

Frequently Asked Questions About Zero Net Energy (ZNE)

Palomar Community College | San Marcos, CA
Credit: Nick Merrick © Hall+Merrick 2019

What is a zero net energy building?

A zero net energy (ZNE) building is an energy efficient building that produces as much energy as it consumes over the course of a year.

What are the key design elements of a ZNE building?

Buildings commonly achieve ZNE with:

- high envelope performance
- system energy efficiency
- the addition of renewable power generation
- building controls and smart operations

ZNE buildings are not just designed but also operated to meet the high efficiency performance level. Design teams should provide operator and occupant training and tools to ensure optimal operation.

What about existing buildings?

Renovating existing buildings is important to substantially reduce the environmental impacts of buildings, as 99% of the building stock in the U.S. is existing. Nearly a third of the buildings in the New Buildings Institute's (NBI's) [Getting to Zero Buildings Database](#) are existing building renovations. NBI's [Five Steps to Net Zero Energy](#) guide helps architects and engineers upgrade their existing buildings to be ZNE.

Are ZNE buildings feasible in all climates?

Yes. There are numerous examples of ZNE buildings around the country, built by various design teams and developers, across many different residential and commercial building types. ZNE building projects are in all U.S. climates. Mild climates with plenty of sunshine, like Southern California, certainly help make ZNE buildings more easily achievable, but successful projects have also been completed in harsher climates like those in Minnesota or New York.

What are the benefits of ZNE buildings?

ZNE buildings and homes are higher performing, offering superior comfort, and healthier places to work and live. Because ZNE buildings often use passive strategies such as natural ventilation and daylighting, they are more resilient to the impacts of climate change. On-site renewables allow occupants to comfortably shelter in place during utility grid disruption events. Additionally, ZNE buildings are also less vulnerable to rising energy prices.

Developers of ZNE buildings have experienced faster lease-up times while tenants see higher employee satisfaction and retention, reducing business expenses. **Homeowners and businesses** pay less for energy, which gives them more money to spend on necessities or grow a company.

Investment in ZNE practices and technologies creates local jobs, workforce development pathways for underrepresented populations, new products that can be exported. They also strengthen local economies and help gain control of energy demand.

Why are ZNE buildings important?

Buildings account for nearly 40% of U.S. greenhouse gas (GHG) emissions, contributing to global climate change. Energy efficient improvements in design and operations substantially reduce the environmental impacts associated with buildings, as they are an essential strategy to help reduce emissions.

How are local communities considered?

Buildings are primarily constructed for people's health, well-being, and safety. It is crucial to consider communities on the frontlines of climate change during the construction and development of a ZNE building. Teams should understand:

- How the construction or renovation will benefit the local community
- How the community will have building/site access
- How to engage, consult, and incorporate local community neighborhood goals
- How the project builds hiring pathways and opportunities for underrepresented populations
- How to prioritize diversity, equity, and inclusion in the design, construction, and operations

What if I have limited space on-site for renewables?

Even on the most energy-efficient buildings, limited rooftop space on high-rise structures and shading from adjacent buildings mean that ZNE buildings with solar photovoltaics (PVs) on-site may not be practical. Building-integrated PV products offer an innovative solution that could help address the limitations of roof space for siting renewable generation. "ZNE Ready" refers to energy efficient buildings that have been designed to accept future on-site renewables. These buildings could access renewable generation from a community-scale project located offsite or purchase renewable energy from SDG&E, retaining the renewable energy certificates (RECs) for the building's life.

What is California doing to advance ZNE buildings?

To date, California has more ZNE buildings than any other U.S. state due to its ambitious California Energy Efficiency Strategic Plan:

- All new residential construction achieved ZNE levels as of the 2019 code.
- All new commercial construction will be ZNE by 2030.
- 50% of commercial buildings will be retrofitted to ZNE by 2030.
- 50% of new major renovations of state buildings will be ZNE by 2025.

Additionally, AB 3232 addresses the reduction of GHG emissions from the state's residential and commercial building stock by at least 40% below 1990 levels by January 1, 2030. CA jurisdictions with ZNE policies and codes include San Diego, Lancaster, Santa Monica, Marin, and many more. Local leaders understand there is more work to be done to lower GHG emissions. Local governments are developing more financial incentives that prioritize historically underrepresented, low-income communities, and clean power options that acknowledge indigenous land rights.

How is carbon addressed in ZNE buildings?

ZNE buildings are focused on offsetting operational energy with renewable energy. Carbon emissions associated with grid-based energy and on-site combustion are likely to be reduced in ZNE buildings, but are not necessarily carbon neutral. Carbon neutral buildings may address operational carbon, upfront embodied carbon of building materials, or consider the whole life embodied carbon.

