typical Construction Budgets: Preprint](#) – NREL, 2014

Case Studies:

- [Zero Net Energy Case Study Buildings Volume 1](#) – Six case studies of ZNE buildings published in September 2014, written by Edward Dean for PG&E
- [Zero Net Energy Case Study Buildings Volume 2](#) – Five case studies of ZNE buildings published April 2016, written by Edward Dean for PG&E
- [Zero-Net Energy Case Studies](#) – New Buildings Institute, 2014. Brief case studies of various ZNE buildings in US. [More NBI case studies at this link.](#)