



Commercial Buildings

factsheets

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 2006.¹
- 4.9 million commercial buildings in the U.S. covered 72 billion sq ft of floor space in 2003 – an increase of 28% in number of buildings and a 40% increase in floor space since 1979.²
- By 2030, commercial building floor space is expected to reach 108 billion sq ft – a 51% increase over current levels.³
- Four activities dominate the commercial buildings sector – education, mercantile, office, and warehouse/storage – comprising 60% of total commercial floor space and 51% of buildings.²

Resource Consumption

Energy Use

- In 2005, the commercial sector consumed 18 quadrillion BTUs of primary energy – a 65% increase over 1980 levels.⁴
- Lighting and indoor climate control consumed 53% of commercial sector primary energy in 2005.⁴
- Average site energy intensity per sq ft decreased by 21% between 1979 and 2003, from 115,000 BTU/sq ft to 91,000 BTU/sq ft.¹

Material Use

- In 1998, the construction of new non-residential buildings in the U.S. consumed more than 4 billion board feet of lumber, accounting for approximately 10% of wood used in construction.⁵
- 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.⁶

Water Consumption

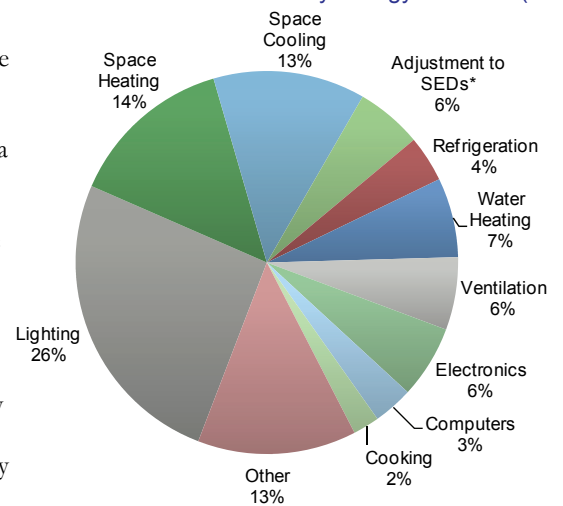
- In 1995, the commercial sector used 9.6 billion gallons of water per day, an increase of 16% from 1990 levels.⁷
- Three applications account for 88% of water used in commercial buildings – sanitary (e.g. toilets and sinks), landscaping, and heating and cooling.⁸

Life Cycle Impacts⁹

Construction and Demolition Waste

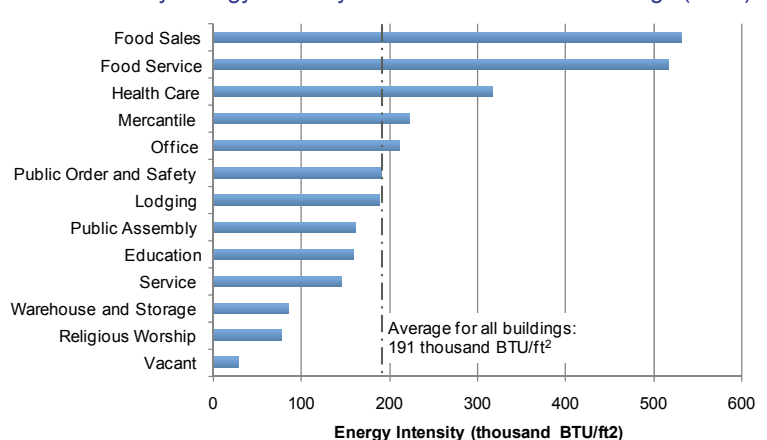
- In 1996, construction, renovation and demolition of non-residential buildings generated 77.4 million tons of waste. This amounts to 1.6 lbs per capita per day – compared to 4.3 lbs per capita per day from municipal solid waste.
- Between 20% and 30% of non-residential building waste was recovered for processing and recycling in 1996. The materials most frequently recovered and recycled were concrete, asphalt, metals, and wood.

U.S. Commercial Sector Primary Energy End-Use (2005)⁴



*SEDS is an energy adjustment used by EIA to relieve discrepancies between data sources.

Primary Energy Intensity for U.S. Commercial Buildings (2003)²



Indoor Air Quality

- Volatile Organic Compounds (VOCs) are found in concentrations 2 to 5 times greater indoors than naturally occurs in the environment. High exposure to VOCs can result in eye, nose, and throat irritation; headaches, loss of coordination, nausea, and extreme effects if concentrations are high enough, such as cancer or damage to the nervous system. VOCs are emitted into commercial buildings through carpet adhesive, paints, paint strippers, and other solvents; aerosol sprays; cleansers and disinfectants; and dry-cleaned clothing.¹⁰

Greenhouse Gas Emissions

- The combustion of fossil fuels to supply energy to commercial buildings resulted in the emission of 277 million metric tons of carbon equivalents in 2005. This represents roughly 17% of all U.S. carbon dioxide (CO₂) emissions for that year.¹¹

