

National Science and Technology Council
Subcommittee for Buildings Technology R&D

Research & Development For Net Zero Energy High Performance Green Buildings

Drivers and Context for Subcommittee Work

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Discussion Topics



- Legislative Policy Drivers
- Information Sources
- Energy, Economic and Environmental Context
- Domestic Water Use Issues
- Materials Utilization Issues
- Indoor Environmental Quality Issues

Legislative Policy Drivers



Energy Policy Act of 2005, Title IX Research and Development, Section 913 calls for an OSTP report to Congress on the Federal role in a national high performance building initiative.

Energy Independence and Security Act of 2007 calls for establishing a Federal Office of High Performance Green Buildings at the General Services Administration, an Office of High Performance Green Commercial Buildings at the Department of Energy, and to undertake a Commercial Buildings Initiative.

2005: http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_bills&docid=f:h6enr.txt.pdf

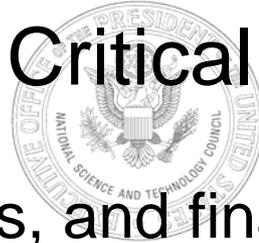
2007: http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=110_cong_bills&docid=f:h6enr.txt.pdf

Information Resources



- Non-Government Sources
 - World Business Council for Sustainable Development, The Zero Net Energy Challenge Conference, Geneva, September 2007
 - Commission for Environmental Cooperation, *Green Building in North America: Opportunities and Challenges*
- Presidential Executive Orders, White House reports, memoranda and circulars.
- Federal agency strategies, plans, budget documents and reports.

Buildings Industry Critical to Economy



The buildings industries, and financial institutions, supporting the 4.9+ million commercial buildings and 107+ million housing units in the United States are central to the economy

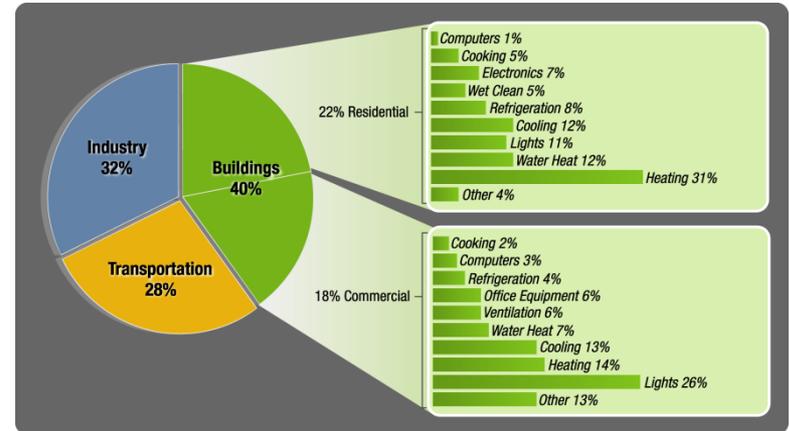
- 14 Percent of United States GDP in 2006
- \$1.2 *Trillion* - Value of construction put in place in 2006
 - New Construction \$873 Billion
 - Renovation \$319 Billion
 - Maintenance and repair \$157 Billion

Buildings Energy Use is Large and Growing

The combined residential and commercial buildings sectors is the largest consumer of energy in the U.S.



