



# 2008 BUILDINGS ENERGY DATA BOOK



U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

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# **2008 Buildings Energy Data Book**

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## Foreword

The U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy has developed this *Buildings Energy Data Book* to provide a current and accurate set of comprehensive buildings-related data, and to promote the use of such data for consistency throughout DOE programs.

Data has been re-organized up front and there are several new data chapters in the back. The first six chapters are re-organized; Chapter 1 – Buildings Sector, Chapter 2 – Residential Sector, Chapter 3 – Commercial Sector, Chapter 4 – Federal Sector, Chapter 5 – Envelope and Equipment, Chapter 6– Energy Supply. The last three chapters are new and we hope to improve upon them, Chapter 7 – Energy Codes, Standards, and Laws, Chapter 8 – Water Data, and Chapter 9 – Market Transformation. Besides these new chapters, you will also find new data sections on embodied energy, multi-family buildings, office buildings, retail buildings, hospital & medical facilities, hotel/motels, water heaters, on-site power, on-site wind power, natural gas production and distribution, and public benefit funds.

We hope you find the *2008 Buildings Energy Data Book* useful. You are encouraged to comment on errors, omissions, emphases, and organization of this report to the person listed below. Requests for additional copies of this report, additional data, or information on an existing table should be referred to D&R International.

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<http://buildingsdatabook.eere.energy.gov/>

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## Introduction

The *2008 Buildings Energy Data Book* is a statistical compendium prepared and published under contract with the National Energy Technology Laboratory (NETL) within the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE). Pacific Northwest National Laboratory (PNNL) first published the predecessor to the annual *Buildings Energy Data Book* in 1986. PNNL published these through 2004; Oak Ridge National Laboratory 2005-2006, and NETL began publishing the *Buildings Energy Data Book* in 2007.

The Department of Energy's Office of Energy Efficiency and Renewable Energy has developed this *2008 Buildings Energy Data Book* to provide a current and accurate set of comprehensive buildings-related data and to promote the use of such data for consistency throughout DOE programs. Additional data (e.g., more current, widely accepted, and/or better documented data) and suggested changes should be submitted to D&R International. Please provide full source references along with all data.

The *Buildings Energy Data Book* is a compendium of data and does not provide original data. Much of the data gathered is from government documents, models, and analysis. All data sources are included with each data table.

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## Glossary

<b>AAMA</b>	American Architectural Manufacturers Association
<b>ACEEE</b>	American Council for an Energy Efficient Economy
<b>AEO</b>	EIA's Annual Energy Outlook
<b>AFEAS</b>	Alternative Fluorocarbons Environmental Acceptability Study
<b>AFUE</b>	Annual Fuel Utilization Efficiency
<b>AHAM</b>	Association of Home Appliance Manufacturers
<b>ARI</b>	Air-Conditioning and Refrigeration Institute
<b>ASHRAE</b>	American Society of Heating, Refrigerating and Air-Conditioning Engineers
<b>BTS</b>	DOE's Office of Building Technology, State and Community Programs
<b>CBECS</b>	EIA's Commercial Building Energy Consumption Survey
<b>CDD</b>	Cooling Degree Days
<b>CF</b>	Cubic feet
<b>CFC</b>	Chlorofluorocarbon
<b>CHP</b>	Combined Heat and Power
<b>CO</b>	Carbon monoxide
<b>CO<sub>2</sub></b>	Carbon dioxide (CO <sub>2</sub> )
<b>COP</b>	Coefficient of Performance (dimensionless, heating/cooling capacity: (Btu) over electric input (Btu))
<b>CPS</b>	Bureau of the Census' Current Population Survey
<b>Delivered</b>	Refers to energy used on site (including purchased electricity)
<b>DG</b>	Distributed Generation
<b>DOC</b>	U.S. Department of Commerce
<b>DOE</b>	U.S. Department of Energy
<b>EER</b>	Energy Efficiency Ratio (Btu/watt-hour)
<b>EERE</b>	DOE's Energy Efficiency and Renewable Energy Office
<b>EF</b>	Energy Factor
<b>EIA</b>	DOE's Energy Information Administration
<b>EPA</b>	U.S. Environmental Protection Agency
<b>FEMP</b>	DOE's Federal Energy Management Program
<b>FT<sup>2</sup></b>	Square Feet
<b>FY</b>	Fiscal Year
<b>GAMA</b>	Gas Appliance Manufacturers Association

## Glossary

<b>GDP</b>	Gross Domestic Product
<b>GWP</b>	Global Warming Potential
<b>HCFC</b>	Hydrochlorofluorocarbon
<b>HFC</b>	Hydrofluorocarbon
<b>HHS</b>	U.S. Department of Health and Human Services
<b>HSPF</b>	Heating Season Performance Factor (Btu/watt-hour)
<b>HUD</b>	U.S. Department of Housing and Urban Development
<b>HVAC/R</b>	Heating, ventilating, and air-conditioning/refrigeration
<b>IEA</b>	International Energy Agency
<b>LBNL</b>	Lawrence Berkeley National Laboratory
<b>LIHEAP</b>	HHS' Low Income Home Energy Assistance Program
<b>LPG</b>	Liquid Petroleum Gas
<b>MEF</b>	Modified Energy Factor
<b>MMT CO<sub>2</sub></b>	Million metric tons of carbon dioxide (includes only energy consumption effects, unless otherwise noted)
<b>N.A.</b>	Not Available
<b>N/A</b>	Not Applicable
<b>NAHB</b>	National Association of Home Builders
<b>NCES</b>	National Center for Educational Statistics
<b>NEMS</b>	National Energy Modeling System
<b>NIST</b>	National Institute of Standards and Technology
<b>NWWDA</b>	National Wood Window and Door Association
<b>NO<sub>x</sub></b>	Nitrogen oxide (NO <sub>x</sub> )
<b>OBE</b>	BTS's Office of Building Equipment
<b>OBT</b>	DOE's Office of Building Technology, State and Community Programs (formerly the Office of Building Technologies)
<b>ODP</b>	Ozone Depletion Potential
<b>ORNL</b>	Oak Ridge National Laboratory
<b>OWIP</b>	Office of Weatherization and Intergovernmental Program
<b>PM-2.5</b>	Particulate matter of aerodynamic diameter less than 2.5 microns
<b>PM-10</b>	Particulate matter of aerodynamic diameter less than 10 microns
<b>PNNL</b>	Pacific Northwest National Laboratory

## Glossary

<b>Primary</b>	Refers to energy used at the source (including fuel input to electric power plants)
<b>PV</b>	Photovoltaic
<b>PY</b>	Program Year
<b>Quad</b>	Quadrillion Btu ( $10^{15}$ Btu)
<b>R-value</b>	Thermal resistance measured in $(\text{Btu}/\text{Hr}\text{-SF}\text{-}^{\circ}\text{F})^{-1}$
<b>RECS</b>	EIA's Residential Energy Consumption Survey
<b>SEDS</b>	State Energy Data System
<b>SEER</b>	Seasonal Energy Efficiency Ratio (Btu/watt-hour)
<b>SEF</b>	Solar Energy Factor
<b>SF</b>	Square feet
<b>SHGC</b>	Solar heat gain coefficient
<b>SIC</b>	Standard Industrial Classification
<b>Site</b>	Refers to energy used on site (i.e., delivered)
<b>SO<sub>2</sub></b>	Sulfur dioxide (SO <sub>2</sub> )
<b>SRCC</b>	Solar Rating and Certification Corporation
<b>U-Factor</b>	Thermal conductance measured in $(\text{Btu}/\text{Hr}\text{-SF}\text{-}^{\circ}\text{F})$
<b>VOC</b>	Volatile organic compounds

Chapter 1 contains energy consumption, expenditures, environmental impacts, and economic data related to the Buildings Sector. There is also some data from the former Quad Equivalents chapter. A new data section, Embodied Energy of Building Assemblies, contains data on energy used during the life-cycle of building materials.

The following pieces of information give some insight into general trends in the Buildings Sector:

- Electricity energy consumption in the sector is increasing. Natural gas and petroleum energy consumption are declining.
- Less than 2 percent of annual Buildings Sector energy consumption is from renewable energy, each year from 1997 through 2030.
- In 2006, the Residential Sector consumed 37 percent of all electricity produced in the United States. The Commercial Sector consumed 36 percent.
- Space heating is the largest energy end-use in the Buildings Sector. In 2006, it was 34 percent of *site* energy and 20 percent of primary energy.
- From 2006 through 2030, space heating, lighting, and space cooling are the top three energy end-uses (as a percentage of primary energy). Water heating and electronics are the next top two end-uses.
- Aggregate energy expenditures will have doubled from 1980 to 2030; the increase is 28 percent from 2006 to 2030.
- Electricity expenditures make up 67 percent of total Buildings Sector energy expenditures in 2006; in 2030, electricity expenditures are up to 70 percent.
- From 2006 to 2030, Buildings Sector electricity expenditures increase 34 percent to a total of \$353 billion. Natural gas increases 19 percent to a total of \$112 billion. Petroleum increases 5.5 percent to a total of \$36 billion.
- The average price of electricity in the Residential Sector in 2006 was 10.4 cents per kWh; 9.5 cents per kWh for the Commercial Sector.
- Space heating, lighting, and space cooling are the top three energy end-use expenditures.
- New buildings construction is \$785 billion in 2006. Building improvements and repairs is \$438 billion.

- Carbon dioxide emissions by utilities generating, transmitting, and distributing electricity drives the Buildings Sector carbon dioxide emissions.
- The Buildings Sector percentage of carbon dioxide emissions increases from 38 percent in 2006 to 43 percent in 2030. Emissions in 1980 were 33 percent.
- World carbon dioxide emissions increased 1.9 percent per year from 1990 through 2005. Emissions are projected to increase 2.1 percent per year from 2005 to 2010.



Year	Natural Gas		Petroleum (1)		Coal		Renewable(2)		Electricity		TOTAL (2)	Growth Rate 2006-Year			
	Quads	%	Quads	%	Quads	%	Quads	%	Sales	Losses			Total		
1980	7.52	28%	3.04	11%	0.15	0.6%	0.87	3.3%	4.35	10.51	14.86	56.2%	26.43	100%	-
1990	7.22	24%	2.36	8%	0.15	0.5%	0.74	2.4%	6.01	13.92	19.93	65.6%	30.41	100%	-
2000	8.35	22%	2.32	6%	0.10	0.3%	0.63	1.7%	8.02	18.26	26.28	69.8%	37.68	100%	-
<b>2006</b>	<b>7.42</b>	<b>19%</b>	<b>1.93</b>	<b>5%</b>	<b>0.09</b>	<b>0.2%</b>	<b>0.58</b>	<b>1.5%</b>	<b>9.05</b>	<b>19.70 (3)</b>	<b>28.75</b>	<b>74.2%</b>	<b>38.77</b>	<b>100%</b>	-
2010	7.99	19%	1.95	5%	0.09	0.2%	0.62	1.5%	9.67	20.71	30.38	74.0%	41.04	100%	1.4%
2015	8.46	20%	2.00	5%	0.09	0.2%	0.61	1.4%	10.22	21.59	31.81	74.0%	42.97	100%	1.1%
2020	8.77	19%	2.01	4%	0.09	0.2%	0.61	1.3%	10.92	23.04	33.96	74.7%	45.45	100%	1.1%
2025	8.98	19%	1.99	4%	0.09	0.2%	0.61	1.3%	11.68	24.44	36.11	75.6%	47.78	100%	1.1%
2030	9.11	18%	1.97	4%	0.09	0.2%	0.61	1.2%	12.50	25.82	38.32	76.5%	50.10	100%	1.1%

Note(s): 1) Petroleum includes distillate and residual fuels, liquefied petroleum gas, kerosene, and motor gasoline. 2) Includes site -marketed and non-marketed renewable energy. 3) 2006 site -to-source electricity conversion = 3.18.

Source(s): EIA, State Energy Data 2005: Consumption, February 2008, Tables 8-12, p. 18-22 for 1980-2005; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 and Table A17, p. 143-144 for non-marketed renewable energy.

Year	U.S. Buildings Site Renewable Energy Consumption (Quadrillion Btu) (1)					Growth Rate 2006-Year
	Wood (2)	Solar Thermal (3)	Solar PV (3)	GSHP (4)	Total	
1980	0.858	0.000	0.000	0.000	0.858	-
1990	0.609	0.056	0.000	0.003	0.668	-
2000	0.559	0.024	0.000	0.017	0.599	-
<b>2006</b>	<b>0.538</b>	<b>0.038</b>	<b>0.001</b>	<b>0.003</b>	<b>0.581</b>	-
2010	0.570	0.043	0.004	0.004	0.621	1.7%
2015	0.547	0.052	0.004	0.006	0.609	0.5%
2020	0.533	0.059	0.006	0.008	0.607	0.3%
2025	0.520	0.066	0.010	0.011	0.607	0.2%
2030	0.508	0.073	0.016	0.014	0.611	0.2%

Note(s): 1) Does not include renewable energy consumed by electric utilities (including hydroelectric). 2) Includes wood and wood waste, municipal solid waste, and other biomass used by the commercial sector to cogenerate electricity. 3) Includes only solar energy. 4) GHP = Ground-coupled heat pumps.

Source(s): EIA, State Energy Data 2005: Consumption, February 2008, Tables 8-12, p. 18-22 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A17, p. 143-144 for 2006-2030; Annual Energy Outlook 2006, Feb. 2006, Table A17 p. 159; EIA, Annual Energy Outlook 2005, Jan. 2005, Table A17 p.163; EIA; Annual Energy Outlook 2004, Jan. 2004, Table A18 p. 157; EIA, Annual Energy Outlook 2002, Dec. 2001, Table A18 p.148 For 1999-2004 Solar

Year	Buildings			Industry	Transportation	Total	Total Consumption (quads)
	Residential	Commercial	Total				
1980(1)	27.4%	18.3%	45.7%	36.0%	18.3%	100%	57.9
1990	22.4%	17.5%	40.0%	38.9%	21.1%	100%	76.1
2000	21.1%	17.7%	38.8%	36.1%	25.2%	100%	97.2
<b>2006</b>	<b>20.9%</b>	<b>18.0%</b>	<b>38.9%</b>	<b>32.7%</b>	<b>28.4%</b>	<b>100%</b>	<b>99.5</b>
2010	21.5%	18.1%	39.7%	32.2%	28.1%	100%	103.3
2015	21.0%	19.0%	40.0%	31.6%	28.4%	100%	107.3
2020	21.1%	19.8%	40.9%	30.9%	28.2%	100%	110.8
2025	21.1%	20.6%	41.6%	30.5%	27.9%	100%	114.5
2030	21.2%	21.2%	42.4%	29.6%	28.0%	100%	118.0

Note(s): 1) Renewables are not included in the 1980 data.