Do ZNE buildings need to be all-electric?

Some programs require ZNE buildings to be all-electric, but not all. To meet the definition of a ZNE building, all fuels—gas and electric, measured at the site or source—must be offset through on-site renewables to be ZNE.

How do I create a ZNE building?

Achieving ZNE is most cost effectively achieved with a combination of deep energy efficiency and renewable energy production. Considering occupant and neighbor engagement ensure that the building integrates into the existing community framework. The following steps are recommended.

MAKE A ZNE COMMITMENT: Establish ZNE as a key project objective and ensure that this goal is explicit in all project documents, including the request for qualifications, and request for proposals.

ALIGN WITH LOCAL COMMUNITY: Consult neighborhood leaders to understand and address neighborhood goals. ZNE buildings should respond to local conditions and support an inclusive workforce.

INTEGRATE THE DESIGN PROCESS: A successful ZNE outcome requires a design team committed to the fundamentals of the integrated design process. The integrated design process is collaborative and aligns all stakeholders to an agreed-upon high performance building goal, considering design, construction, operation, and occupancy.

SET PERFORMANCE TARGET: A ZNE building necessitates establishing an EUI performance target and requirements through every phase of the design process to verify the energy impact of key design decisions. Energy targets must align with the availability of on-site energy production.

SIGNIFICANTLY REDUCE LOADS: The most critical factor in creating a ZNE building is the maximum reduction of all building energy loads through passive design strategies and highly efficient technologies.

OPTIMIZE OPERATIONS AND MEASURE RESULTS: Ensure low-energy building operation by implementing monitoring and verification strategies, management of plug loads, and engaging tenants in energy-efficient behavior using tenant guidelines, green purchasing policies (e.g., for appliances), and/or green leases. The increased attention to operations requires a sustained focus and building management staff expertise, but it is critical to achieving ZNE performance.

How efficient are typical ZNE buildings?

A ZNE building is an energy efficient building that produces renewable energy generation. Energy efficiency is measured as an Energy Use Intensity (EUI) target. The exact targets vary by building type and climate, but generally, buildings should use about one-third of the energy of typical existing commercial buildings—about 18 kBtu/sf/yr, or less for an office building. The best examples are ~20 kBtu/sf/yr. Best-in-class high-intensity building types, such as restaurants and hospitals, have a higher target, near 45 kBtu/sf/yr.

What are the additional costs to build for ZNE performance?

According to the California Zero Net Energy Buildings Cost Study, commercial buildings have achieved ZNE (or near ZNE) at little or no additional cost. Low-cost examples are usually due to trade-offs made through integrated design, higher-performing, higher-cost envelope offsets the price of a smaller, less expensive HVAC system, resulting in no additional cost.

Several studies have found the incremental first cost of ZNE buildings to be in the range of 0% to 15% more than conventional construction costs. This incremental cost is for design and construction only and does not consider the life-cycle cost savings of lower energy costs to operate the building over time.

Does ZNE equal a zero cost utility bill?

Probably not. Over the course of a year, a building will draw energy from the grid when renewable generation is low, and other times it will return energy to the grid or a battery storage system when it generates more than is used. Utility bills also include ongoing charges for maintenance of transmission and distribution lines beyond the cost of energy.

How do I know if my building has achieved ZNE performance?

Metered energy data will illustrate if the building has met a ZNE standard—both grid-derived energy and energy generated by the on-site renewable sources. Because ZNE buildings achieve this status over the course of a year, data at full occupancy for 12 consecutive months is required to verify ZNE performance. Proper management of plug loads, controls, and occupant behavior has a significant and ongoing impact on a building's energy performance.

Buildings designed to be ZNE may not be designated ZNE for a year after the doors are officially opened. New Buildings Institute (NBI) verifies 12 months of energy consumption and generation data for all fuels to confirm zero energy performance. NBI maintains a list of ZNE and ZNE-capable buildings. In addition, the [International Living Future Institute](#) offers Zero Net Energy and Net Zero Carbon certifications. [LEED Zero](#) is another platform to independently certify ZNE performance.

Resources

NBI maintains a collection of ZNE resources, including case studies, research, and tools and guides for getting your project to ZNE. Visit gettingtozeroforum.org.



New Buildings Institute (NBI) is a nonprofit organization driving better energy performance in commercial buildings. We work collaboratively with industry market players—governments, utilities, energy efficiency advocates and building professionals—to promote advanced design practices, innovative technologies, public policies and programs that improve energy efficiency. We also develop and offer guidance and tools to support the design and construction of energy efficient buildings.

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