40% of U.S. Primary Energy Consumption

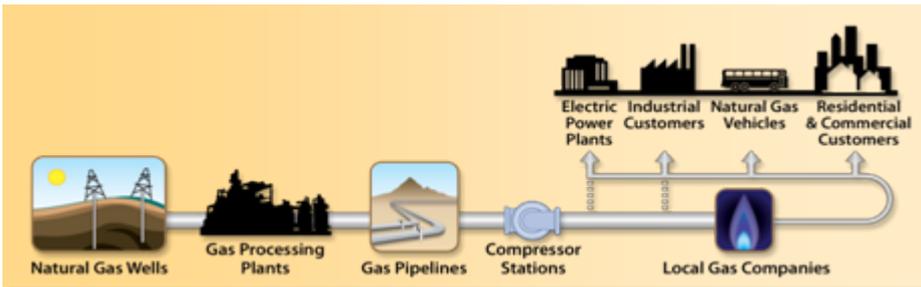


Source: 2007 Buildings Energy Data Book. Tables 1.1.3, 1.2.3, 1.3.3

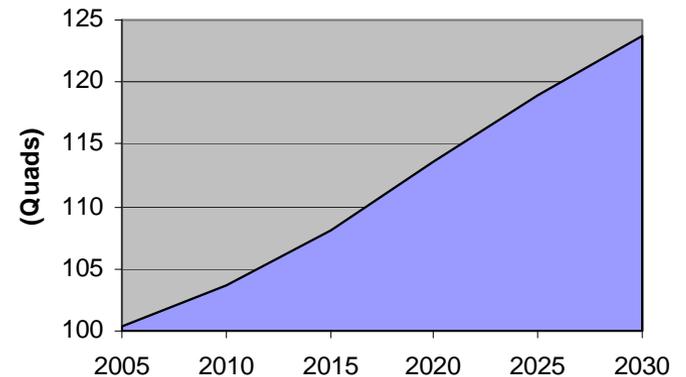
72% of U.S. Electricity



55% of U.S. Natural Gas