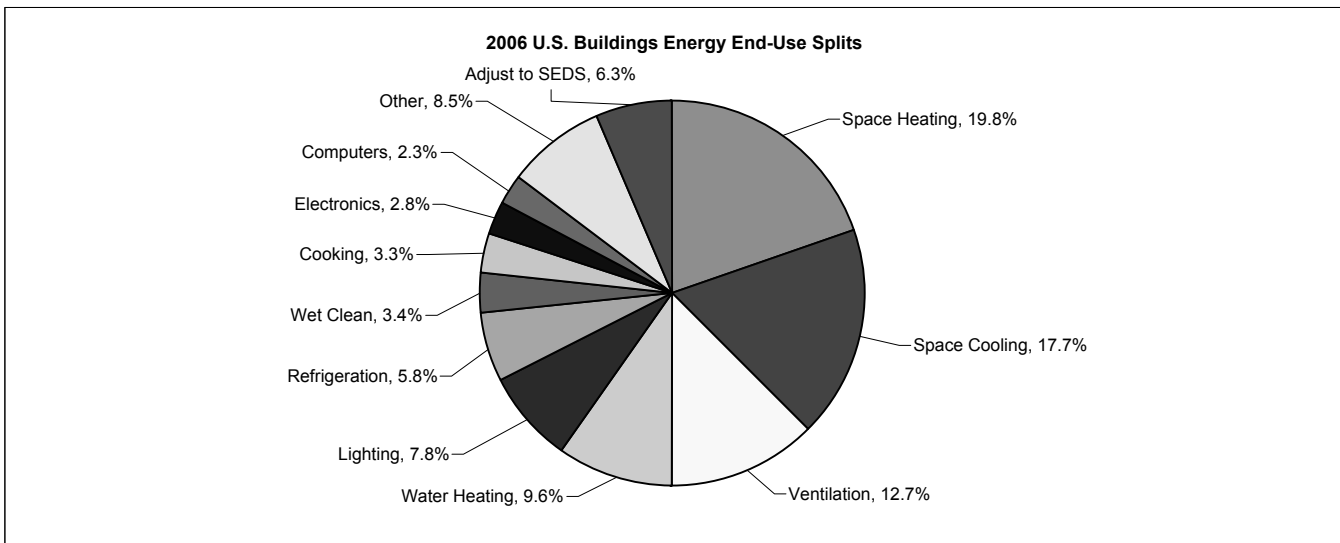
Source(s): EIA, State Energy Data 2005: Consumption, February 2008, Tables 8-12, p. 18-22 for 1980-2005; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 data and Table A17, p. 143-144 for non-marketed renewable energy.

1.1.4 2006 U.S. Buildings Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Fuel		Other Renw.		Site	Site		Primary	Primary		
	Gas	Oil (1)	LPG	Fuel(2)	En.(3)	Electric	Total	Percent	Electric (4)	Total	Percent
Space Heating (5)	4.31	0.84	0.23	0.18	0.41	0.53	6.50	34.1%	1.69	7.66	19.8%
Lighting						2.16	2.16	11.3%	6.86	6.86	17.7%
Space Cooling	0.02					1.54	1.56	8.2%	4.89	4.91	12.7%
Water Heating	1.63	0.15	0.06		0.04	0.58	2.45	12.9%	1.85	3.72	9.6%
Electronics (6)						0.96	0.96	5.0%	3.04	3.04	7.8%
Refrigeration (7)						0.70	0.70	3.7%	2.23	2.23	5.8%
Cooking	0.45		0.03			0.27	0.75	3.9%	0.85	1.33	3.4%
Wet Clean (8)	0.07					0.38	0.46	2.4%	1.22	1.30	3.3%
Ventilation (9)						0.35	0.35	1.8%	1.10	1.10	2.8%
Computers						0.28	0.28	1.5%	0.89	0.89	2.3%
Other (10)	0.27	0.02	0.23	0.05	0.13	0.82	1.52	8.0%	2.60	3.30	8.5%
Adjust to SEDS (11)	0.67	0.23				0.48	1.37	7.2%	1.54	2.43	6.3%
<b>Total</b>	<b>7.42</b>	<b>1.24</b>	<b>0.55</b>	<b>0.23</b>	<b>0.58</b>	<b>9.05</b>	<b>19.06</b>	<b>100%</b>	<b>28.75</b>	<b>38.77</b>	<b>100%</b>

Note(s): 1) Includes distillate fuel oil (1.12 quad) and residual fuel oil (0.9 quad). 2) Kerosene (0.12 quad) and coal (0.09 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of wood space heating (0.41 quad), biomass (0.13 quad), solar water heating (0.03 quad), geothermal space heating (less than 0.01 quad), and solar photovoltaics (PV) less than 0.01 quad). 4) Site -to-source electricity conversion (due to generation and transmission losses) = 3.18. 5) Includes furnace fans (0.21 quad). 6) Includes color television (1.05 quad) and other office equipment (0.64 quad). 7) Includes refrigerators (1.24 quad) and freezers (0.49 quad). Includes commercial refrigeration. 9) Includes clothes washers (0.11 quad), natural gas clothes dryers (0.07 quad), electric clothes dryers (0.81 quad) and dishwashers (0.3 quad). Does not include water heating energy. 8) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 10) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 11) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential and commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Tables A2, p. 117-119, Table A4, p. 122-123, Table A5, p. 124-125, and Table A17, p. 143-144; EIA, National Energy Modeling System (NEMS) for AEO 2008, Mar. 2008; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses; BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2 and 5-25 - 5-26; EIA, Annual Energy Outlook 1998, Dec. 1997, Table A5, p. 108-109 for 1995 ventilation; BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, Sept. 2002, Table 8-2, p. 63; and EIA, Supplement to the AEO 2008, April 2008, Table 22.

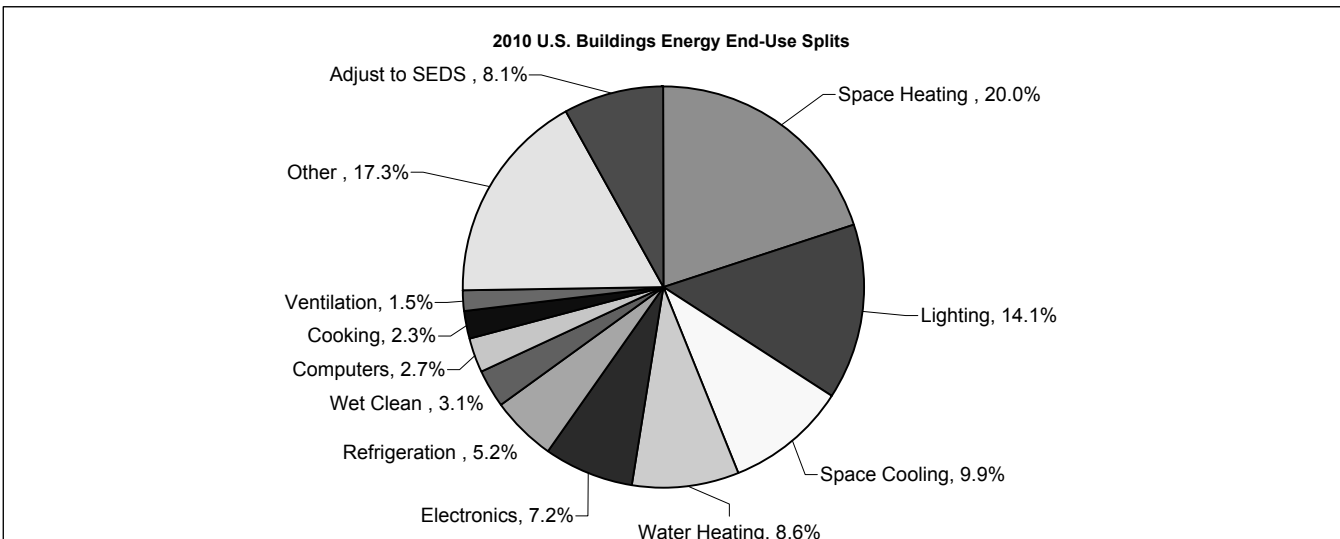


1.1.5 2010 U.S. Buildings Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas		Fuel Oil (1)		LPG	Other Fuel(2)		Renw. En.(3)	Site Electric		Site Total		Primary Electric (4)	Primary Total	
	Gas	Oil (1)	Fuel(2)	En.(3)		Electric	Total		Percent	Total	Percent				
Space Heating (5)	4.86	0.89	0.24	0.19	0.44	0.50	7.13	35.1%	1.59	8.21	20.0%				
Lighting						1.29	1.29	6.3%	5.78	5.78	14.1%				
Space Cooling	0.02					0.19	0.21	1.0%	4.04	4.06	9.9%				
Water Heating	1.62	0.14	0.05		0.04	0.54	2.39	11.7%	1.69	3.54	8.6%				
Electronics (6)						1.84	1.84	9.0%	2.96	2.96	7.2%				
Refrigeration (7)						0.68	0.68	3.4%	2.14	2.14	5.2%				
Wet Clean (8)	0.07					0.94	1.02	5.0%	1.19	1.27	3.1%				
Computers						0.35	0.35	1.7%	1.10	1.10	2.7%				
Cooking	0.47		0.03			0.38	0.88	4.3%	0.46	0.96	2.3%				
Ventilation (9)						0.15	0.15	0.7%	0.60	0.60	1.5%				
Other (10)	0.29	0.02	0.25	0.05	0.13	2.02	2.76	13.6%	6.35	7.09	17.3%				
Adjust to SEDS (11)	0.66	0.19				0.80	1.64	8.1%	2.50	3.34	8.1%				
<b>Total</b>	<b>7.99</b>	<b>1.23</b>	<b>0.57</b>	<b>0.24</b>	<b>0.62</b>	<b>9.67</b>	<b>20.33</b>	<b>100%</b>	<b>30.38</b>	<b>41.04</b>	<b>100%</b>				

Note(s): 1) Includes distillate fuel oil (1.13 quad) and residual fuel oil (0.10 quad). 2) Kerosene (0.08 quad) and coal (0.09 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of wood space heating (0.44 quad), biomass (0.13 quad), solar water heating (0.05 quad), geothermal space heating (less than 0.01 quad), and solar photovoltaics (PV) less than 0.01 quad). 4) Site -to-source electricity conversion (due to generation and transmission losses) = 3.14. 5) Includes furnace fans (0.20 quad). 6) Includes color television (1.23 quad). 7) Includes refrigerators (1.89 quad) and freezers (0.25 quad). Includes commercial refrigeration. 8) Includes clothes washers (0.09 quad), natural gas clothes dryers (0.07 quad), electric clothes dryers (0.80 quad) and dishwashers (0.29 quad). Does not include water heating energy. 9) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 10) Includes residential smallelectric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 11) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential and commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Tables A2, p. 117-119, Table A4, p. 122-123, Table A5, p. 124-125, and Table A17, p. 143-144; EIA, National Energy Modeling System (NEMS) for AEO 2008, Mar. 2008; and EIA, Supplement to the AEO 2008, April 2008, Table 22.

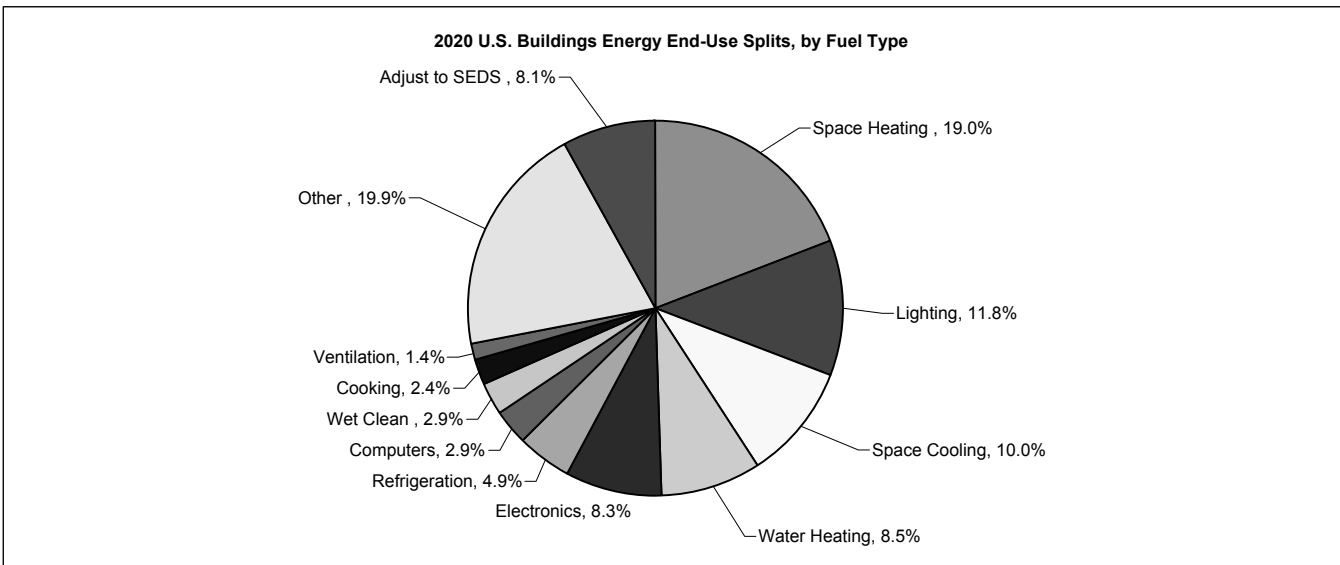


**1.1.6 2020 U.S. Buildings Energy End-Use Splits, by Fuel Type (Quadrillion Btu)**

	Natural Fuel		LPG	Other Renw.		Site	Site		Primary Electric (4)	Primary	
	Gas	Oil (1)		Fuel(2)	En.(3)	Electric	Total	Percent		Total	Percent
Space Heating (5)	5.23	0.90	0.24	0.19	0.41	0.54	7.51	33.5%	1.68	8.65	19.0%
Lighting						1.73	1.73	7.7%	5.37	5.37	11.8%
Space Cooling	0.02					1.46	1.48	6.6%	4.53	4.55	10.0%
Water Heating	1.80	0.13	0.05		0.06	0.58	2.62	11.7%	1.81	3.85	8.5%
Electronics (6)						1.22	1.22	5.4%	3.79	3.79	8.3%
Refrigeration (7)						0.71	0.71	3.2%	2.21	2.21	4.9%
Computers						0.42	0.42	1.9%	1.31	1.31	2.9%
Wet Clean (8)	0.08					0.39	0.47	2.1%	1.22	1.30	2.9%
Cooking	0.54		0.03			0.16	0.73	3.3%	0.50	1.08	2.4%
Ventilation (9)						0.21	0.21	0.9%	0.65	0.65	1.4%
Other (10)	0.38	0.02	0.30	0.05	0.14	2.62	3.51	15.6%	8.14	9.03	19.9%
Adjust to SEDS (11)	0.72	0.19				0.88	1.80	8.0%	2.74	3.66	8.1%
<b>Total</b>	<b>8.77</b>	<b>1.25</b>	<b>0.61</b>	<b>0.25</b>	<b>0.61</b>	<b>10.92</b>	<b>22.41</b>	<b>100%</b>	<b>33.96</b>	<b>45.45</b>	<b>100%</b>

