



Zero Net Carbon (ZNC) Building

In December 2015, the world came together in Paris and reached a monumental agreement to limit global average temperature increase to “well below 2°C and to drive efforts to limit the temperature increase even further to 1.5°C above pre-industrial levels.”

To realize this goal, the [scientific community estimates](#) that the world must peak CO₂ emissions by 2020, reach zero fossil fuel emissions by about 2050 and zero total global greenhouse gas (GHG) emissions by 2060 to 2080.

Today, [cities](#) are responsible for 70% of global energy consumption and approximately 75% of GHG emissions, mostly from building energy use. Over the next two decades, it’s projected that about 900 billion square feet of [additional building area](#) will be built or rebuilt in cities worldwide to accommodate approximately 1.1 billion [new city dwellers](#). To put this in perspective, the entire population of the western hemisphere is about 1.1 billion people. This trend points toward urban buildings and built environments as the source of solutions to address the climate change crisis.

To keep the global average temperature increase to well below 2°C, the building sector must adopt a clear definition for both new and existing building energy consumption that is based on zero net CO₂ emissions.

A Pathway for All Building Types

A **zero net carbon (ZNC)** building definition must accommodate all building types – new and existing residential, commercial, institutional, and industrial buildings – in various settings, including those located in dense urban environments where on-site renewable energy production may be limited. A ZNC building is here defined as:

a highly energy efficient building that produces on-site, or procures, enough carbon-free renewable energy to meet building operations energy consumption annually.

Efficiency First

While the metrics for a “highly energy efficient building” should be defined by each jurisdiction and professional organization, a ZNC building dramatically reduces its fossil fuel generated energy consumption, *first* through building design strategies and energy efficiency measures, *then* incorporates on-site renewable energy systems *and then* procures locally produced renewable energy to meet the balance of its energy needs (see the [2030 Challenge](#)).

Net Balance

A zero net carbon balance is achieved when an equivalent unit of carbon-free renewable energy is produced (on or off-site) to offset each unit of fossil fuel energy used by the building. The “net” balance of carbon-free energy is critical to the definition, as this provides a path to achieve ZNC for buildings that use some form of fossil fuel energy or are unable to produce sufficient renewable energy on-site.

A ZNC building may meet its energy demands or offset its carbon-based energy consumption by the following:

- Production of on-site renewable energy
- Procurement of off-site renewable energy from local providers

In summary, a ZNC building can achieve a carbon neutral balance through (in order of priority) a combination of design strategies and materials, energy efficiency measures, efficient equipment, renewable energy production, and clean energy procurement.

Industry Net Zero Definitions

Many definitions exist for energy efficient buildings that meet a “net zero” energy or emissions threshold, including (but not limited to):

- [Zero Energy Building](#) (ZEB)
- [Zero Net Energy](#) (ZNE) Building
- [Net Zero Site Energy](#) Building (Site ZEB)
- [Net Zero Source Energy](#) Building (Source ZEB)
- [Zero Emissions Building](#) (ZEB)

Each of these definitions is compatible with ZNC because they offset carbon-based energy consumption with energy efficiency and new renewable energy capacity. In fact, these definitions represent a narrower path for achieving zero net carbon, specifically for locations that have the on-site renewable energy production capability to meet annual energy demands. However, this limits their application to mostly low-density, low-rise, suburban, or rural building applications. A standard that is more closely aligned to ZNC is the European definition of a [Nearly-Zero Energy Building](#) (NZEB) as it also allows for accessing nearby off-site generated renewable energy.

While all energy and greenhouse gas emissions reduction targets are important, as we move to a carbon emissions-free built environment by 2050, all strategies and definitions will converge to meet the **ZNC** definition.

ZNC Applications

Public and private actions aligned toward climate action must lead the building sector on a path of rapid CO₂ emissions reductions. A ZNC definition clarifies the approach for meeting the [2030 Challenge](#), American Institute of Architects [AIA 2030 Commitment](#), and the [China Accord](#)'s “carbon neutral” target, and can play an important role in guiding the design and development of new and rebuilt urban buildings as we all work to meet the goals set by the Paris Agreement.