Total U.S. Energy Consumption

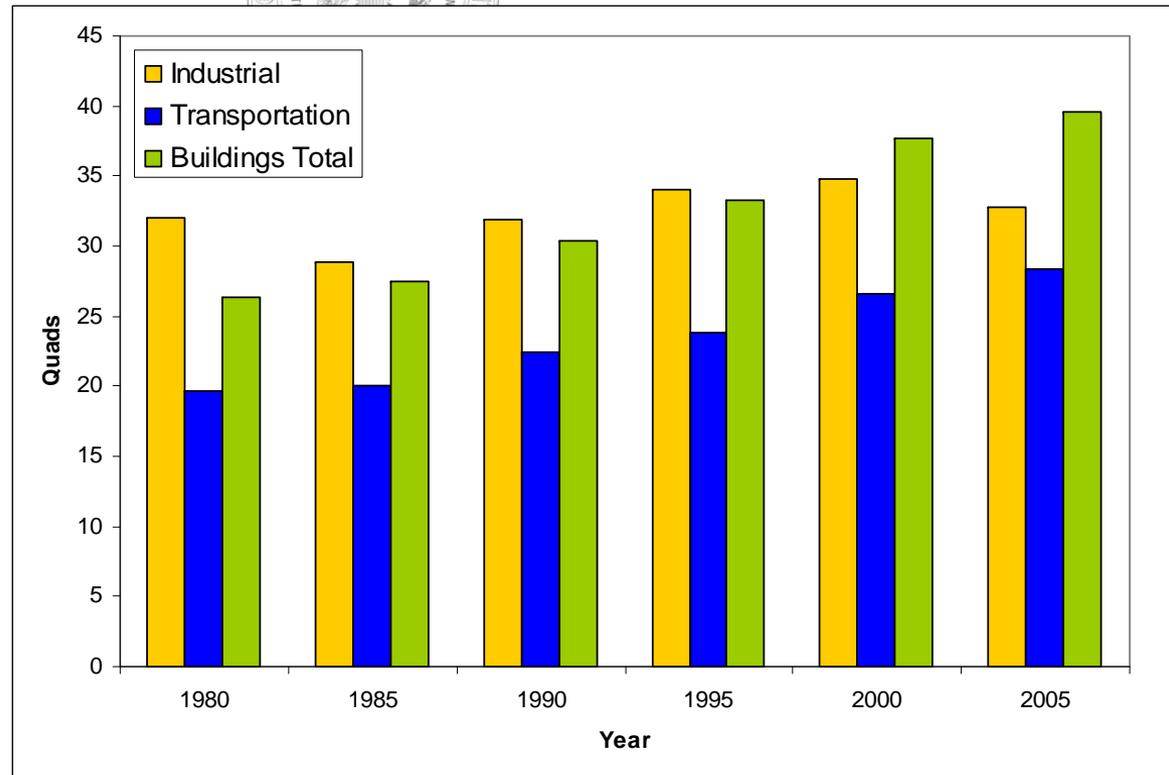


Source: 2008 EIA Annual Energy Outlook

Buildings Energy Use Fastest Growing



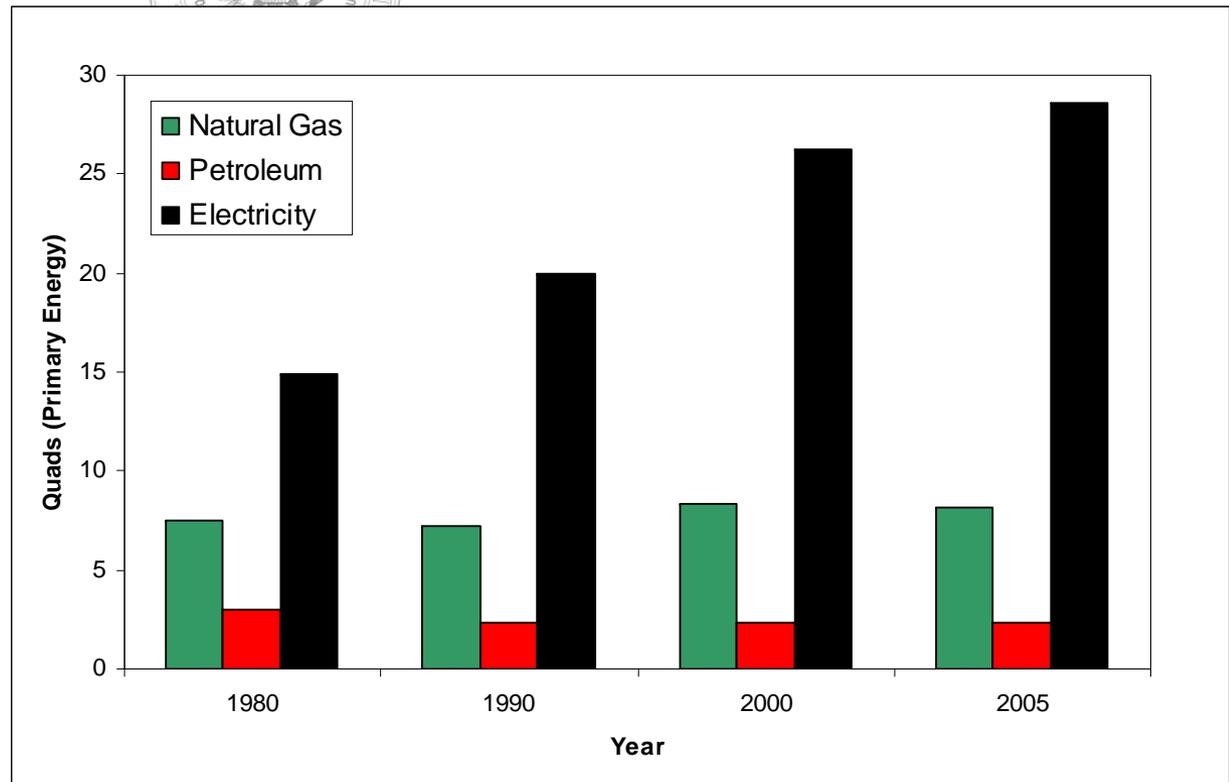
- Buildings sector energy consumption growing faster than any other sector.