Note(s): 1) Includes distillate fuel oil (1.14 quad) and residual fuel oil (0.10 quad). 2) Kerosene (0.08 quad) and coal (0.09 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of wood space heating (0.40 quad), biomass (0.13 quad), solar water heating (0.06 quad), geothermal space heating (0.01 quad), and solar photovoltaics (PV) less than 0.01 quad). 4) Site -to-source electricity conversion (due to generation and transmission losses) = 3.11. 5) Includes furnace fans (0.23 quad). 6) Includes color television (1.33 quad). 7) Includes refrigerators (1.93 quad) and freezers (0.29 quad). Includes commercial refrigeration. 8) Includes clothes washers (0.09 quad), natural gas clothes dryers (0.08 quad), electric clothes dryers (0.84 quad) and dishwashers (0.30 quad). Does not include water heating energy. 9) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 10) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 11) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential and commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Tables A2, p. 117-119, Table A4, p. 122-123, Table A5, p. 124-125, and Table A17, p. 143-144; and EIA, National Energy Modeling System for AEO 2008, Mar. 2008.

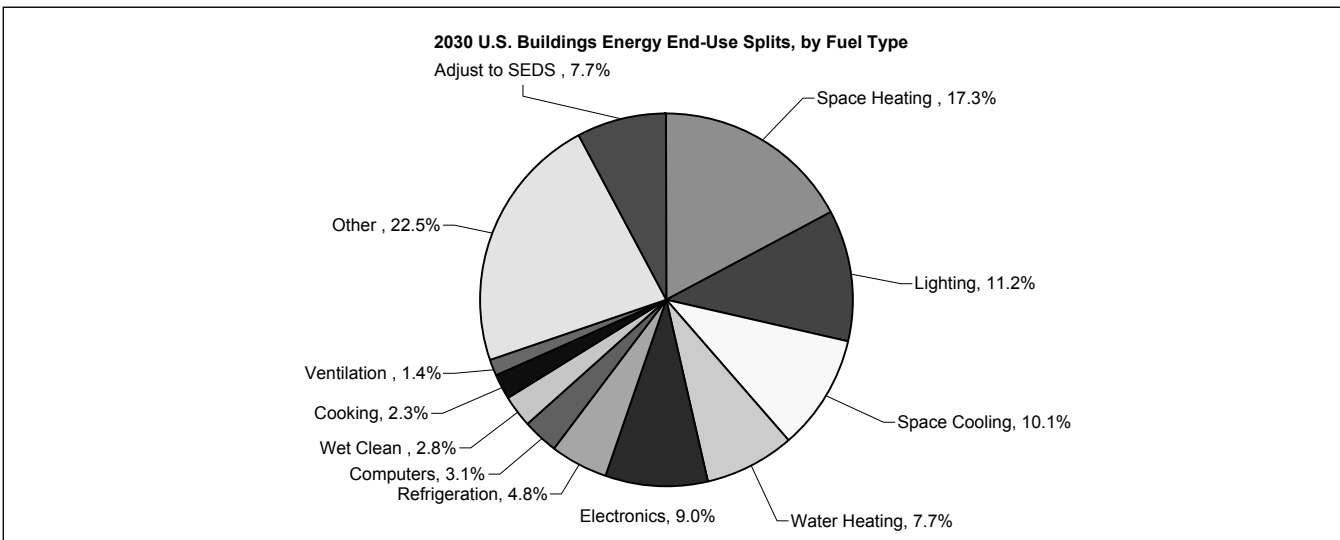


1.1.7 2030 U.S. Buildings Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Fuel		Other		Renw.	Site	Site		Primary	Primary	
	Gas	Oil (1)	LPG	Fuel(2)	En.(3)	Electric	Total	Percent	Electric (4)	Total	Percent
Space Heating (5)	5.30	0.84	0.23	0.19	0.39	0.56	7.51	30.9%	1.71	8.67	17.3%
Lighting						1.83	1.83	7.5%	5.61	5.61	11.2%
Space Cooling	0.02					1.65	1.67	6.9%	5.06	5.08	10.1%
Water Heating	1.82	0.12	0.04		0.07	0.59	2.65	10.9%	1.81	3.87	7.7%
Electronics (6)						1.47	1.47	6.0%	4.50	4.50	9.0%
Refrigeration (7)						0.78	0.78	3.2%	2.40	2.40	4.8%
Computers						0.51	0.51	2.1%	1.56	1.56	3.1%
Wet Clean (8)	0.08					0.43	0.51	2.1%	1.31	1.40	2.8%
Cooking	0.59		0.03			0.17	0.80	3.3%	0.54	1.16	2.3%
Ventilation (9)						0.23	0.23	1.0%	0.71	0.71	1.4%
Other (10)	0.62	0.02	0.34	0.05	0.15	3.30	4.47	18.4%	10.11	11.28	22.5%
Adjust to SEDS (11)	0.67	0.19				0.97	1.84	7.6%	2.99	3.85	7.7%
<b>Total</b>	<b>9.11</b>	<b>1.17</b>	<b>0.64</b>	<b>0.25</b>	<b>0.61</b>	<b>12.50</b>	<b>24.28</b>	<b>100%</b>	<b>38.32</b>	<b>50.09</b>	<b>100%</b>

Note(s): 1) Includes distillate fuel oil (1.45 quad) and residual fuel oil (0.12 quad). 2) Kerosene (0.11 quad) and coal (0.10 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of wood space heating (0.38 quad), biomass (0.13 quad), solar water heating (0.07 quad), geothermal space heating (less than 0.01 quad), and solar photovoltaics (PV) 0.02 quad. 4) Site-to-source electricity conversion (due to generation and transmission losses) = 3.07. 5) Includes furnace fans (0.25 quad). 6) Includes color television (1.69 quad) and other office equipment (2.81 quad). 7) Includes refrigerators (2.10 quad) and freezers (0.34 quad). Includes commercial refrigeration. 8) Includes clothes washers (0.08 quad), natural gas clothes dryers (0.08 quad), electric clothes dryers (0.91 quad) and dishwashers (0.33 quad). Does not include water heating energy. 9) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 10) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 11) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential and commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Tables A2, p. 117-119, Table A4, p. 122-123, Table A5, p. 124-125, and Table A17, p. 143-144; and EIA, National Energy Modeling System for AEO 2008, Mar. 2008



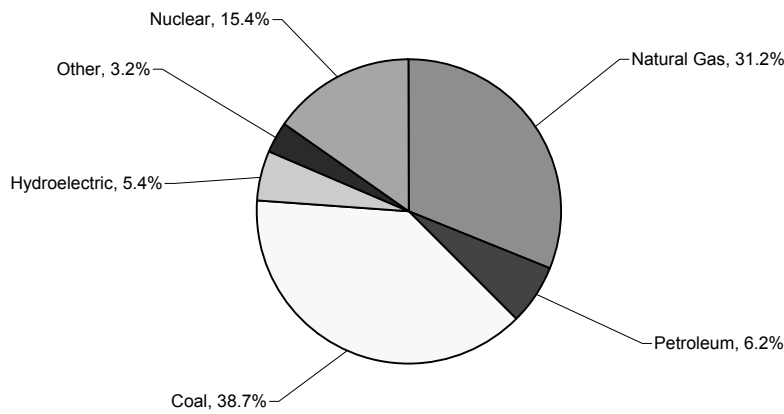
**1.1.8 Shares of U.S. Buildings Generic Quad (Percent) (1)**

	<u>Natural Gas</u>	<u>Petroleum</u>	<u>Coal</u>	<u>Renewables (2)</u>			<u>Nuclear</u>	<u>Total</u>
				<u>Hydroelectric</u>	<u>Other</u>	<u>Total</u>		
1980	37%	18%	29%	7%	4%	10%	6%	100%
1990	31%	11%	35%	6%	4%	10%	13%	100%
2000	32%	8%	37%	5%	3%	8%	14%	100%
<b>2006</b>	<b>31%</b>	<b>6%</b>	<b>39%</b>	<b>5%</b>	<b>3%</b>	<b>9%</b>	<b>15%</b>	<b>100%</b>
2010	32%	6%	38%	5%	4%	10%	15%	100%
2015	31%	6%	38%	5%	5%	10%	14%	100%
2020	29%	5%	39%	5%	6%	11%	15%	100%
2025	28%	5%	41%	5%	6%	11%	15%	100%
2030	26%	5%	43%	5%	6%	11%	15%	100%

Note(s): 1) A generic quad is primary energy apportioned between the various primary fuels according to their relative consumption. 2) Electric imports included in renewables. 3) Independent rounding.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 consumption and Table A17, p. 143-144 for non-marketed renewable energy.

**2006 Share of U.S. Buildings Generic Quad**



**1.1.9 Buildings Share of U.S. Electricity Consumption (Percent)**

	<u>Buildings</u>			<u>Industry</u>	<u>Transportation</u>	<u>Total</u>	<u>Delivered Total (quads)</u>
	<u>Residential</u>	<u>Commercial</u>	<u>Total</u>				
1980	34%	27%	<b>61%</b>	39%	0%	100%	7.15
1990	34%	31%	<b>65%</b>	35%	0%	100%	9.26
2000	35%	34%	<b>69%</b>	31%	0%	100%	11.67
<b>2006</b>	<b>37%</b>	<b>36%</b>	<b>72%</b>	<b>27%</b>	<b>0%</b>	<b>100%</b>	<b>12.49</b>
2010	37%	36%	<b>73%</b>	27%	0%	100%	13.20
2015	36%	38%	<b>74%</b>	26%	0%	100%	13.85
2020	36%	39%	<b>75%</b>	25%	0%	100%	14.54
2025	36%	40%	<b>77%</b>	23%	0%	100%	15.26
2030	37%	41%	<b>78%</b>	22%	0%	100%	16.05

Note(s): 1) Buildings accounted for 81% (or \$272 billion) of total U.S. electricity expenditures.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 137-139 for 2006-2030 consumption, Table A3, p. 120-121 for 2006 expenditures.

**1.1.10 Buildings Share of U.S. Natural Gas Consumption (Percent)**

	Site Consumption				Primary Consumption			U.S. Natural Gas
	<b>Buildings</b>	Industry	Electric Gen.	Transportation	<b>Buildings</b>	Industry	Transportation	Total (quads)
1980	<b>37%</b>	41%	19%	3%	<b>48%</b>	49%	3%	20.38
1990	<b>37%</b>	43%	17%	3%	<b>47%</b>	49%	3%	19.75
2000	<b>35%</b>	40%	22%	3%	<b>50%</b>	47%	3%	23.80
<b>2006 (1)</b>	<b>33%</b>	<b>35%</b>	<b>29%</b>	<b>3%</b>	<b>54%</b>	<b>43%</b>	<b>3%</b>	<b>22.30</b>
2010	<b>33%</b>	35%	29%	3%	<b>55%</b>	43%	3%	23.93
2015	<b>35%</b>	35%	28%	3%	<b>55%</b>	42%	3%	24.35
2020	<b>37%</b>	35%	25%	3%	<b>56%</b>	41%	3%	24.01
2025	<b>38%</b>	36%	23%	3%	<b>56%</b>	41%	3%	23.66
2030	<b>39%</b>	36%	22%	3%	<b>56%</b>	41%	3%	23.39

Note(s): 1) Buildings accounted for 58% (or \$97 billion) of total U.S. natural gas expenditures.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 consumption, Table A3, p. 120-121 for 2006 expenditures.

**1.1.11 Buildings Share of U.S. Petroleum Consumption (Percent)**

	Site Consumption				Primary Consumption			U.S. Petroleum
	<b>Buildings</b>	Industry	Electric Gen.	Transportation	<b>Buildings</b>	Industry	Transportation	Total (quads)
1980	<b>9%</b>	28%	8%	56%	<b>14%</b>	31%	56%	34.2
1990	<b>7%</b>	25%	4%	64%	<b>10%</b>	26%	64%	33.6
2000	<b>6%</b>	24%	3%	67%	<b>8%</b>	25%	67%	38.4
<b>2006</b>	<b>5%</b>	<b>25%</b>	<b>2%</b>	<b>69%</b>	<b>6%</b>	<b>25%</b>	<b>69%</b>	<b>40.1</b>
2010	<b>5%</b>	24%	1%	70%	<b>6%</b>	24%	70%	40.5
2015	<b>5%</b>	23%	1%	71%	<b>6%</b>	23%	71%	41.8
2020	<b>5%</b>	22%	1%	72%	<b>6%</b>	22%	72%	42.2
2025	<b>5%</b>	21%	1%	73%	<b>6%</b>	22%	73%	42.8
2030	<b>4%</b>	21%	1%	73%	<b>6%</b>	21%	73%	44.0

Note(s): 1) Buildings accounted for an estimated 7.3% (or \$30 billion) of total U.S. petroleum expenditures.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 consumption, Table A3, p. 120-121 for 2006 expenditures.

