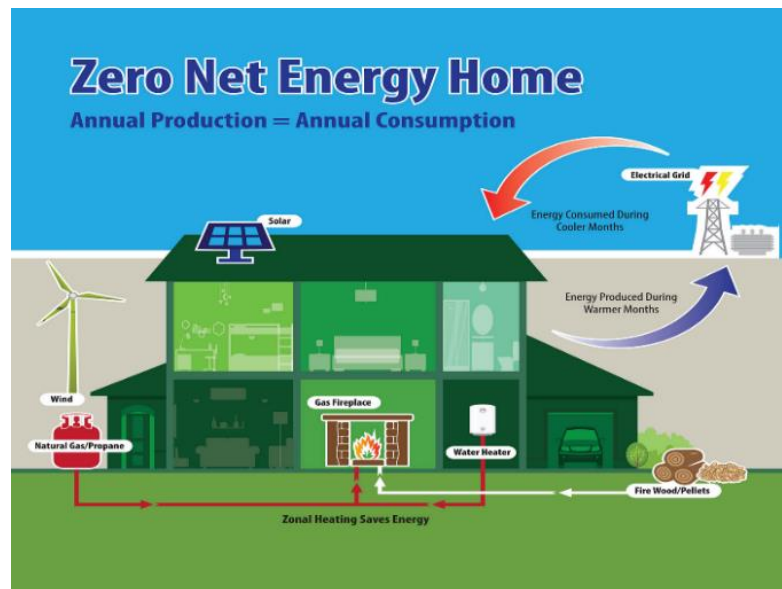


Zero Net Energy Buildings

Zero net energy buildings combine renewable energy technologies and energy efficiency measures to reduce greenhouse gas emissions and improve the resiliency of our built environment.

The U.S. Department of Energy defines a ZNE building as 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.”¹ This means that for a building to be classified as ZNE, it should produce enough renewable energy to offset the amount of energy that it consumes over the course of a year. The inclusion of ZNE buildings in both residential and commercial sectors would reduce greenhouse gas emissions, while improving the resiliency of buildings in both sectors.



Source: [HPBA, Zero Net Energy](#)

\$ The global zero net energy buildings market is estimated to reach \$47.4 billion by 2026²

Zero Net Energy Building Certification

Third party certifications are used to verify that buildings meet ZNE criteria under normal use conditions. One way to meet certification is through the U.S. Green Building Council’s LEED Zero certification. The LEED Zero certification requires that a building offsets its source energy using on-site renewable or through carbon offsets. It requires monitoring 12 months of the building’s energy performance and the building must already have a LEED Building Design and Construction (BD+C) or Operations and Maintenance (O+M) certifications.³

ZNE certifications for residential buildings often factor in a Home Energy Rating System (HERS) score, which is determined by a nationally recognized system that assesses features like its building envelope and HVAC system to evaluate the home’s energy performance. Lower scores mean that the home is more energy efficient compared to a reference home. A score of 0 indicates a zero net energy home, while a score lower than 0 represents a home producing more renewable energy than it consumes.

¹ U.S. DOE, [A Common Definition for Zero Energy Buildings, 2015](#)

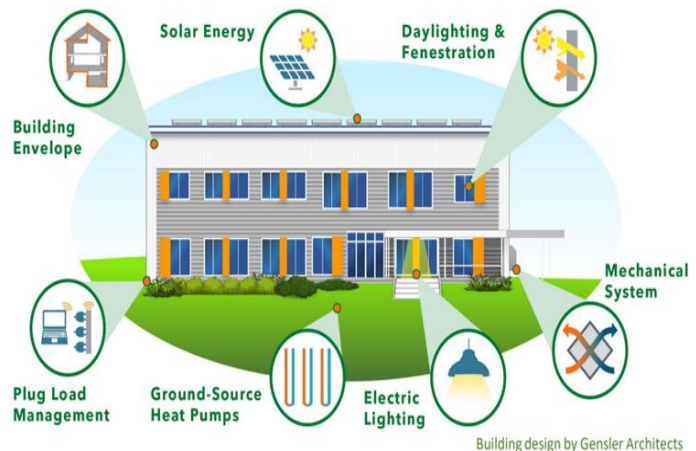
² Global Industry Analysts, [Net-Zero Energy Buildings-Global Market Trajectory & Analytics, 2022](#)

³ USGBC, [LEED Rating System](#)

How to Achieve Zero Net Energy in Buildings

ZNE buildings often consume electricity from the utility grid, produce their own electricity via on-site renewable energy, and return any surplus renewable energy to the grid to be used by other buildings. Highly efficient technologies and systems can reduce the amount of energy required for routine building use and operations, making it easier to reach ZNE status. Incorporating highly efficient technologies also serves to lower the cost of serving the building's energy needs with renewable energy. Some features of ZNE buildings include:⁴

- Exterior wall insulation and air sealing to protect against moisture problems and reduce air leaks
- Rooftop solar photovoltaic (PV) and renewable thermal energy such as biomass to meet the energy needs of the building
- Daylighting to control the admission of natural, direct light to reduce electricity use
- Monitoring plug loads with meters
- Ground-source heat pumps that use the earth's constant temperature to cool and heat the building
- ENERGY STAR appliances (lighting, stovetops, water heaters and coolers, air conditioners, etc.) that are highly efficient



Source: [DOE, "Zero Energy Building Highlight: Houston Advanced Research Center"](#)

What Role can Natural Gas Play in Zero Net Energy Buildings?

Many ZNE buildings source electricity from renewables like solar PV but require natural gas for heating and cooking functions. Efficient natural gas systems can be used in ZNE buildings, but the emissions associated with their combustion must be offset by onsite renewable energy production. For this reason, it is critical that natural gas systems in ZNE buildings be highly efficient to minimize the amount of non-renewable energy used. Combined heat and power (CHP) systems, which are usually fueled with natural gas, can be used to provide electricity, heat, and hot water for buildings with greater efficiency. CHP systems have fuel efficiencies of around 80% compared to 52% for separate heat and power systems.⁵

Habitat for Humanity's Zero Net Energy Home

Habitat for Humanity has supported construction of ZNE homes in several states that pair high-efficiency natural gas heating equipment, efficient insulation, and window features, with solar PV panels. These homes achieve ZNE by reducing energy requirements while generating excess PV electricity, delivered to the electric grid. One home in Taylor, Texas, has achieved a -14 HERS score, meaning that it generates more renewable energy on site than the total energy it consumes.⁶

⁴ [Whole Building Design Guide, Net Zero Energy Buildings, 2016](#)

⁵ [U.S. EPA, CHP Benefits, 2022](#)

⁶ [Atmos Energy, ZNE Home Info, 2022](#)