Source: EIA Annual Energy Review, Tables 2.1b-2.1f., June 2007

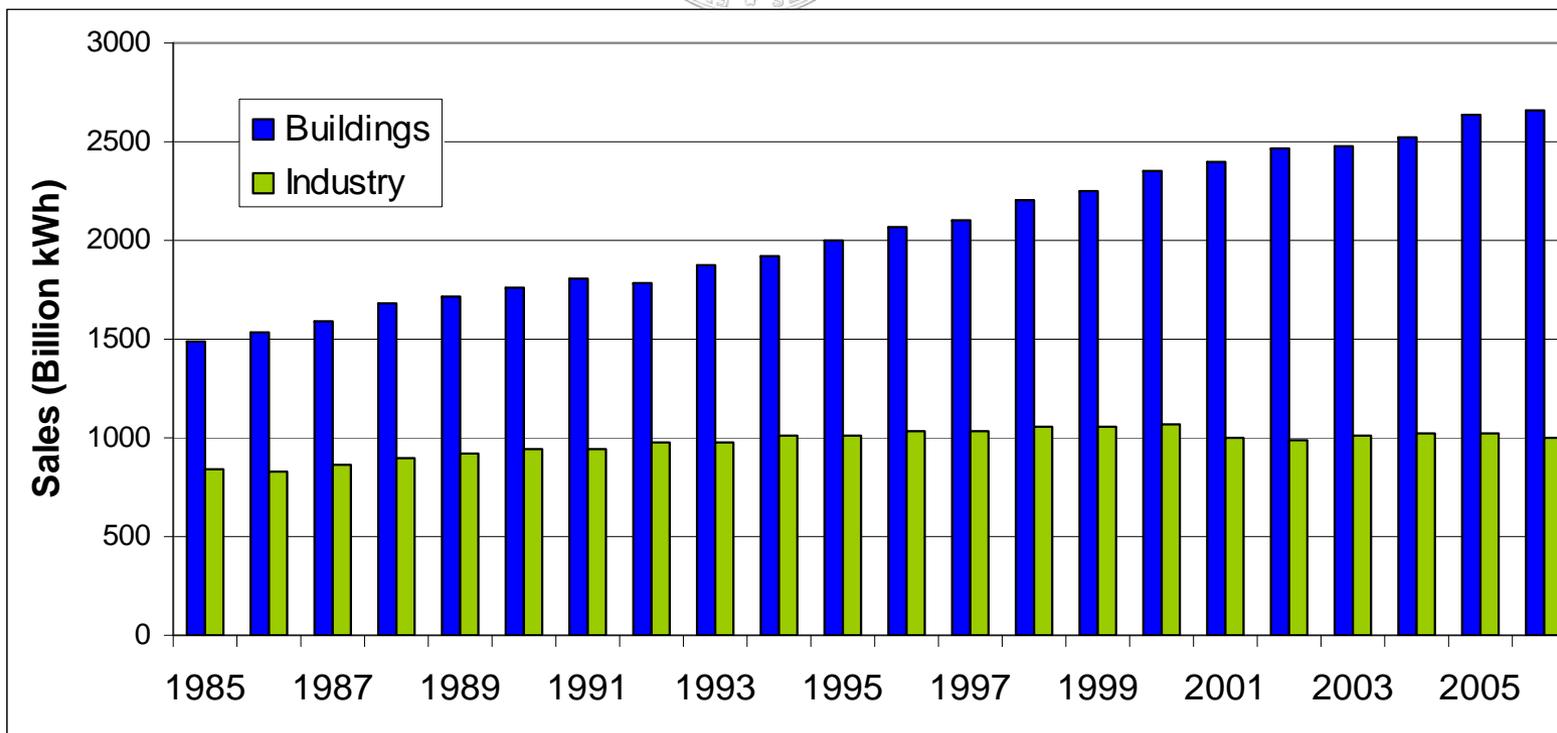
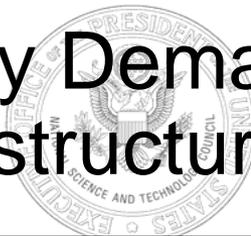
Electricity Growing Source of Building Energy

- Electricity increased from 56% of overall primary energy use in buildings in 1980 to 72% in 2005.



Source: 2007 BED, Tables 1.1.1

Buildings Electricity Demand is Driving Need for Electricity Infrastructure Investment

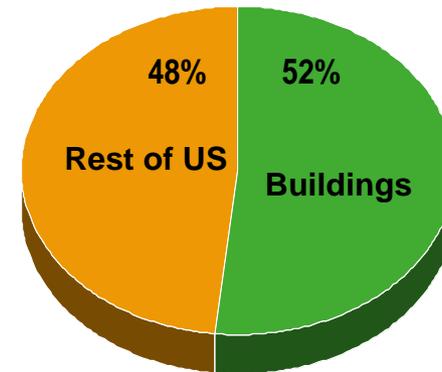


Source: EIA Annual Energy Review, Table 8.9, June 2007

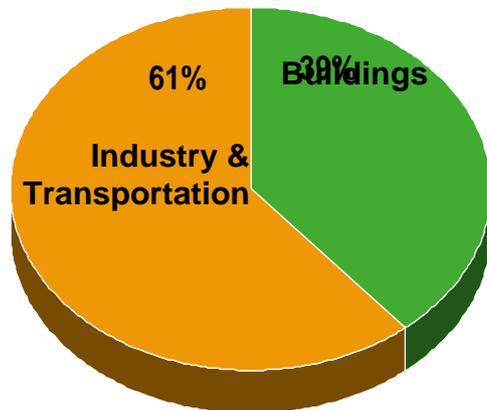
Buildings Environmental Footprint is Large



