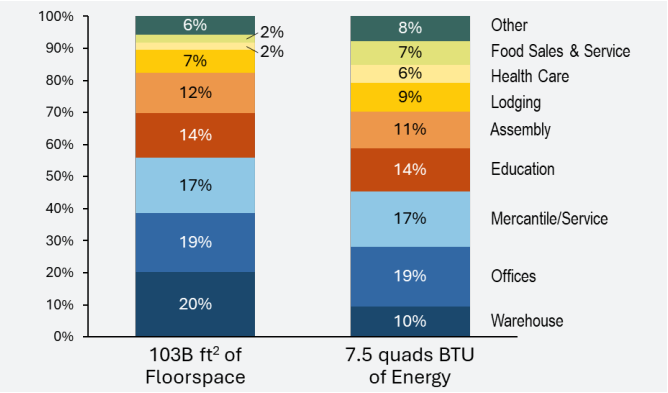
Commercial Buildings

Commercial buildings include, but are not limited to, stores, offices, schools, places of worship, gymnasiums, libraries, museums, hospitals, clinics, warehouses, and jails. Their design, construction, operation, and demolition impact natural resources, environmental quality, worker productivity, and community well-being.

Patterns of Use

- In 2018, 5.9M commercial buildings contained 96B ft^2 of floor space in the U.S.—an increase of 56% in the number of buildings and 89% in floor space since 1979.[1,2] By 2050, commercial floor space is expected to reach 143B ft^2, a 38% increase from 2024.[3]
- Warehouses occupy the largest share of U.S. commercial floor space, accounting for 20.1%. Offices make up 18.5%, mercantile buildings (e.g., retail stores) 17.2%, and assembly spaces (e.g., auditoriums, convention centers) 12.4%.[3]

U.S. Commercial Buildings by Principal Activity, 2024[3]



Resource Use

Energy Use

- In 2024, the commercial sector used 16.45 quads of energy, 17% of the U.S. total, a 64% increase from 1980.[4]
- In 2024, U.S. commercial buildings spent over $241B on energy. Space heating and cooling accounts for 21% of commercial energy use.[3]
- Operation accounts for 80–90% of a building's life cycle energy consumption, vs. 10–20% for construction.[8]
- A University of Michigan campus building with a 75-year lifespan used more energy in under 2.5 years of operation than was used in its material production and construction combined.[9]

Material Use

- Typical buildings contain materials including drywall, asphalt, wood, metals, and concrete (a mixture of minerals, sand, water, and gravel).[10,11]
- In 2017, structural steel made up 46% of the material market share for non-residential and multi-story residential buildings, followed by concrete at 34%. While durable, both materials have higher embodied emissions than other materials and require significant energy to produce.[12]

Water Consumption

- The commercial and institutional sector is the second largest user of publicly supplied water in the U.S., accounting for 17% of withdrawals from public water supplies.[14]
- In 2005, commercial buildings used an estimated 10.2B gal/d of water, an increase of 23% from 1990 levels.[6]
- Domestic and restroom use is the largest water use in most commercial buildings, except in restaurants where 52% of water is used for dishwashing and kitchen activities.[15]

Life Cycle Impacts

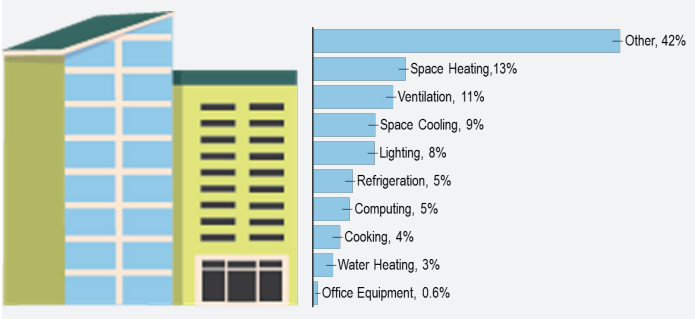
Construction and Demolition Waste

- In 2018, 600 Mt of construction and demolition (C&D) waste was generated in the U.S.[10]—approximately 10 lbs/capita of waste daily, or twice the per capita municipal solid waste average of 4.9 lbs.[10,16] See Municipal Solid Waste Factsheet.
- 76% of C&D waste was repurposed or recycled in 2018, mostly for use as aggregate and in manufacturing.[5] Most frequently recovered and recycled were concrete, asphalt, metals, and wood.[17] More than 75% of unrecycled construction waste has a residual value.[7]

Indoor Air Quality

- Volatile Organic Compounds (VOCs) are found in concentrations 2 to 5 times greater indoors than in nature. Exposure to high concentrations of VOCs can result in eye, nose, and throat irritation, headaches and nausea, and extreme effects, such as cancer or nervous system damage. VOCs are emitted from adhesives, paints, solvents, aerosol sprays, and disinfectants.[18]

U.S. Commercial Buildings Energy Use, 2024[3]