**1.1.12 Buildings Share of U.S. Petroleum Consumption (Million Barrels per Day)**

	Buildings			Industry	Transportation	Total
	Residential	Commercial	Total			
1980	1.31	0.92	<b>2.22</b>	5.30	9.57	19.33
1990	0.96	0.64	<b>1.60</b>	4.50	10.89	18.59
2000	1.08	0.56	<b>1.63</b>	5.07	13.05	21.39
<b>2006</b>	<b>0.69</b>	<b>0.43</b>	<b>1.12</b>	<b>4.81</b>	<b>13.02</b>	<b>20.07</b>
2010	0.71	0.39	<b>1.10</b>	4.67	13.36	20.23
2015	0.72	0.42	<b>1.14</b>	4.63	14.00	20.90
2020	0.73	0.43	<b>1.15</b>	4.48	14.34	21.13
2025	0.72	0.44	<b>1.16</b>	4.41	14.66	21.39
2030	0.72	0.44	<b>1.16</b>	4.45	15.19	21.96

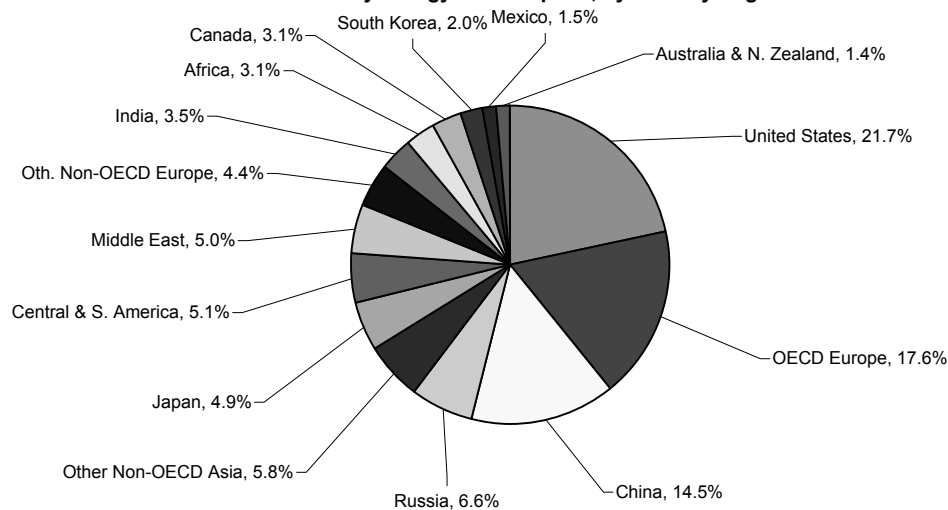
Source(s): EIA, Annual Energy Review 2007, June 2008, Table 5.13a for 1980-2005 buildings, Table 5.13b for 1980 to 2005 industry, Table 5.13c for 1980-2005 transportation, and Table 5.13d for 1980-2005 electricity generators; and EIA, Annual Energy Outlook 2008, Mar. 2007, Table A2, p. 117-119 for 2006-2030 consumption; EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2005.

## 1.1.13 World Primary Energy Consumption and Population, by Country/Region

Region/Country	Energy Consumption (Quad)				Population (million)				Annual Growth Rate			
	1990		2005		1990		2005		1990-2005		2005-2010	
	Value	%	Value	%	Value	%	Value	%	Energy	Pop.	Energy	Pop.
United States	84.7	21.7%	100.1	103.3	254	297	4.6%	311	1.1%	1.0%	0.6%	0.9%
OECD Europe	69.9	17.6%	81.4	83.9	497	536	8.2%	547	1.0%	0.5%	0.6%	0.4%
China	27.0	6.7%	67.1	87.3	1,155	1,313	20.2%	1,352	6.3%	0.9%	5.4%	0.6%
Russia	39.0	9.7%	30.3	32.7	148	144	2.2%	140	-1.7%	-0.2%	1.5%	-0.6%
Other Non-OECD Asia	12.5	3.1%	26.6	30.5	743	984	15.1%	1,060	5.2%	1.9%	2.8%	1.5%
Japan	18.4	4.6%	22.6	22.4	124	128	2.0%	128	1.4%	0.2%	-0.2%	0.0%
Central & S. America	14.5	3.6%	23.4	27.7	360	454	7.0%	483	3.2%	1.6%	3.4%	1.2%
Middle East	11.3	2.8%	22.9	26.4	137	193	3.0%	213	4.8%	2.3%	2.9%	2.0%
Oth. Non-OECD Europe	28.3	7.1%	20.4	22.4	200	198	3.0%	199	-2.2%	-0.1%	1.9%	0.1%
India	8.0	2.0%	16.2	19.4	849	1,134	17.4%	1,220	4.8%	1.9%	3.7%	1.5%
Africa	9.5	2.4%	14.4	16.5	636	922	14.2%	1,032	2.8%	2.5%	2.8%	2.3%
Canada	11.1	2.8%	14.3	15.7	28	32	0.5%	34	1.7%	0.9%	1.9%	1.2%
South Korea	3.8	0.9%	9.3	10.3	43	48	0.7%	49	6.1%	0.7%	2.1%	0.4%
Mexico	5.0	1.2%	6.9	7.4	84	104	1.6%	110	2.2%	1.4%	1.4%	1.1%
Australia & N. Zealand	4.4	1.1%	6.3	6.6	20	24	0.4%	26	2.4%	1.2%	0.9%	1.6%
<b>Total World</b>	<b>347.3</b>	<b>100%</b>	<b>462.2</b>	<b>512.5</b>	<b>5,278</b>	<b>6,512</b>	<b>100%</b>	<b>6,903</b>	<b>1.9%</b>	<b>1.4%</b>	<b>2.1%</b>	<b>1.2%</b>

Source(s): EIA, International Energy Outlook 2008, June 2008, Table A1, p. 83 and Table A14, p. 97.

World Primary Energy Consumption, by Country/Region





**1.2.1 Building Energy Prices, by Year and Major Fuel Type (\$2006 per Million Btu)**

	Residential Buildings				Commercial Buildings				Building Avg. (3)
	Electricity	Natural Gas	Petroleum (1)	Avg.	Electricity	Natural Gas	Petroleum (2)	Avg.	
1980	33.86	7.77	15.66	16.35	34.62	7.16	12.17	17.19	16.68
1990	32.78	8.04	12.49	17.32	30.27	6.71	8.49	17.32	17.32
2000	28.12	8.90	13.45	16.85	25.07	7.64	9.43	16.46	16.69
<b>2006</b>	<b>30.52</b>	<b>13.40</b>	<b>19.68</b>	<b>21.78</b>	<b>27.75</b>	<b>11.50</b>	<b>14.75</b>	<b>20.75</b>	<b>21.33</b>
2010	31.37	12.15	20.05	21.56	27.89	10.59	15.48	20.69	21.19
2015	30.04	11.20	17.90	20.19	25.52	9.68	13.29	18.93	19.63
2020	30.20	11.39	18.09	20.45	25.64	9.91	13.64	19.25	19.91
2025	30.33	11.94	18.95	21.04	25.71	10.47	14.24	19.67	20.41
2030	30.63	12.91	20.14	22.00	26.17	11.43	15.22	20.47	21.28

Note(s): 1) Residential petroleum products include distillate fuel, LPG, and kerosene. 2) Commercial petroleum products include distillate fuel, LPG, kerosene, motor gasoline, and residual fuel. 3) In 2005, buildings average electricity price was \$29.16/10<sup>6</sup> Btu or (\$0.10/kWh), average natural gas price was \$12.655/10<sup>6</sup> Btu (\$13.03/1000 CF), and petroleum was \$17.94/10<sup>6</sup> Btu (\$1.94/gal.). Averages do not include wood or coal prices.

Source(s): EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, Tables 2-3, p. 24-25 for 1980-2005 and prices for note, Tables 8-9, p. 18-19 for 1980-2005 consumption; EIA, Annual Energy Outlook 2008 Mar. 2008, Table A2, p. 117-119, Table A3, p. 120-121, Table A12, p. 138, and Table A13, p. 139 for 2006-2030 consumption and prices; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**1.2.2 Building Energy Prices, by Year and Fuel Type (\$2006)**

	Residential Buildings				Commercial Buildings			
	Electricity (¢/kWh)	Natural Gas (¢/therm)	Distillate Oil (\$/gal)	LPG (\$/gal)	Electricity (¢/kWh)	Natural Gas (¢/therm)	Distillate Oil (\$/gal)	Residual Oil (\$/gal)
1980	11.55	77.68	1.46	2.10	11.81	71.63	1.33	1.93
1990	11.18	80.38	1.34	1.59	10.33	67.12	0.73	1.18
2000	9.59	89.00	1.45	1.61	8.55	76.39	0.78	1.21
<b>2006</b>	<b>10.41</b>	<b>133.99</b>	<b>1.98</b>	<b>2.49</b>	<b>9.47</b>	<b>115.03</b>	<b>1.29</b>	<b>2.02</b>
2010	10.70	121.52	2.16	2.39	9.52	105.95	1.51	2.11
2015	10.25	112.02	2.07	1.98	8.71	96.75	1.19	1.79
2020	10.30	113.94	2.08	1.98	8.75	99.06	1.19	1.84
2025	10.35	119.35	2.11	2.10	8.77	104.67	1.29	1.92
2030	10.45	129.12	2.18	2.26	8.93	114.32	1.38	2.08

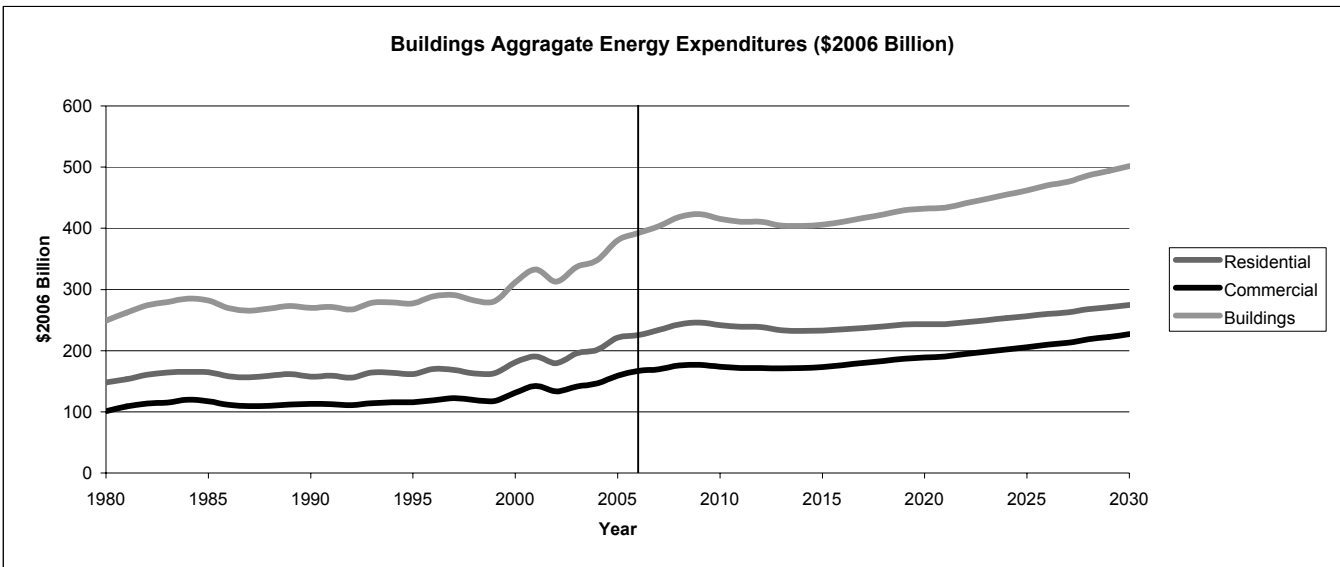
Source(s): EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. Tables 2-3, p. 24-25 for 1980-2005; EIA, Annual Energy Outlook 2008, Mar. 2008, Table A3, p. 120-121 for 2006-2030 and Table G1, p. 215 for fuels' heat content; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**1.2.3 Buildings Aggregate Energy Expenditures, by Year and Major Fuel Type (\$2006 Billion) (1)**

	Residential Buildings				Commercial Buildings				Total Building Expenditures
	Electricity	Natural Gas	Petroleum (2)	Total	Electricity	Natural Gas	Petroleum (3)	Total	
1980	82.9	37.7	27.4	148.0	66.0	19.1	15.7	100.7	248.7
1990	103.3	36.3	17.6	157.2	86.6	18.1	8.1	112.8	270.0
2000	114.4	45.4	21.0	180.8	99.2	24.9	7.1	131.2	312.0
<b>2006</b>	<b>140.8</b>	<b>60.3</b>	<b>24.5</b>	<b>225.6</b>	<b>123.1</b>	<b>33.6</b>	<b>10.0</b>	<b>166.7</b>	<b>392.2</b>
2010	155.2	60.2	26.3	241.7	131.9	32.3	9.8	173.9	415.5
2015	150.9	57.8	23.9	232.6	132.6	31.9	8.9	173.3	405.9
2020	158.7	60.4	24.1	243.2	145.3	34.4	9.2	188.9	432.2
2025	167.7	63.8	24.9	256.3	158.1	38.0	9.7	205.8	462.1
2030	180.0	68.7	26.0	274.7	173.3	43.2	10.4	226.9	501.6

Note(s): 1) Expenditures exclude wood and coal. 2006 U.S. energy expenditures were 1.14 trillion. 2) Residential petroleum products include distillate fuel oil, LPG, and kerosene. 3) Commercial petroleum products include distillate fuel oil, LPG, kerosene, motor gasoline, and residual fuel.