Solutions and Sustainable Alternatives

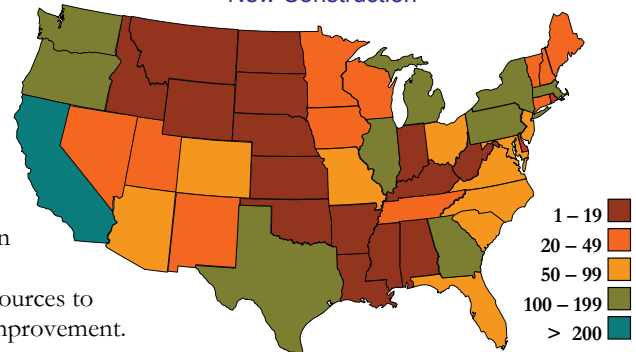
Opportunities

- 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.¹² Consider workplace awareness initiatives on recycling, energy and water conservation.
- 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.
- Utilize renewable materials in building construction 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 stormwater runoff.

Design Guidelines and Rating Systems

- The Leadership in Energy and Environmental Design (LEED) rating system developed by the U.S. Green Buildings Council provides a system for evaluating overall building performance. The LEED system assigns points to buildings based on design attributes that reduce environmental or energy impacts. Additional information and resources: <http://www.usgbc.org/LEED>
- The High Performance Buildings program is an initiative of the U.S. DOE that provides research, guidelines, tools and related materials for the design and operation of energy-efficient, healthy buildings. Additional information and resources: <http://www.eere.energy.gov/buildings/highperformance>
- The U.S. EPA Energy Star buildings program provides recognition and resources to assist organizations that have committed to continuous energy efficiency improvement. Additional information and resources: <http://www.energystar.gov>

LEED Registered Green Building Projects in the U.S.:
New Construction¹³



Case Studies

- The Samuel Trask Dana Building, a 100 year old structure located on the Ann Arbor campus of the University of Michigan, 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, materials use (cork, bamboo, linoleum, recycled glass, recycled plastics, biocomposites), and reclamation and reuse of original building materials.¹⁴
- The National Park Service recently renovated the visitor center at Zion National Park in Utah. The result was a 70% reduction in energy use achieved through the design and implementation of natural ventilation, efficient lighting, window glazing, insulation, passive cooling, Trombe walls, photovoltaics, energy-efficient landscaping, and digital energy management systems.¹⁵
- The American Institute of Architects recognized the Heifer International Headquarters building as one of the top ten green projects of 2007. This commercial office building was designed to use 55% less energy than a conventional office building and to last for at least 100 years. This project incorporates extensive natural lighting, rainwater harvesting, waterless urinals, low-flow toilets, a greywater recycling system and a restored wetland wraps around three sides of the building.¹⁶

¹ Energy Information Administration (EIA) (2008) *Annual Energy Review 2007*.

² EIA (2006) *2003 Commercial Buildings Energy Consumption Survey*.

³ EIA (2007) *Annual Energy Outlook 2007*.

⁴ U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (2007) *2007 Buildings Energy Data Book*. *State Energy Database System (SEDS) is an energy adjustment used by EIA to relieve discrepancies between data sources. Energy is attributable to the commercial sector, but not directly to specific end-uses.

⁵ McKeever, D.B. (2002) *Domestic market activity in solid wood products in the United States, 1950-1998*. Gen. Tech. Rep. PNW-GTR-524. Portland, OR: USDA, Forest Service, Pacific Northwest Research Station.

⁶ Portland Cement Association (2003) *United States Cement Industry Fact Sheet, 2003 Edition*.

⁷ U.S. Geological Survey (1998) *Estimated Use of Water in the United States in 1995*.

⁸ U.S. General Services Administration (1999) *Water Management Guide*.

⁹ U.S. Environmental Protection Agency (EPA) (1998) *Characterization of Building-Related Construction and Demolition Debris in the United States*.

¹⁰ EPA (2007) *An Introduction to Indoor Air Quality – Organic Gases (Volatile Organic Compounds - VOCs)*.

¹¹ EPA (2007) *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2005*. Washington, DC 20460.

¹² Sheuer, C., G.A. Keoleian, and P. Reppe (2003) "Life cycle energy and environmental performance of a new university building: modeling challenges and design implications." *Energy and Buildings* 35, 1049-1064.

¹³ U.S. Green Buildings Council (2006) "Introduction to LEED and Green Building." Presentation.

¹⁴ School of Natural Resources and Environment, University of Michigan (2003) "The Greening of Dana."

¹⁵ U.S. Department of Energy (2003) "Zion National Park Visitor Center, Case Study."

¹⁶ American Institute of Architects (2007) "AIA's Top Ten Green Projects for 2007."