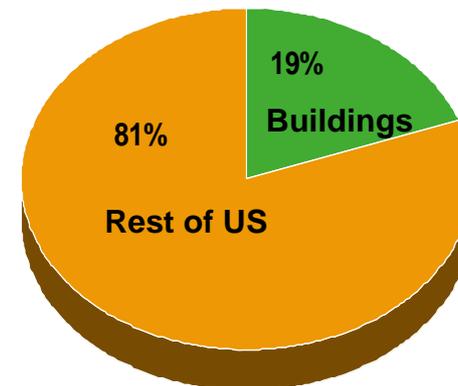
52% of U.S. SO₂ Emissions



39% of U.S. Carbon Dioxide Emissions



19% of U.S. NO_x Emissions

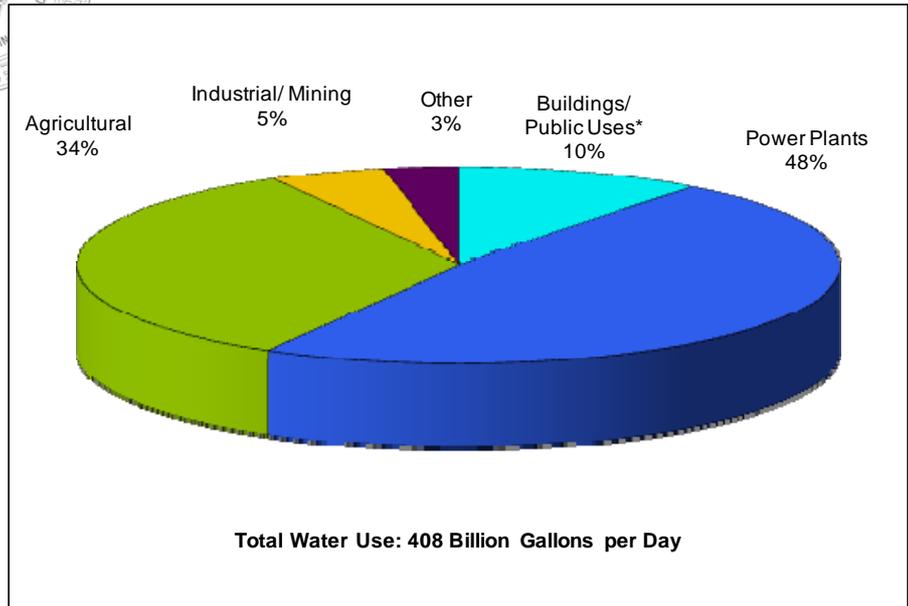


Source: 2007 BED, tables 3.1.1 and table 3.3.1

Buildings Water Use is Significant

Including electric generation, buildings account for 45 percent of U.S. water use

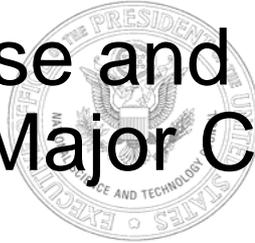
- Not including electricity, per capita use is 100 gallons per day for domestic use.
- Approximately 140 billion gallons of water per day is used to provide electricity to buildings



*Does not include self-supplied water of approximately 4 billion gallons/day.