Source(s): EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 24-25 for 1980-2005; EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 and Table A3, p. 120-121 for 2006-2030; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.



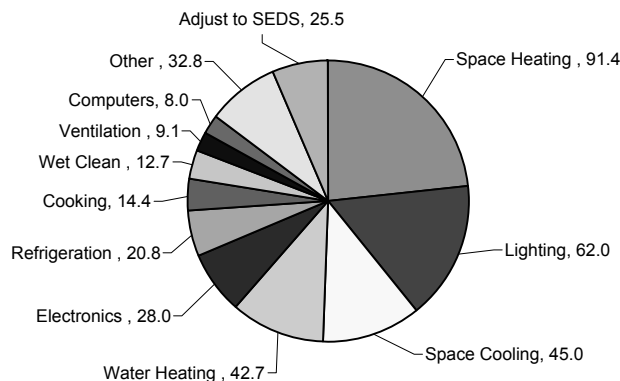
**1.2.4 2006 Buildings Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion) (1)**

	Natural	Petroleum					Coal	Electricity	Total	Percent
	Gas	Distil.	Resid.	LPG	Oth(2)	Total				
Space Heating (3)	55.5	12.6	1.0	5.3	1.4	20.2	0.2	15.5	91.4	23.3%
Lighting								62.0	62.0	15.8%
Space Cooling	0.2							44.8	45.0	11.5%
Water Heating (4)	20.8	2.6		1.3		3.9		18.1	42.7	10.9%
Electronics (5)								28.0	28.0	7.1%
Refrigeration (6)								20.8	20.8	5.3%
Cooking	5.6			0.7		0.7		8.1	14.4	3.7%
Wet Clean (7)	1.0							11.7	12.7	3.2%
Ventilation (8)								9.1	9.1	2.3%
Computers								8.0	8.0	2.0%
Other (9)	3.1	0.3		5.1	1.0	6.5		23.2	32.8	8.4%
Adjust to SEDS (10)	7.7	3.3				3.3		14.5	25.5	6.5%
<b>Total</b>	<b>93.9</b>	<b>18.7</b>	<b>1.0</b>	<b>12.4</b>	<b>2.4</b>	<b>34.5</b>	<b>0.2</b>	<b>263.8</b>	<b>392.4</b>	<b>100%</b>

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating (\$1.2 billion) and motor gasoline other uses (\$1.0 billion). 3) Includes furnace fans (\$1.7 billion). 4) Includes residential recreation water heating (\$1.3 billion). 5) Includes color televisions (\$10.1 billion) and other electronics (\$17.9 billion). 6) Includes refrigerators (\$18.3 billion) and freezers (\$2.5 billion). 7) Includes clothes washers (\$1.1 billion), natural gas clothes dryers (\$1.0 billion), electric clothes dryers (\$7.7 billion) and dishwashers (\$2.9 billion). 8) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial services station equipment, ATMs, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, manufacturing performed in commercial buildings. 10) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential and commercial buildings sectors, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A3, p. 120-121 for prices, Table A4, p. 122-123 for residential energy consumption, and Table A5, p. 124-125 for commercial energy consumption; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 24-25 for coal prices; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses; BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2, 5-25 and 5-26 for commercial ventilation; and BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, Sept. 2002, Table 8-2, p. 63 for commercial lighting.

**2006 Buildings Primary Energy End-Use Expenditures Splits (\$2006 Billion)**



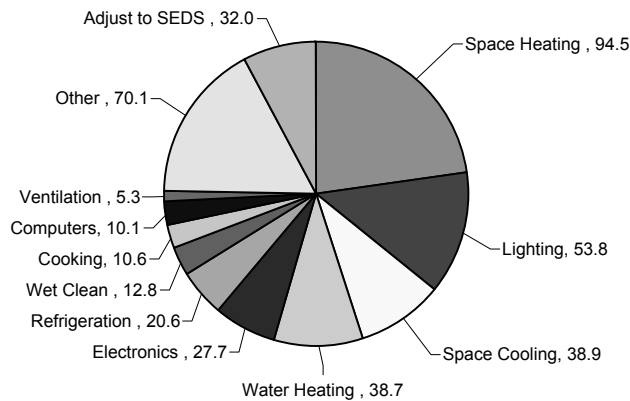
**1.2.5 2010 Buildings Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion) (1)**

	Natural	Petroleum					Coal	Electricity	Total	Percent
	Gas	Distil.	Resid.	LPG	Oth(2)	Total				
Space Heating (3)	57.1	13.4	1.0	6.0	1.5	21.9	0.2	15.4	94.5	22.8%
Lighting								53.8	53.8	13.0%
Space Cooling	0.2							38.6	38.9	9.4%
Water Heating	18.9	2.3		1.2		3.5		16.3	38.7	9.3%
Electronics (4)								27.7	27.7	6.7%
Refrigeration (5)								20.6	20.6	5.0%
Wet Clean (6)	0.9							11.9	12.8	3.1%
Cooking	5.3			0.8		0.8		4.5	10.6	2.5%
Computers								10.1	10.1	2.4%
Ventilation (7)								5.3	5.3	1.3%
Other (8)	2.3	0.3		5.7	1.1	7.0		60.8	70.1	16.9%
Adjust to SEDS (9)	7.0	2.8				2.8		22.2	32.0	7.7%
<b>Total</b>	<b>91.7</b>	<b>18.7</b>	<b>1.0</b>	<b>13.8</b>	<b>2.6</b>	<b>36.1</b>	<b>0.2</b>	<b>287.0</b>	<b>415.0</b>	<b>100%</b>

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating (\$1.3 billion) and motor gasoline other uses (\$1.1 billion). 3) Includes furnace fans (\$2.0 billion). 4) Includes color televisions (\$12.3 billion). 5) Includes refrigerators (\$18.1 billion) and freezers (\$2.5 billion). 6) Includes clothes washers (\$1.0 billion), natural gas clothes dryers (\$0.9 billion), electric clothes dryers (\$8.0 billion) and dishwashers (\$2.9 billion). 7) Commercial only; residential fan proportionately in space heating and cooling. 8) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial services station equipment, ATMs, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, manufacturing performed in commercial buildings. 10) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential and commercial buildings sectors, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A3, p. 120-121 for prices, Table A4, p. 122-123 for residential energy consumption, and Table A5, p. 124-125 for commercial energy consumption; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 24-25 for coal prices; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**2010 Buildings Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion)**

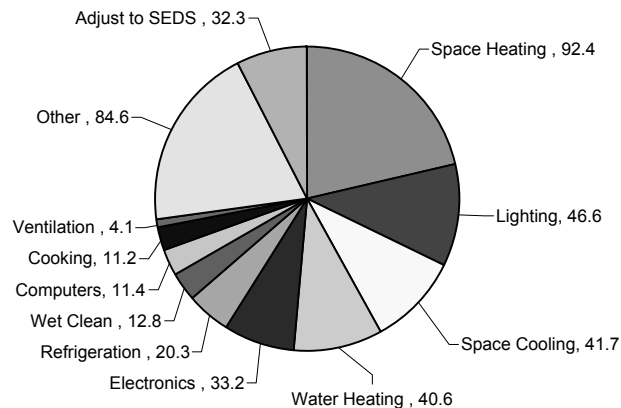


**1.2.6 2020 Buildings Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion) (1)**

	Natural	Petroleum					Coal	Electricity	Total	Percent
	Gas	Distil.	Resid.	LPG	Oth(2)	Total				
Space Heating (3)	57.5	11.2	0.8	5.7	1.4	19.1	0.2	15.7	92.4	21.4%
Lighting								46.6	46.6	10.8%
Space Cooling	0.2							41.5	41.7	9.7%
Water Heating (4)	19.6	1.8		1.1		2.9		18.1	40.6	9.4%
Electronics (5)								33.2	33.2	7.7%
Refrigeration (6)								20.3	20.3	4.7%
Wet Clean (7)	0.9							11.9	12.8	3.0%
Computers								11.4	11.4	2.6%
Cooking	5.7			0.8		0.8		4.7	11.2	2.6%
Ventilation (8)								4.1	4.1	1.0%
Other (9)	2.8	0.3		6.6	1.0	7.9		73.9	84.6	19.6%
Adjust to SEDS (10)	7.2	2.6				2.6		22.6	32.3	7.5%
<b>Total</b>	<b>93.8</b>	<b>15.9</b>	<b>0.8</b>	<b>14.3</b>	<b>2.4</b>	<b>33.4</b>	<b>0.2</b>	<b>304.0</b>	<b>431.3</b>	<b>100%</b>

Note(s): 1) Expenditures include coal and exclude wood . 2) Includes kerosene space heating (\$1.4 billion) and motor gasoline other uses (\$1.0 billion). 3) Includes furnace fans (\$2.2 billion). 5) Includes color televisions (\$12.9 billion). 6) Includes refrigerators (\$17.6 billion) and freezers (\$2.8 billion). 7) Includes clothes washers (\$0.8 billion), natural gas clothes dryers (\$0.9 billion), electric clothes dryers (\$8.2 billion) and dishwashers (\$2.9 billion). 8) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial services station equipment, ATMs, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, manufacturing performed in commercial buildings. 10) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential and commercial buildings sectors, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A3, p. 120-121 for prices, Table A4, p. 122-123 for residential energy consumption, and Table A5, p. 124-125 for commercial energy consumption; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 24-25 for coal prices; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators

**2020 Buildings Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion)**

**1.2.7 2030 Buildings Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion) (1)**

	Natural	Petroleum					Coal	Electricity	Total	Percent
	Gas	Distil.	Resid.	LPG	Oth(2)	Total				
Space Heating (3)	66.3	11.8	0.9	5.8	1.6	20.2	0.2	16.5	103.1	20.6%
Lighting								50.1	50.1	10.0%
Space Cooling	0.2							47.9	48.1	9.6%
Water Heating (4)	22.5	1.9		1.1		2.9		19.2	44.6	8.9%
Electronics (5)								40.9	40.9	8.2%
Refrigeration (6)								22.7	22.7	4.5%
Wet Clean (7)	1.1							13.1	14.2	2.8%
Cooking	7.1			0.9		0.9		5.2	13.2	2.6%
Computers								14.0	14.0	2.8%
Ventilation (8)								4.2	4.2	0.8%
Other (9)	4.6	0.3		8.1	1.1	9.5		94.0	108.2	21.7%
Adjust to SEDS (10)	7.7	2.8				2.8		25.5	36.0	7.2%
<b>Total</b>	<b>109.6</b>	<b>16.8</b>	<b>0.9</b>	<b>15.9</b>	<b>2.7</b>	<b>36.3</b>	<b>0.2</b>	<b>353.3</b>	<b>499.4</b>	<b>100%</b>

Note(s): 1) Expenditures include coal and exclude wood . 2) Includes kerosene space heating (\$1.3 billion) and motor gasoline other uses (\$1.1 billion). 3) Includes furnace fans (\$2.4 billion). 5) Includes color televisions (\$16.9 billion). 6) Includes refrigerators (\$19.3 billion) and freezers (\$3.4 billion). 7) Includes clothes washers (\$0.8 billion), natural gas clothes dryers (\$1.1 billion), electric clothes dryers (\$9.0 billion) and dishwashers (\$3.3 billion). 8) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial services station equipment, ATMs, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, manufacturing performed in commercial buildings. 10) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential and commercial buildings sectors, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A3, p. 120-121 for prices, Table A4, p. 122-123 for residential energy consumption, and Table A5, p. 124-125 for commercial energy consumption; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 24-25 for coal prices; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**1.2.8 Implicit Price Deflators (2000 = 1.00)**

Year	Implicit Price Deflator	Year	Implicit Price Deflator	Year	Implicit Price Deflator
1980	0.54	1990	0.82	2000	1.00
1981	0.59	1991	0.84	2001	1.02
1982	0.63	1992	0.86	2002	1.04
1983	0.65	1993	0.88	2003	1.06
1984	0.68	1994	0.90	2004	1.09
1985	0.70	1995	0.92	2005	1.13
1986	0.71	1996	0.94	2006	1.17
1987	0.73	1997	0.95		
1988	0.76	1998	0.96		
1989	0.79	1999	0.98		

Source(s): EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377.

**1.3.1 Estimated Value of All U.S. Construction Relative to the GDP (\$2006)**

- 2006 estimated value of all U.S. construction is \$1.77 trillion (including renovation; heavy construction; public works; residential, commercial, and industrial new construction; and non-contract work).
- Compared to the \$13.2 trillion U.S. gross domestic product (GDP), all construction holds a 13.4% share.
- In 2006, residential and commercial building renovation (valued at \$438 billion) and new building construction (valued at \$785 billion) is estimated to account for over 69% (approximately \$1.22 trillion) of the \$1.77 trillion.

Source(s): National Science and Technology Council, Construction & Building: Interagency Program for Technical Advancement in Construction and Building, 1999, p. 5; DOC, 1997 Census of Construction Industries: Industry Summary, Jan. 2000, Table 7, p. 15; DOC, Annual Value of Construction Put in Place, August 2008; DOC, Expenditures for Residential Improvements and Repairs by Property Type, Table S2, August 2008; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators and GDP.

**1.3.2 Value of New Building Construction Relative to GDP, by Year (\$2006 Billion)**

	Value of New Construction Put in Place			GDP	Bldgs. Percent of Total U.S. GDP
	Residential	Commercial (1)	All Bldgs. (1)		
1980	154.4	148.7	303.0	6,013	5.0%
1985	198.5	210.4	408.9	7,053	5.8%
1990	194.1	211.7	405.8	8,286	4.9%
1995	221.8	190.0	411.7	9,357	4.4%
2000	312.2	291.9	604.1	11,437	5.3%
2006	489.6	283.3	784.7	13,187	6.1%

Note(s): 1) New buildings construction differs from Table 1.3.2 by excluding industrial building construction.

Source(s): DOC, Current Construction Reports: Value of New Construction Put in Place, C30, Aug. 2003, Table 1 for 1980-1990; DOC, Annual Value of Private Construction Put in Place, August 2008 for 1995-2006; DOC, Annual Value of Public Construction Put in Place, August 2008 for 1995-2006; DOC, Expenditures for Residential Improvements and Repairs by Property Type, July 2007; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for GDP and price deflators.

