



Commercial Buildings

Commercial buildings include, but are not limited to, stores, offices, schools, churches, gymnasiums, libraries, museums, hospitals, clinics, warehouses, and jails. The design, construction, operation, and demolition of commercial buildings impact natural resources, environmental quality, worker productivity, and community well-being. Existing strategies offer tremendous opportunities for enhancing the overall sustainability of these structures.

Patterns of Use

- Commercial buildings consumed 18% of all energy in the U.S. in 2015.¹
- In the U.S., 5.6 million commercial buildings covered 87 billion square feet of floor space in 2012—an increase of 46% in number of buildings and 70% in floor space since 1979.^{2,3}
- By 2040, commercial building floor space is expected to reach 109.1 billion square feet, a 32% increase over 2013 levels.⁴
- Education, mercantile, office, and warehouse/storage buildings comprise 60% of total commercial floor space and 50% of buildings.²

Resource Consumption

Energy Use

- In 2010, the commercial sector consumed 18.3 quadrillion Btu of primary energy, a 73% increase from 1980.⁵
- Lighting and indoor climate control consumed 51% of commercial sector primary energy in 2010.⁵
- Average energy intensity per square foot decreased by 8.5% between 1980 and 2010, from 118,000 Btu/sq ft to 108,000 Btu/sq ft.⁵

Material Use

- In 2011, the construction of new low-rise non-residential buildings in the U.S. consumed about 627 million board feet of lumber, accounting for approximately 1% of all lumber consumed in the U.S.⁶
- In 2001, construction of commercial buildings used 19 million metric tons of cement. From 1996 to 2001, 19% of all U.S. cement use was for commercial building construction.⁷

Water Consumption

- In 2005, the commercial sector used an estimated 10.2 billion gallons of water per day, an increase of 23% from 1990 levels.⁸
- Domestic/restroom water is the largest end use in commercial buildings except in restaurants where 52% of the water is used for dishwashing or kitchen use.⁸

Life Cycle Impacts

Construction and Demolition Waste

- In 2003, the EPA estimated that construction, renovation, and demolition of non-residential U.S. buildings generated 103 million tons of waste.¹⁰ This amounts to 1.94 lbs per capita per day, compared to 4.72 lbs per capita per day of municipal solid waste.^{10,11}
- Between 20% to 30% of non-residential building waste was recovered for processing and recycling in 1996. Most frequently recovered and recycled were concrete, asphalt, metals, and wood.¹²

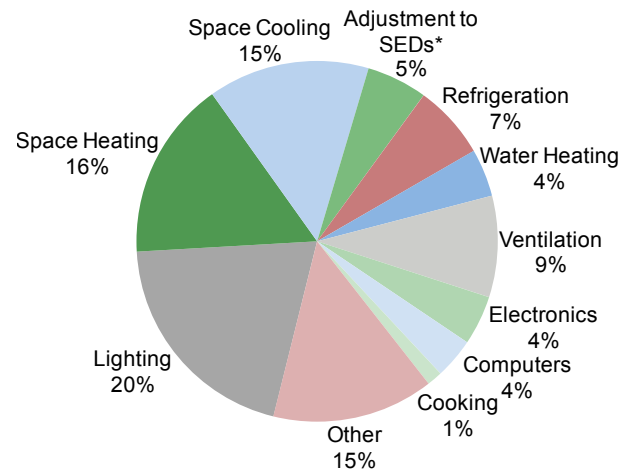
Indoor Air Quality

- Volatile Organic Compounds (VOCs) are found in concentrations 2 to 5 times greater indoors than naturally occurs in the environment. Exposure to VOCs can result in eye, nose, and throat irritation; headaches, loss of coordination, and nausea; and extreme effects, such as cancer or nervous system damage, if concentrations are high enough. VOCs are emitted in commercial buildings through carpet adhesive, paints, solvents, aerosol sprays, cleansers, disinfectants, and dry-cleaned clothing.¹³

Greenhouse Gas Emissions

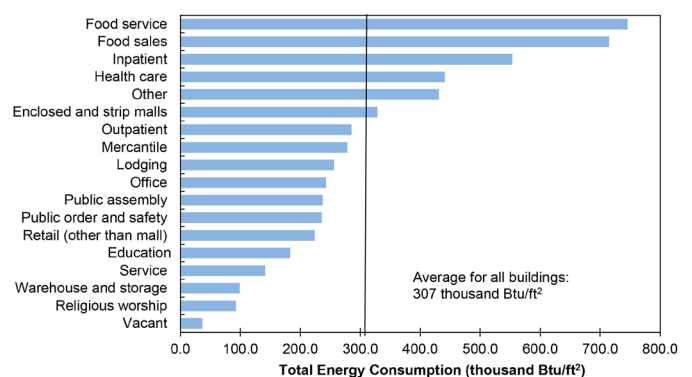
- The combustion of fossil fuels to supply energy to commercial buildings resulted in the emission of 968 million metric tons of carbon dioxide (CO₂) in 2013, representing approximately 18% of all U.S. CO₂ emissions in that year.⁴

U.S. Commercial Sector Primary Energy End Use, 2010⁵



*State Energy Database System (SEDS) is an energy adjustment that EIA uses to relieve discrepancies between data sources. Energy in this case is attributable to the commercial sector, but not to specific end uses.

