

The Bullitt Center | Seattle, WA  
Photo: Bullitt Foundation



Rooftop Mini Split HVAC Vertical | Washington DC  
Photo: New Buildings Institute

## What is a zero energy building?

A zero energy (ZE) building produces as much energy as it consumes over the course of a year. These buildings achieve ZE first through high levels of energy efficiency, and then through the addition of on-site renewable power generation.

## Are ZE buildings feasible?

Yes. There are numerous examples of ZE buildings around the country, built by a variety of design teams and developers, across many different residential and commercial building types.

Zero energy building projects are located in all U.S. climates. Mild climates certainly help make zero energy buildings more easily achievable, but successful projects have also been completed in the harsher climates of Minnesota, Massachusetts, and New York.

ZE performance is frequently an added feature of buildings that already have a strong energy-efficient design and a low energy use intensity.

## What are the benefits of ZE buildings?

ZE buildings and homes are higher performing, offering superior comfort and healthier places to work and live. Because ZE buildings use passive strategies such as natural ventilation and daylighting, they are more resilient to the impacts of climate change and are also less vulnerable to rising energy prices.

ZE developers 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 in turn gives them more money to spend on necessities or to grow the company.

Investment in ZE practices and technologies creates local jobs and new products that can be exported worldwide, strengthens local economies, and helps us gain control of our energy future.



David and Lucile Packard Foundation | Los Altos, CA  
Photo: Jeremy Bittermann

## Why is it important to make buildings ZE?

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. Buildings are an important strategy to help reduce emissions.

With rising energy costs, increasing climate-related impacts, and natural disasters, ZE buildings help reduce our demand for energy and provide more resilience to climate impacts. Additionally, passive building design strategies coupled with on-site renewables allow for occupants to comfortably shelter in place during utility grid disruption events.

## 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 means that ZE buildings with solar photovoltaics (PVs) on-site may not be practical in urban cores. In the future, building-integrated PV products offer an innovative solution that could help address limitations of roof space for siting renewable generation. “ZE Capable” or “ZE Ready” refers to buildings that are as energy efficient as ZE buildings but don’t have PV on-site. These buildings could access renewable generation from a community-scale project located elsewhere or purchase renewable energy from the local utility retaining the renewable energy certificates (RECs) for the life of the building.

## Who are the leaders in advancing ZE buildings?

Governments in California, New York, and Washington, D.C., have set the stage for leadership by:

**PUBLIC BUILDING LEADERSHIP:** Encourage and support public buildings’ deep and continuing energy performance improvement.

**MARKET LEADERSHIP AND DEVELOPMENT:** Reward early adopters of high performing buildings and spotlight success through education and recognition.

**CODES AND POLICIES:** Create public codes and policies that support improved building performance and require enhanced measurement and reporting.

**FINANCE AND INCENTIVES:** Effective financial mechanisms and incentives remove first-cost barriers that can stall projects.

**CLEAN POWER:** Encourage development of clean power options.

Other leading states include Massachusetts, Vermont, Oregon, and Washington. In all cases, progressive policies and programs are driving increases in ZE projects.

## Does ZE mean all fuels or electric only?

To meet the definition of a ZE building, all fuels—gas and electric, measured at the site or source—must be offset through on-site renewables to be truly ZE.

Some definitions refer to ZE electric buildings, which do not offset direct use of gas or other fossil fuels. Alternatively, other definitions preclude the use of any combustion fuel at all.

## How do I create a ZE building?

Achieving ZE requires a combination of deep energy efficiency and renewable energy production. Designing for high energy performance is the first step and requires establishing a goal at the beginning of the project and working under an “integrated design process.” Design teams must:

**MAKE A ZE COMMITMENT:** Establish ZE as a key project objective and ensure that this goal is explicit in all project documents (RFQs and RFPs).

**INTEGRATE THE DESIGN PROCESS:** A successful ZE outcome requires a design team that is committed to the fundamentals of the integrated design process before design starts.

**SET PERFORMANCE TARGETS:** A ZE building necessitates the establishment of performance targets and requirements through every phase of the design process in order to verify the impact of key design decisions.

**SIGNIFICANTLY REDUCE LOADS:** The most critical factor in creating a ZE building is the maximum reduction of all building loads through the use of 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 through the use of 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 a critical aspect of achieving ZE performance.

## How efficient are typical ZE or ZE-capable buildings?

A commitment to energy efficiency should be the first step toward ZE. 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 30 kBtu/sf/yr, or less. The best examples are closer to 20 kBtu/sf/yr. Generally, for single-family residential buildings, the energy use intensity (EUI) for ZE performance is 11-17 kBtu/sf/yr. And high-intensity building types such as restaurants and hospitals often have a higher target, near 45 kBtu/sf/yr.

## What are the additional costs to build for ZE performance?

There are examples of commercial buildings achieving ZE (or near ZE) at little or no additional cost. Low-cost examples are usually due to trade-offs made by the project team through an integrated design process.

Several studies have found the incremental cost of ZE 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 ZE 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 ZE performance?

Metered data will illustrate if the building has met a ZE standard—both grid-derived energy and energy generated by the on-site renewable sources. Because ZE buildings achieve this status over the course of a year, data at full occupancy for 12 consecutive months is required to verify zero energy performance.

Proper management of plug loads, controls, and occupant behavior all have a significant and ongoing impact on a building’s energy performance. This means that buildings designed to be ZE may not be designated ZE for some time 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 ZE and ZE-capable buildings. In addition, the International Living Future Institute offers a Zero Energy certification.

## RESOURCES

To access NBI's collection of ZE resources, including case studies, research, and tools and guides for getting your project to ZE, visit [gettingtozeroforum.org](http://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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