**1.3.3 Value of Building Improvements and Repairs Relative to GDP, by Year (\$2006 Billion) (1)**

	Value of Improvements and Repairs			GDP	Bldgs. Percent of Total U.S. GDP
	Residential	Commercial	All Bldgs.		
1980	99.9	N.A.	N.A.	6,013	N.A.
1985	137.2	130.4 (2)	267.7	7,053	3.8%
1990	164.8	132.6 (3)	297.4	8,286	3.6%
1995	158.1	140.6	298.7	9,357	3.2%
2000	178.2	122.8	301.0	11,437	2.6%
2006	228.2	209.7	437.9	13,187	3.3%

Note(s): 1) Improvements includes additions, alterations, reconstruction, and major replacements. Repairs include maintenance.  
2) 1986. 3) 1989.

Source(s): DOC, Expenditures for Residential Improvements and Repairs by Property Type, Quarterly, May 2005 for 1980-1990; DOC, Expenditures for Residential Improvements and Repairs by Property Type, Table S2, August 2008 for 1995-2006; DOC, Current Construction Reports: Expenditures for Nonresidential Improvements and Repairs: 1992, CSS/92, Sept. 1994, Table A, p. 2 for 1986-1990 expenditures; DOC, 1997 Census of Construction Industries: Industry Summary, Jan. 2000, Table 7, p. 15; DOC, Annual Value of Private Construction Put in Place, July 2008 for 1995-2006; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for GDP and price deflators.

**1.3.4 2003 U.S. Private Investment into Construction R&D**

Sector	Percent of Sales	Building Technology	Percent of Sales
<b>Average Construction R&amp;D (1)</b>	<b>1.2</b>		
Heavy Construction	2.0	Appliances	2.0
Special Trade Construction	0.2	Lighting	1.2
		HVAC	1.5
<b>U.S. Average of All Private R&amp;D (2)</b>	<b>3.2</b>	Fans, Blowers, & Air Cleaning Equipment	1.6
Manufacturing Average	3.1	Lumber and Wood Products	0.3
Service Industry Average	3.3	Commercial Building Operations	2.2

Note(s): 1) Includes all construction (e.g., bridges, roads, dams, buildings, etc.).

Source(s): National Science Foundation, Research and Development in Industry: 2003, Table 27, p. 76-77; and Schonfeld & Associates, R&D Ratios & Budgets, June 2003, p. 219-222.

**1.3.5 1997/1998 International Investment into Construction and Energy R&D**

	Construction Percent of Private R&D to Total Private R&D	Gas, and Water Percent of Private R&D to Total Private R&D	Mining Percent of Private R&D to Total Private R&D
United States	0.2	0.2	0.1
Canada	0.3	2.7	2.9
Germany	0.3	0.3	0.5
France	1.0	3.0	1.8
Italy	0.3	1.7	0.0
Japan	2.1	0.9	0.0
United Kingdom	0.4	1.4	1.4
Russian Federation	0.9	0.5	3.3
Sweden	0.6	0.8	1.1
Finland	0.8	1.6	0.7

Source(s): National Science Foundation, Science & Engineering Indicators -- 2002, Volume 1, Jan. 2002, Table 4-16, p. 4-53.

**1.3.6 FY2003-2005 Green Building R&D, as Share of Federal Budget and by Organization**

Budget Function	Percent of U.S. Federal Budget	Organization	Average Annual Funding (\$1,000s)
National Defense	57.2%	DOE	123,170
Health	23.1%	EPA	25,317
<b>Other energy, general science, natural resources, and environment</b>	<b>8.0%</b>	NSF	22,940
Space research and technology	6.3%	PIER (1)	11,100
Transportation	1.5%	DOC-NIST	7,500
Agriculture	1.5%	NYSERDA	5,800
Veterans' benefits and services research	0.7%	HUD	5,000
<b>Green building</b>	<b>0.2%</b>	GSA	3,000
<u>Other functions (2)</u>	<u>1.6%</u>	ASHRAE	2,400
Total	100%		

Note(s): 1) PIER = Public Interest Energy Research 2) Includes education, training, employment, and social services; income security; and commerce.

Source(s): U.S. Green Building Council, Green Building Research Funding: An Assessment of Current Activity in the United States, 2006, Chart 1, p. 3, Chart 2, p. 3.



**1.3.7 Buildings Design and Construction Trades, by Year**

	Employees, in thousands			Number of Residential Builder Establishments with Payrolls, in thousands (2)			
	Architects	Construction (1)		New Construction	Remodeling	Both	Total (3)
1980	N.A.	3,065	1982	14.4	21.7	57.5	93.6
1990	N.A.	3,861	1987	38.4	32.8	48.1	119.3
2000 (4)	215	5,183	1992	36.3	43.3	51.0	130.6
2003	180	6,735	1997	46.6	33.6	52.1	134.1
2004	207	6,976	2002	95.4	28.0	47.7	167.4
2005	235	7,336					
2006	221	7,689					

Note(s): 1) Does not include industrial building or heavy construction (e.g., dam and bridge building). In 1999, 76% of the employment shown is considered for production. The entire U.S. construction industry employs an estimated 10 million people, including manufacturing. 2) In 2000, NAHB report having 200,000 members, one-third of which were builders. 3) Excludes homebuilding establishments without payrolls, estimated by NAHB at an additional 210,000 in 1992. 4) NAHB reports that 2,448 full-time jobs in construction and related industries are generated from the construction of every 1,000 single-family homes and 1,030 jobs are created from the construction of every 1,000 multi-family units.

Source(s): DOC, Statistical Abstract of the U.S. 2001, May 2002, Table 593, p. 380 for 2000 architect employment, Table 609, p. 393; Statistical Abstract of the U.S. 2004-2005, December 2004, Table 597, p. 385 for 2003 architect employment, Table 602 for 2005 architect employment, Table 613, p. 400; DOC, 1992 Census of Construction Activities: U.S. Summary, CC92-I-27, Jan. 1996, p. 27-5 for construction employees; DOC, 1997 Economic Census: Construction - Industry Summary, EC97C23IS, Jan. 2000, Table 2, p. 8 for industrial builders; DOC, 1997 Economic Census: Construction - Single-Family Housing Construction, EC97C-2332A, Nov. 1999, Table 10, p. 14 for 1997 builder establishments; DOC, 2002 Economic Census: Construction - New Single-Family Housing Construction, EC02-231-236115, Dec. 2004, New Housing Operatives, ECO2-231-236118, Dec. 2004, Residential Remodelers, EC02-231-236119, Dec. 2004, Industrial Building Construction, 231-236210, Dec. 2004; NAHB, Housing Economics, May 1995, Table 2, p. 14 for 1982-1992 builder establishments; National Science and Technology Council, Construction & Building: Federal Research and Development in Support of the U.S. Construction industry for construction employees in Note 1; NAHB, Housing at the Millennium: Facts, Figures, and Trends, May 2000, p. 21 for Note 2; and NAHB, 1997 Housing Facts, Figures and Trends, 1997, p. 35 for Note 3, and p. 13 for Note 4.; DOC, Statistical Abstract of the U.S. 2008, May 2008, table 612, p. 401 for 2003-2006 construction employment and Table 598, p. 388 for 2006 Architects Employed

**1.3.8 Heating, Cooling, and Ventilation Equipment Trades, by Year (Thousand Employees)**

Industry	1980	1985	1990	1995	2000	2003
Air-Conditioning and Refrigeration Equipment (incl. warm-air furnaces): SIC 3585						
- Total Employment	118.4	122.8	126.9	136.3	150.2	109.1
- Production Workers	81.6	87.2	92.4	102.4	111.6	76.7
Plumbing, Heating, and Air-Conditioning Contractors: SIC 171						
- Total Employment	532.8	605.1	649.2	736.5	928.5	844.9
- Construction Workers	400.4	447.3	476.7	542.4	687.2	630.4
Wholesalers of Hardware, Plumbing and Heating Equipment: SIC 507						
- Total Employment	242.7	254.1	283.8	288.2	318.3	230.5

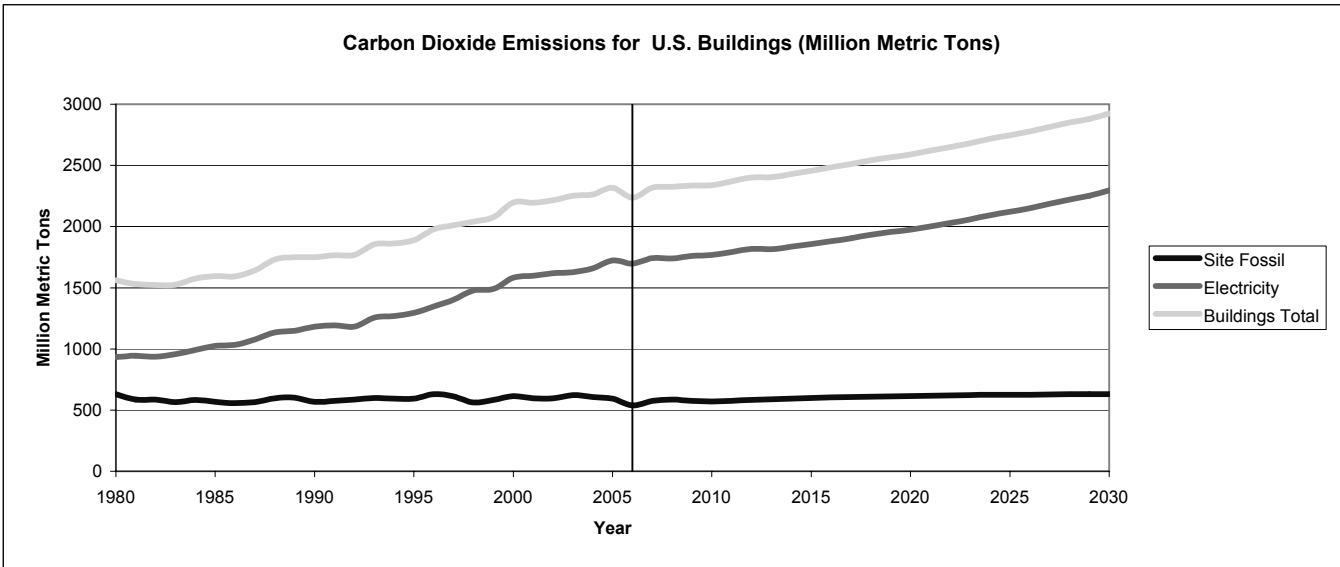
Source(s): ARI, Statistical Profile of the Air-Conditioning, Refrigeration, and Heating Industry (from U.S. Bureau of Labor Statistics), April 2001, Table 3, p. 10, Table 4, p. 11, Table 5, p. 13, Table 6, p. 14, and Table 8, p. 16 for 1980 to 1990 data; ARI, Statistical Profile of the Air-Conditioning, Refrigeration and Heating Industry, October 2004, Table 3, p. 9, Table 4, p. 10, Table 5, p. 12, Table 6, p. 13 and Table 8, p. 15 for 1995 to 2003 data.

**1.4.1 Carbon Dioxide Emissions for U.S. Buildings, by Year (Million Metric Tons) (1)**

	Buildings				U.S.		Buildings % of Total U.S.	Buildings % of Total Global
	Site Fossil	Electricity	Total	Growth Rate 2006-Year	Total	Growth Rate 2006-Year		
1980	630	933	1562	-	4723	-	33%	8.5%
1990	567	1183	1749	-	5012	-	35%	8.2%
2000	615	1581	2197	-	5847	-	38%	9.2%
<b>2006</b>	<b>538</b>	<b>1698</b>	<b>2236</b>	-	<b>5890</b>	-	<b>38%</b>	<b>7.9%</b>
2010	570	1768	2338	1.1%	6011	0.5%	39%	7.5%
2015	598	1858	2456	1.0%	6226	0.6%	39%	7.2%
2020	616	1974	2589	1.1%	6384	0.6%	41%	7.0%
2025	625	2121	2745	1.1%	6571	0.6%	42%	6.9%
2030	630	2295	2925	1.1%	6851	0.6%	43%	6.9%

Note(s): 1) Excludes emissions of buildings-related energy consumption in the industrial sector. Emissions assume complete combustion from energy consumption and exclude energy production activities such as gas flaring, coal mining, and cement production. 2) Carbon emissions calculated from EIA, Assumptions to the AEO 2008 and differs from EIA, AEO 2008, Table A18. Buildings sector total varies by 0.7% for year 2006 from EIA, AEO 2008. 3) U.S. buildings emissions approximately equal the combined carbon emissions of Japan, France, and the United Kingdom.

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 1985-1990, Sept. 1993, Appendix B, Tables B1-B5, p. 73-74 for 1980; EIA, Emissions of Greenhouse Gases in the U.S. 2003, Dec. 2004, Tables 7-11, p. 29-31 for 1990 and 2000; EIA, Assumptions to the Annual Energy Outlook 2008, April 2008, Table 2, p. 10 for carbon coefficients; EIA, AEO 2008, Mar. 2008, Table A2, p. 137-139 for 2005-2030 energy consumption and Table A18, p. 164 for 2005-2030 emissions; EIA, International Energy Outlook 2008, June 2008, Table A10, p. 93 for 2005-2030 global emissions; and EIA, International Energy Annual 2006, July 2006, Table H1, www.eia.doe.gov for 1980-2000 global emission.