Greenhouse Gas Emissions

- The buildings sector generates 1,563 Mt CO_2/yr, one-third of total U.S. energy system emissions. Commercial buildings account for nearly 50% of buildings sector and 15% of total energy system emissions.[3]
- As energy efficiency and renewable energy adoption reduce operational emissions, embodied emissions from building materials and construction are projected to dominate new building life cycle emissions by 2050.[20]

Solutions and Sustainable Actions

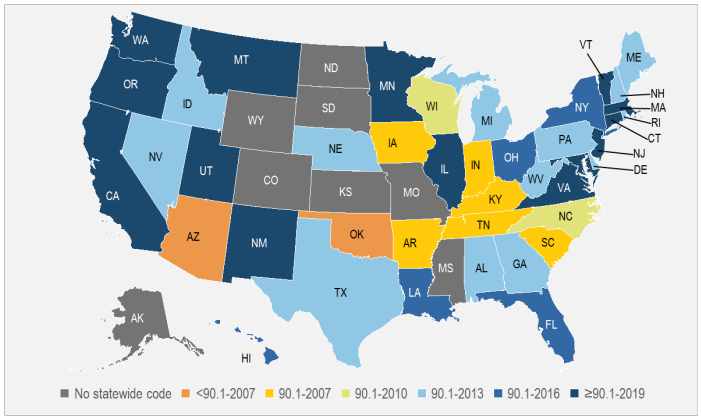
Opportunities

- Before 2000, building design and construction paid little attention to energy use and environmental impact.[21] For typical commercial buildings, energy efficiency measures can reduce energy use by 30% without major design changes.[22]
- As of 2007, 62% of office buildings could achieve net-zero energy use with existing energy efficiency technologies and solar PV. Redesigning all buildings to meet current standards, implementing efficiency measures, and adding solar PV could reduce average energy use intensity by 86%.[23]
- Energy Star Portfolio Manager tracks energy and water use, covering nearly 25% of U.S. commercial building space. It is the leading database to benchmark performance and provide transparency to building managers and tenants.[24]
- States are moving to increase transparency in buildings' energy and water use. New York City passed local laws requiring large building owners to publicly report energy and water use.[25]
- U.S. office vacancy rates have climbed 47% since the start of COVID-19, suggesting potential for real estate repurposing.[26] Repurposing can significantly cut emissions, with retrofitting halving carbon output compared to new construction.[27]
- Using porous paving materials and native vegetation instead of grass lawns can reduce erosion and pollution from stormwater runoff. A typical city block generates 5 times more runoff than a woodland area of equal size.[28]

Design Guidelines and Rating Systems

- The International Energy Conservation Code (IECC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE 90.1) provide minimum energy efficiency standards for commercial buildings.[13] These provisions will save 7.75 quads of energy and reduce commercial energy costs by $78B (2021$) from 2010–2040.[44]
- The U.S. Green Building Council developed the Leadership in Energy and Environmental Design (LEED) rating system to assess building performance. LEED awards points for design features that reduce environmental impact and support healthy, sustainable buildings.[29] By November 2024, the U.S. had 89,512 LEED certified buildings.[30]
- Passive House Institute U.S. provides a climate-specific building standard to minimize energy use and emissions,[31] mainly focused on insulation and airtightness.[32] As of July 2025, there are 522 certified PHIUS buildings.[33]
- The Living Building Challenge, an initiative by the International Living Future Institute, comprises seven performance areas, or "petals:" place, water, health and happiness, energy, materials, equity, and beauty.[34] As of 2025, there are over 250 certified Living Buildings.[35]
- SITES certification for landscapes promotes nature-based solutions to protect ecosystems, while enhancing benefits to communities (e.g., climate mitigation and improving public health). As of 2025, 106 projects have SITES certification.[36, 37]
- BREEAM certification measures sustainability across multiple categories. As of July 2025, 207 projects worldwide have achieved BREEAM Outstanding In-Use.[38,39]

ASHRAE Commercial Building Code by State, 2024[45]



Case Studies

- The Center for Sustainable Landscapes (CSL) was recognized by the American Institute of Architects (AIA) in its 2016 Commitment to the Environment Top Ten Projects. It was the first building to meet seven of the highest green certifications — the Living Building Challenge, LEED Platinum, SITES Platinum, WELL Building Platinum, BREEAM Outstanding In-Use, Zero Energy Certification, and Fitwel 3 Star green certifications.[40,41] CSL is a net-zero energy building, which significantly reduces its operational environmental impact, however, it had near equal embodied energy and 10% higher global warming potential than a conventional building.[42]
- Boardwalk Campus, an AIA COTE 2025 Top 10 Award Winner, is the first net-zero energy and water school in Massachusetts and was built within a standard school budget. It consolidates two elementary schools and a preschool into a low-impact campus featuring stormwater conservation and reuse, PV and energy storage, ground-source heat pump, high insulation, and low-carbon concrete. The school is carefully sited to protect adjacent wetlands and the local ecosystem.[43]