Total Energy Consumption, U.S. Commercial Buildings, 2012⁹



Solutions and Sustainable Alternatives

Opportunities

- Find ways to reduce environmental impacts and energy use during building operation, when a majority of building impacts occur. For example, in as little as 2.5 years of operation, commercial buildings may consume more energy than was required for material production and construction combined.¹⁴ The average commercial building wastes 30% of its consumed energy. Consider workplace awareness initiatives on recycling, energy use, and water conservation.¹⁵
- Consider opportunities to purchase energy from renewable sources to reduce fossil fuel use and emissions. Additional strategies for reducing building energy impacts include the use of passive solar heating and lighting, low emissivity windows, structural insulating panels, and energy efficient landscaping.¹⁵
- Utilize renewable materials to improve sustainability and indoor air quality while reducing environmental impact and maintenance costs. The use of porous materials for paved surfaces can reduce pollution and erosion caused by storm water runoff.¹⁶
- The Energy Policy Act of 2005 established the Commercial Building Tax Deduction, which expired on December 31, 2014, after several extensions. In December of 2015, the Consolidated Appropriations Act retroactively reinstated the tax deduction for 2015 and 2016 completed projects.¹⁷

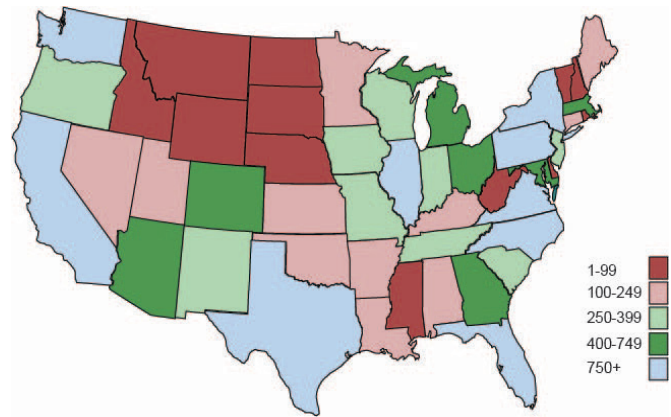
Design Guidelines and Rating Systems

- The Leadership in Energy and Environmental Design (LEED) rating system developed by the U.S. Green Buildings Council provides an evaluation metric for overall building performance. The LEED system assigns points to buildings based on design attributes that reduce environmental or energy impacts.¹⁸
- The Better Buildings Challenge, sponsored by the U.S. Department of Energy, is a government initiative aimed at reducing energy usage of commercial buildings in the United States by 20% by the year 2020.¹⁹
- The U.S. EPA Energy Star buildings program provides recognition and resources to assist organizations that have committed to continuous energy efficiency improvement.²⁰
- The Living Building Challenge, a green building initiative supported by the International Living Future Institute, is comprised of seven performance areas, called 'petals': place, water, energy, health/happiness, materials, equity, and beauty.²¹

Case Studies

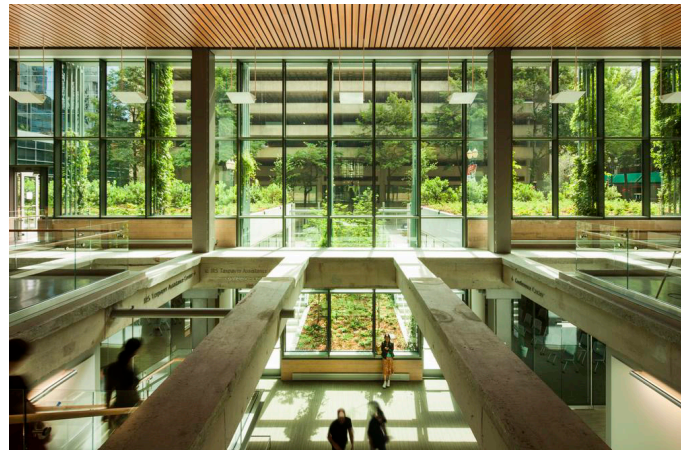
- The Samuel Trask Dana Building, a 100-year-old structure located on University of Michigan's Ann Arbor campus, was recently renovated to improve energy and environmental performance. Added or enhanced building attributes include on-site photovoltaic electricity generation, natural lighting, radiant cooling, composting restrooms, selective materials use (cork, bamboo, linoleum, recycled glass, recycled plastics, biocomposites), and reclamation/reuse of original building materials.²³
- The American Institute of Architects recognized the Edith Green - Wendell Wyatt Federal Building in Portland, Oregon the 2016 top ten plus green project winner. This 512,474 square foot building has achieved a 55% reduction in energy consumption and a 65% reduction in water consumption.²⁴
- The Energy Star buildings program sponsors a "Battle of the Buildings" each year. The Energy Service Company (ESCO) Project at Texas A&M University was the top 2015 team winner, cutting an average energy usage of 35.5% in six buildings, saving \$548,900 and preventing 1,726 metric tons of greenhouse gas emissions. The top building winner was Woodville Chapel, cutting energy usage by 89.4%.²⁵

LEED Registered Green Building Projects, New Construction²²



46,034 total U.S. certified projects (commercial, residential, etc.) as of May 2016.

The Edith Green - Wendell Wyatt Federal Building
AIA Top Ten Plus Green Project, 2016²⁴



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