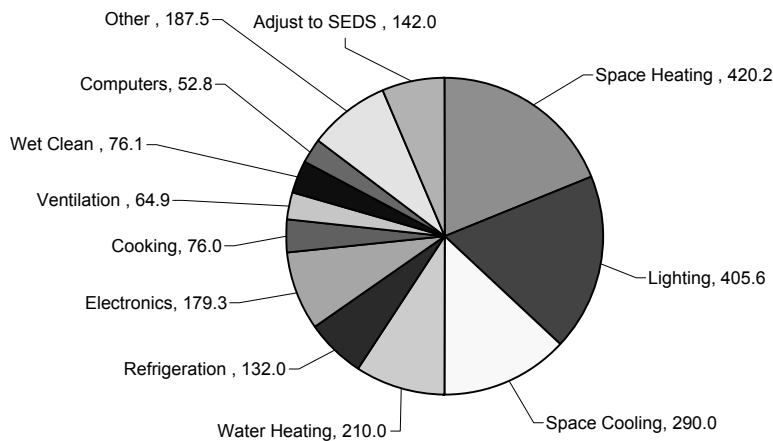
**1.4.2 2006 Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)**

	Natural	Petroleum					Coal	Electricity (3)	Total	Percent
	Gas	Distil.	Resid.	LPG	Oth(2)	Total				
Space Heating (4)	228.7	53.1	8.9	14.4	6.6	83.0	8.9	99.6	420.2	18.8%
Lighting								405.6	405.6	18.1%
Space Cooling	1.1							288.9	290.0	13.0%
Water Heating	86.4	11.1		3.5		14.6		109.0	210.0	9.4%
Refrigeration (5)								132.0	132.0	5.9%
Electronics (6)								179.3	179.3	8.0%
Cooking	23.8			2.0		2.0		50.2	76.0	3.4%
Ventilation (7)								64.9	64.9	2.9%
Wet Clean (8)	3.9							72.2	76.1	3.4%
Computers								52.8	52.8	2.4%
Other (9)	14.5	1.4		14.7	3.5	19.5		153.5	187.5	8.4%
Adjust to SEDS (10)	35.3	16.6				16.6		90.2	142.0	6.4%
<b>Total</b>	<b>393.7</b>	<b>82.1</b>	<b>8.9</b>	<b>34.6</b>	<b>10.1</b>	<b>135.7</b>	<b>8.9</b>	<b>1,698.0</b>	<b>2,236.3</b>	<b>100%</b>

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. Carbon emissions calculated from EIA, Assumptions to the AEO 2008 and differs from EIA, AEO 2008, Table A18. Buildings sector total varies by 0.7% from EIA, AEO 2008. 2) Includes kerosene space heating (5.4 MMT) and motor gasoline other uses (3.5 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (10.1 MMT). 5) Includes refrigerators (116.5 MMT) and freezers (15.6 MMT). 6) Includes color television (62.2 MMT) and other office equipment. 7) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 8) Includes clothes washers (6.7 MMT), natural gas clothes dryers (3.9 MMT), electric clothes dryers (47.7 MMT), and dishwashers (17.9 MMT). Does not include water heating energy. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 10) Emissions related to a discrepancy between data sources. Energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 132-133 and Table A5, p. 134-135 for energy consumption, and Table A18, p. 143-144 for emissions; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; EIA, Assumptions to the AEO 2008, April 2008, Table 2, p. 10 for emission coefficients; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses; BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2; BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, Sept. 2002, Table 8-2, p.63; and EIA, AEO 1999, Dec. 1998, Table A4, p. 118-119 and Table A5, p. 120-121 for 1996 data.

**2006 Buildings Energy End-Use Carbon Dioxide Emissions (Million Metric Tons)**



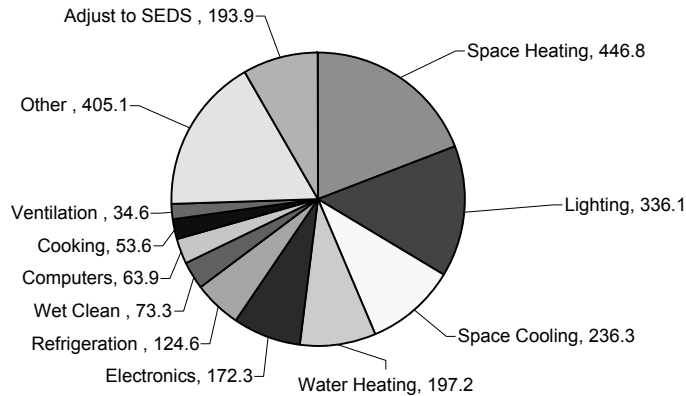
**1.4.3 2010 Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)**

	Natural Gas	Petroleum					Coal	Electricity (3)	Total	Percent
		Distil.	Resid.	LPG	Oth(2)	Total				
Space Heating (4)	258.1	57.9	7.7	15.1	7.1	87.7	8.8	92.3	446.8	19.1%
Lighting								336.1	336.1	14.4%
Space Cooling	1.1							235.2	236.3	10.1%
Water Heating	86.0	10.0		3.1		13.2		98.1	197.2	8.4%
Electronics (5)								172.3	172.3	7.4%
Refrigeration (6)								124.6	124.6	5.3%
Wet Clean (7)	3.9							69.4	73.3	3.1%
Computers								63.9	63.9	2.7%
Cooking	24.9			2.0		2.0		26.7	53.6	2.3%
Ventilation (8)								34.6	34.6	1.5%
Other (9)	15.3	1.3		15.6	3.5	20.4		369.4	405.1	17.3%
Adjust to SEDS (10)	34.9	13.5				13.5		145.4	193.9	8.3%
<b>Total</b>	<b>424.2</b>	<b>82.8</b>	<b>7.7</b>	<b>35.8</b>	<b>10.6</b>	<b>136.8</b>	<b>8.8</b>	<b>1,768.0</b>	<b>2,337.8</b>	<b>100%</b>

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (7.7 MMT) and motor gasoline other uses (3.5 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (11.6 MMT). 6) Includes color television (71.7 MMT) and other office equipment (100.6 MMT). 5) Includes refrigerators (109.8 MMT) and freezers (14.8 MMT). 8) Includes clothes washers (6.0 MMT), natural gas clothes dryers (3.9 MMT), electric clothes dryers (46.5 MMT), and dishwashers (16.9 MMT). Does not include water heating energy. 7) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 10) Emissions related to a discrepancy between data sources. Energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123 and Table A5, p. 134-135 for energy consumption, and Table A18, p. 143-144 for emissions; EIA, National Energy Modeling System for AEO 2008, Feb. 2008; EIA, Assumptions to the AEO 2008, April 2008, Table 2, p. 10 for emission coefficients.

**2010 Buildings Energy End-Use Carbon Dioxide Emissions Splits  
(Million Metric Tons)**



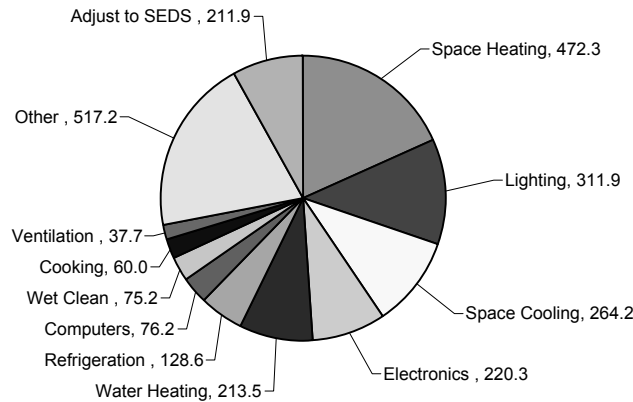
**1.4.4 2020 Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)**

	Natural Gas	Petroleum					Coal	Electricity (3)	Total	Percent
		Distil.	Resid.	LPG	Oth(2)	Total				
Space Heating (4)	277.4	58.2	8.1	14.9	7.4	88.6	8.7	97.6	472.3	18.2%
Lighting								311.9	311.9	12.0%
Space Cooling	1.1							263.1	264.2	10.2%
Electronics (5)								220.3	220.3	8.5%
Water Heating	95.6	9.6		2.9		12.6		105.4	213.5	8.2%
Refrigeration (6)								128.6	128.6	5.0%
Computers								76.2	76.2	2.9%
Wet Clean (7)	4.2							71.0	75.2	2.9%
Cooking	28.6			2.1		2.1		29.3	60.0	2.3%
Ventilation (8)								37.7	37.7	1.5%
Other (9)	20.3	1.4		18.6	3.7	23.7		473.2	517.2	20.0%
Adjust to SEDS (10)	38.4	14.2				14.2		159.3	211.9	8.2%
<b>Total</b>	<b>465.5</b>	<b>83.5</b>	<b>8.1</b>	<b>38.5</b>	<b>11.1</b>	<b>141.2</b>	<b>8.7</b>	<b>1,973.7</b>	<b>2,589.2</b>	<b>100%</b>

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (7.4 MMT) and motor gasoline other uses (3.7 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (13.2 MMT). 5) Includes color television (77.3 MMT) and other office equipment (143.2 MMT). 6) Includes refrigerators (112.1 MMT) and freezers (16.6 MMT). 7) Includes clothes washers (4.8 MMT), natural gas clothes dryers (4.2 MMT), electric clothes dryers (48.9 MMT), and dishwashers (17.3 MMT). Does not include water heating energy. 8) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 10) Emissions related to a discrepancy between data sources. Energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123 and Table A5, p. 134-135 for energy consumption, and Table A18, p. 143-144 for emissions; EIA, National Energy Modeling System for AEO 2008, Feb. 2008; EIA, Assumptions to the AEO 2008, April 2008, Table 2, p. 10 for emission coefficients;

**2020 Buildings Energy End-Use Carbon Dioxide Emissions Splits  
(Million Metric Tons)**



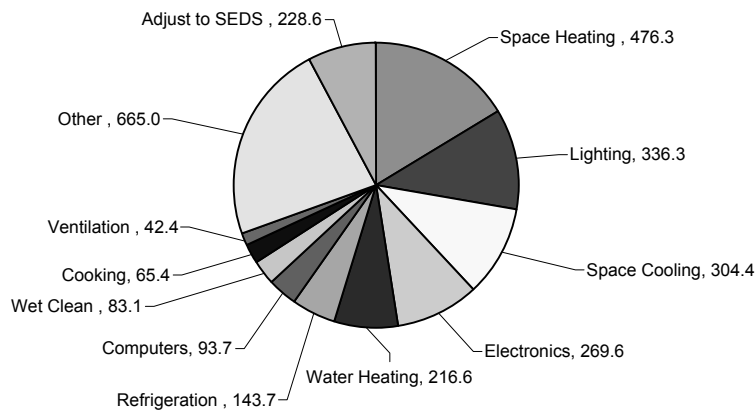
**1.4.5 2030 Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)**

	Natural Gas	Petroleum					Coal	Electricity (3)	Total	Percent
		Distil.	Resid.	LPG	Oth(2)	Total				
Space Heating (4)	281.2	53.8	8.1	14.5	7.4	83.9	8.6	476.3	16.3%	
Lighting								336.3	11.5%	
Space Cooling	1.1							304.4	10.4%	
Electronics (5)								269.6	9.2%	
Water Heating	96.8	8.7		2.7		11.3		108.5	7.4%	
Refrigeration (6)								143.7	4.9%	
Computers								93.7	3.2%	
Wet Clean (7)	4.4							78.7	2.8%	
Cooking	31.1			2.2		2.2		32.1	2.2%	
Ventilation (8)								42.4	1.4%	
Other (9)	32.7	1.6		21.4	3.8	26.8		605.5	22.7%	
Adjust to SEDS (10)	35.8	13.8				13.8		179.0	7.8%	
<b>Total</b>	<b>483.2</b>	<b>77.9</b>	<b>8.1</b>	<b>40.7</b>	<b>11.2</b>	<b>137.9</b>	<b>8.6</b>	<b>2,295.4</b>	<b>2,925.1</b>	<b>100%</b>

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (7.4 MMT) and motor gasoline other uses (3.8 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (14.6 MMT). 5) Includes color television (101.5 MMT) and other office equipment (168.2 MMT). 6) Includes refrigerators (123.2 MMT) and freezers (20.5 MMT). 7) Includes clothes washers (5.0 MMT), natural gas clothes dryers (4.4 MMT), electric clothes dryers (54.2 MMT), and dishwashers (19.5 MMT). Does not include water heating energy. 8) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 10) Emissions related to a discrepancy between data sources. Energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123 and Table A5, p. 134-135 for energy consumption, and Table A18, p. 143-144 for emissions; EIA, National Energy Modeling System for AEO 2008, Feb. 2008; EIA, Assumptions to the AEO 2008, April 2008, Table 2, p. 10 for emission coefficients;

**2030 Buildings Energy End-Use Carbon Dioxide Emissions Splits  
(Million Metric Tons)**



**1.4.6 World Carbon Dioxide Emissions**

<u>Nation/Region</u>	<u>Emissions (million metric tons)</u>			<u>Annual Growth Rate</u>		
	<u>1990</u>	<u>2005</u>	<u>2010</u>	<u>1990-2005</u>	<u>2005-2010</u>	
United States	4989	5982	21%	6011	1.2%	0.1%
China	2241	5323	19%	6898	5.9%	5.3%
OECD Europe	4092	4383	16%	4512	0.5%	0.6%
Russia	2334	1696	6%	1789	-2.1%	1.1%
Other Non-OECD Asia	807	1690	6%	1938	5.1%	2.8%
Middle East	704	1400	5%	1622	4.7%	3.0%
Japan	1011	1230	4%	1196	1.3%	-0.6%
Other Non-OECD Eurasia	1859	1169	4%	1278	-3.0%	1.8%
India	578	1164	4%	1349	4.8%	3.0%
Central and S. America	673	1078	4%	1308	3.2%	3.9%
Africa	649	966	3%	1090	2.7%	2.4%
Canada	474	628	2%	669	0.0%	0.0%
South Korea	234	500	2%	559	5.2%	2.3%
Australia and New Zealand	291	444	2%	454	2.9%	0.4%
Mexico	300	398	1%	430	1.9%	1.6%
<b>Total World</b>	<b>21223</b>	<b>28051</b>	<b>100%</b>	<b>31100</b>	<b>1.9%</b>	<b>2.1%</b>

Source(s): EIA, International Energy Outlook 2008, June 2008, Table A10, p. 93.

**1.4.7 2006 Methane Emissions for U.S. Buildings Energy Production, by Fuel Type (MMT CO2 Equivalent) (1)**

<u>Fuel Type</u>	<u>Residential</u>	<u>Commercial</u>	<u>Buildings Total</u>
Petroleum	1.0	0.5	1.4
Natural Gas	30.8	20.0	50.9
Coal	0.0	0.2	0.3
Wood	2.3	0.4	2.7
Electricity (2)	38.2	36.7	74.9
<b>Total</b>	<b>72.3</b>	<b>57.9</b>	<b>130.1</b>

Note(s): 1) Sources of emissions include oil and gas production, processing, and distribution; coal mining; and utility and site combustion. Carbon Dioxide equivalent units are calculated by converting methane emissions to carbon dioxide emissions (methane's global warming potential is 23 times that of carbon dioxide). 2) Emissions of electricity generators attributable to the buildings sector.