Source: Hutson, S.S., Barber, N.L., Kenny, J.F., Linsey, K.S., Lumia, D.S., and Maupin, M.A., 2004, Estimated use of water in the United States in 2000: Reston, Va., U.S. Geological Survey Circular 1268; <http://www.epa.gov/WaterSense/water/save/use.htm>

Buildings Water Use and Site Water Management are Major Concerns



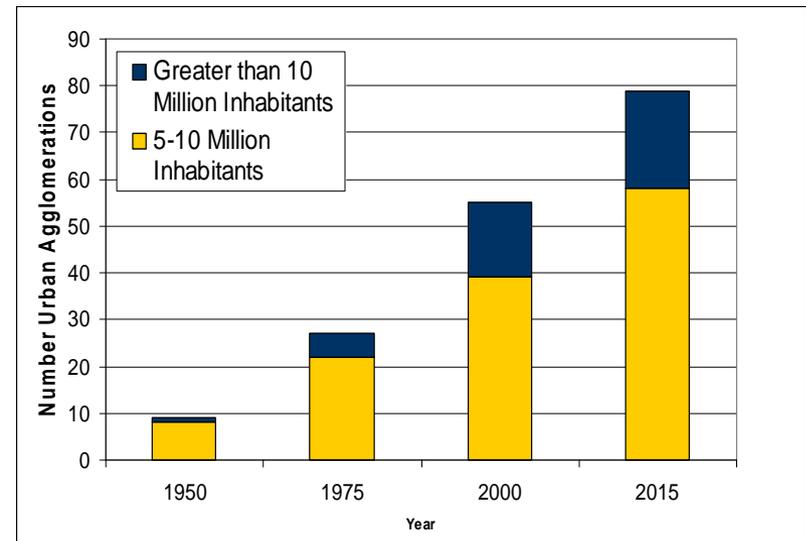
- A recent U.S. study shows 36 states will have local, regional or statewide shortages by 2013
- Rainwater retention and storm water management critical environmental issues
- Increased water use also strains aging water and wastewater infrastructure

Buildings and Urbanization Driving Materials Demand



- Construction materials (including buildings, roads and infrastructure) account for 60% of the total flow of materials through the US economy (excluding food and fuel).
- The embodied energy of these materials are estimated to account for 10% or more of the building's total energy use over a 50 year lifetime.
- Demand here and abroad, particularly in developing countries, is expected to grow (see growth in urban areas).
- The nature of future building materials may need to change to meet our goals, including:
 - Adaptive and alternative material
 - Life cycle impacts of materials production and use will be increasingly important

Growth in Worldwide Urban Areas



Source: UN 2001 World Urbanization Prospectus, http://www.un.org/esa/population/publications/wup2001/WUP2001_CH6.pdf

Indoor Environmental Quality Critical Concern

- Concerns about IEQ increased since energy conservation measures instituted in buildings in 1970s
 - Minimized infiltration of outside air contributed to buildup of indoor air contaminants (e.g. Radon)
- OSHA Standards
 - [1910 Subpart G](#), [1910.94](#), Ventilation
 - Construction Industry ([29 CFR 1926](#))
 - [1926 Subpart D](#), [1926.57](#), Ventilation
- ANSI/ASHRAE
 - 62.1-2004, Ventilation for Acceptable Indoor Air Quality
 - Min ventilation rates & IAQ acceptable to minimize potential for adverse health effects

Indoor Contaminants and Reactions



- Combustion
 - Environmental Tobacco Smoke (ETS)
 - Other Combustion Products
 - Carbon Monoxide (CO)
 - Nitrogen dioxide and Sulfur dioxide
- Biological
 - Dander, Molds, Dust Mites
 - Other Biologicals
- Mycotoxins
- Volatile Organic Compounds (VOCs)
- Pesticides
- Heavy Metals
 - Airborne Lead
 - Mercury Vapor
- Asbestos
- Radon
- Airborne Disease
 - Tuberculosis
 - Legionnaires Disease
- Occupant Sensitivity
 - Allergic Reactions
 - Hypersensitivity Pneumonitis
 - Humidifier Fever
- Sick Building Syndrome (SBS)
- NIOSH: Protecting Building Environments from Airborne Chemical, Biological, or Radiological Attacks
 - Physical security
 - Ventilation and filtration
 - Maintenance, administration, and training

Federal R&D Agenda for Net Zero Energy, High-Performance Green Buildings



- Introduction
- Integrated, Performance-Based Design and Operation
- Net Zero Energy Building Technologies and Strategies
- Water Use and Rainwater Retention
- Material Consumption, Waste, and Life Cycle Environmental Impacts
- Occupant Health and Performance
- Overcoming Barriers to Implementation
- Collection, Analysis, and Dissemination of Research Results
- Conclusions and Next Steps