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 2006, Nov. 2007, Table 15, p. 22 for energy production emissions; EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, April 2008, Table 3-16, p. 3-25 for stationary combustion emissions; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for energy consumption.

**1.4.8 2006 Carbon Dioxide Emission Coefficients for Buildings (MMT CO<sub>2</sub> per Quadrillion Btu) (1)**

	All Buildings	Residential Buildings	Commercial Buildings
<b>Coal</b>			
Average (2)	95.35	95.35	95.35
<b>Natural Gas</b>			
Average (2)	53.06	53.06	53.06
<b>Petroleum Products</b>			
Distillate Fuel Oil/Diesel	73.15	-	-
Kerosene	72.31	-	-
Motor Gasoline	70.88	-	-
Liquefied Petroleum Gas	63.03	-	-
Residual Fuel Oil	78.80	-	-
Average (2)	70.50	69.30	72.70
<b>Electricity Consumption (3)</b>			
Average - Primary (4)	59.16	59.16	59.16
Average - Site (5)	188.6	188.6	188.6
<b>New Generation</b>			
Gas Combined Cycle - Site (6)	115.5	115.5	115.5
Gas Combustion Turbine - Site (6)	173.8	173.8	173.8
Stock Gas Generator - Site (7)	141.4	141.4	141.4
<b>All Fuels (3)</b>			
Average - Primary	57.75	57.25	58.34
Average - Site	117.8	110.5	126.6

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. The combustion of fossil fuels produces carbon in the form of carbon dioxide and carbon monoxide; however, carbon monoxide emissions oxidize in a relatively short time to form carbon dioxide. 2) Coefficients do not match total emissions reported in the AEO 2008 and were adjusted using Assumptions to the AEO 2008. 3) Excludes electricity imports from utility consumption. Includes nuclear and renewable (including hydroelectric) generated electricity. 4) Use this coefficient to estimate CO<sub>2</sub> emissions resulting from the consumption of energy by electric generators. 5) Use this coefficient to estimate CO<sub>2</sub> emissions resulting from the consumption of electricity by end-users. 6) Use this coefficient to estimate emissions of the next-built (2006) natural gas-fired, electric generator resulting from the consumption of electricity by end-users. 7) Use this coefficient to estimate emissions of existing natural gas-fired, electric generators resulting from the consumption of electricity by end-users.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A8, p. 131-132, Table A17, p. 143-144 for consumption and Table A18, p. 145 for emissions; EIA, Assumptions to the AEO 2008, June 2008, Table 2, p. 10 for coefficients and Table 38, p. 76 for generator efficiencies; EIA, Annual Energy Review 2007, June 2008, Diagram 5, p. 221 for Transmission and Distribution (T&D) losses.



**1.4.9 Average Carbon Dioxide Emissions from a Generic Quad in the Buildings Sector with Stock Fuel Mix and Projected Fuel Mix of New Marginal Utility Capacity and Site Energy Consumption (Million Metric Tons) (1)**

	Stock			Projected Fuel Mix of New Marginal Utility Capacity and Site Consumption								
	2006			2010			2020			2030		
	Resid.	Comm.	Bldgs.	Resid.	Comm.	Bldgs.	Resid.	Comm.	Bldgs.	Resid.	Comm.	Bldgs.
Electricity (2)	41.59	46.48	43.85	29.52	40.01	33.52	37.20	47.26	43.36	56.59	55.35	55.82
Petroleum	4.15	2.75	3.51	3.31	0.55	2.26	2.26	0.21	1.00	1.41	0.17	0.64
Natural Gas	11.47	8.65	10.17	16.51	7.42	13.04	16.48	7.10	10.73	10.24	6.46	7.88
Renew. En. (3)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coal	0.04	0.45	0.23	0.04	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total</b>	<b>57.25</b>	<b>58.34</b>	<b>57.75</b>	<b>49.39</b>	<b>47.98</b>	<b>48.85</b>	<b>55.93</b>	<b>54.58</b>	<b>55.10</b>	<b>68.24</b>	<b>61.98</b>	<b>64.34</b>

Note(s): 1) This table provides estimates of the carbon emissions resulting from consumption of a generic quad in the buildings sector, at current and projected fuel shares. Projected increases in site energy will be primarily met by electricity and natural gas. Projected new marginal emissions will result from natural gas- and coal-fired power plants. Electricity imports from utility consumption were not included since this energy was produced outside of the U.S. "Average" means the weighted average of different fuels (e.g., petroleum is the average of residual and distillate fuel oils, LPG, kerosene, and motor gasoline). The combustion of fossil fuels produces carbon in the form of carbon dioxide and carbon monoxide; however, carbon monoxide emissions oxidize in a relatively short time to form carbon dioxide. 2) Includes renewables. 3) Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 and Table A17, p. 143 for energy consumption and Table A18, p. 144 for carbon emissions; and EIA, Assumptions to the AEO 2008, June 2008, Table 2, p. 9.

**1.4.10 2006 EPA Emissions Summary Table for U.S. Buildings Energy Consumption (Thousand Short Tons) (1)**

	Buildings			U.S. Total	Buildings Percent of U.S. Total
	Wood/ Site Fossil	Electricity	Total		
SO <sub>2</sub>	561	6,964 (2)	7,525	13,770	55%
NO <sub>x</sub>	723	2,597	3,320	18,226	18%
CO	3,265	490	3,755	100,552	4%
VOCs	1,364	37	1,401	17,383	8%
PM-2.5	388	362	750	4,574	16%
PM-10	439	448	887	18,420	5%

Note(s): 1) VOCs = volatile organic compounds; PM-10 = particulate matter less than 10 micrometers in aerodynamic diameter. PM-2.5 = particulate matter less than 2.5 micrometers in aerodynamic diameter. CO and VOCs site fossil emissions mostly from wood burning. 2) Emissions of SO<sub>2</sub> are 28% lower for 2002 than 1994 estimates since Phase II of the 1990 Clean Air Act Amendments began in 2000. Buildings Energy Consumption related to SO<sub>2</sub> emissions dropped 27% from 1994 to 2002.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 140-142; and EPA, 1970-2006 National Emissions Inventory, Average Annual Emissions, All Criteria Pollutants, July 2007.

**1.4.11 2006 EPA Criteria Pollutant Emissions Coefficients (Million Short Tons/Delivered Quadrillion Btu, unless otherwise noted)****All Buildings**

	Electricity (1)	Site Fossil Fuel (2)	Electricity (per primary quad) (1)
SO <sub>2</sub>	0.770	0.056	0.242
NO <sub>x</sub>	0.287	0.073	0.090
CO	0.054	0.329	0.017

Note(s): 1) Emissions of SO<sub>2</sub> are 28% lower for 2002 than 1994 estimates since Phase II of the 1990 Clean Air Act Amendments began in 2000. Buildings energy consumption related SO<sub>2</sub> emissions dropped 27% from 1994 to 2002. 2) Includes natural gas, petroleum liquid fuels, coal, and wood.

Source(s): EPA, 2006 Average Annual Emissions, All Criteria Pollutants, July 2007; and EIA, AEO 2008, Mar. 2008, Table A2, p. 140-142 for energy consumption.

**1.4.12 Characteristics of U.S. Construction Waste**

- Two to seven tons of waste (a rough average of 4 pounds of waste per square foot) are generated during the construction of a new single-family detached house.
- 15 to 70 pounds of hazardous waste are generated during the construction of a detached, single-family house. Hazardous wastes include paint, caulk, roofing cement, aerosols, solvents, adhesives, oils, and greases.
- Each year, U.S. builders produce between 30 and 35 million tons of construction, renovation, and demolition (C&D) waste.
- Annual C&D debris accounts for roughly 24% of the municipal solid waste stream.
- Wastes include wood (27% of total) and other (73% of total, including cardboard and paper; drywall/plaster; insulation; siding; roofing; metal; concrete, asphalt, masonry, bricks, and dirt rubble; waterproofing materials; and landscaping material).
- As much as 95% of buildings-related construction waste is recyclable, and most materials are clean and unmixed.

Source(s): First International Sustainable Construction Conference Proceedings, Construction Waste Management and Recycling Strategies in the U.S., Nov. 1994, p. 689; Fine Homebuilding, Construction Waste, Feb./Mar. 1995, p. 70-75; NAHB, Housing Economics, Mar. 1995, p. 12-13; and Cost Engineering, Cost-Effective Waste Minimization for Construction Managers, Vol. 37/No. 1, Jan. 1995, p. 31-39.

**1.4.13 "Typical" Construction Waste Estimated for a 2,000-Square-Foot Home (1)**

<u>Material</u>	<u>Weight (pounds)</u>		<u>Volume (cu. yd.) (2)</u>
Solid Sawn Wood	1,600	20%	6
Engineered Wood	1,400	18%	5
Drywall	2,000	25%	6
Cardboard (OCC)	600	8%	20
Metals	150	2%	1
Vinyl (PVC) (3)	150	2%	1
Masonry (4)	1,000	13%	1
Hazardous Materials	50	1%	-
<u>Other</u>	<u>1,050</u>	<u>13%</u>	<u>11</u>
<b>Total (5)</b>	<b>8,000</b>	<b>100%</b>	<b>50</b>

Note(s): 1) See Table 2.2.7 for materials used in the construction of a new single-family home. 2) Volumes are highly variable due to compressibility and captured air space in waste materials. 3) Assuming 3 sides of exterior clad in vinyl siding. 4) Assuming a brick veneer on home's front facade. 5) Due to rounding, sum does not add up to total.

Source(s): NAHB's Internet web site, www.nahb.org, Residential Construction Waste: From Disposal to Management, Oct. 1996.

**1.4.14 1996 Construction and Demolition Debris Generated from Construction Activities and Debris Generation Rates**

	<u>Debris (million tons)</u>				<u>Debris Generation Rates (lbs/ sq. ft.)</u>	
	<u>Residential</u>	<u>Commercial</u>	<u>Buildings</u>		<u>Residential</u>	<u>Commercial</u>
New Construction	6.6	4.3	10.8		4.38	3.89
Demolition	19.7	45.1	64.8		115	155
Renovation	31.9	28.0	59.9		N.A.	N.A.
<b>Total</b>	<b>58.2</b>	<b>77.4</b>	<b>135.5</b>			

Source(s): EPA/OSW, Characterization of Buildings-Related Construction and Demolition Debris in the United States, June 1998, Tables 3-6, p. 2-3 - 2-8, and Table 8, p. 2-11.

**1.5.1 Key Definitions**

**Quad:** Quadrillion Btu ( $10^{15}$  or 1,000,000,000,000,000 Btu)

**Generic Quad for the Buildings Sector:** One quad of primary energy consumed in the buildings sector (includes the residential and commercial sectors), apportioned between the various primary fuels used in the sector according to their relative consumption in a given year. To obtain this value, electricity is converted into its primary energy forms according to relative fuel contributions (or shares) used to produce electricity in the given year.

**Electric Quad (Generic Quad for the Electric Utility Sector):** One quad of primary energy consumed at electric utility power plants to supply electricity to end-users, shared among various fuels according to their relative contribution in a given year. (Note: The consumption of an electric quad results in the delivery of just under 1/3 the electric quad due to generation and transmission losses.)

**Primary Energy:** The total energy consumed by an end-user, including the energy used in the generation and transmission of electricity. Also referred to as "source" energy.

**Delivered Energy:** The energy consumed by an end-user on site, not including electricity generation and transmission losses.

**1.5.2 Consumption Comparisons in 2005**

One quad equals:

- 49 million short tons of coal
  - = enough coal to fill a train of railroad cars 4,072 miles long (about one and a half times across the U.S.)
- 971 billion cubic feet natural gas
- 8 billion gallons of gasoline = 21 days of U.S. gasoline use
  - = 20.1 million passenger cars each driven 12,500 miles
  - = 17.2 million light-duty vehicles each driven 12,200 miles
  - = all new passenger cars and light-duty trucks sold, each driven 13,000 miles
  - = 13.1 million stock passenger cars, each driven 11,500 miles = 10% of all passenger cars, each driven 11,500 miles
  - = all new passenger cars each making 6 round-trips from New York to Los Angeles
- 172 million barrels of crude oil = 14.26 days of U.S. imports = 167 days of oil flow in the Alaska pipeline at full capacity
  - = the amount of crude oil transported by 484 supertankers
- 19 hours of world energy use
- the electricity *delivered* from 235 coal-fired power plants (200-MW each) in one year
- the electricity *delivered* from 37 nuclear power plants (1000-MW each) in one year
- average annual per capita consumption of 2.95 million people in the U.S.
- the approximate annual primary consumption of any one of the following states: Arkansas, Connecticut, Iowa, Kansas, Mississippi, Oregon, or West Virginia

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A7, p. 129-130, Table A8, p. 131-132, Table A9, p. 133-134, Table A11, p. 136-137 for consumption, Table G1, p. 215 for heat rates; EIA, State Energy Data 2005: Consumption, Feb. 2008, Table S3, p. 5, Table R1, p. 13, and Table R2, p. 14; EIA, Electric Power Annual 2006, September 2007, Table 2.2, p. 19; EIA, International Energy Outlook 2008, June 2008, Table A1, p. 83; DOC, Statistical Abstract of the United States 2008, May 2008, No. 1031, p. 658, No. 1074, p. 686, and No. 1080, p. 690; and Newport News Shipbuilding Web site.

**1.5.3 Carbon Emission Comparisons**

One million metric ton of carbon dioxide-equivalent emissions equals:

- the combustion of 518 thousand short tons of coal
- the coal input to 1 coal plant (200-MW) in ten and a half months
- the combustion of 18 billion cubic feet of natural gas
- the combustion of 116 million gallons of gasoline = the combustion of gasoline for 7 hours in the U.S.
  - = 0.28 million new cars, each driven 12,500 miles
  - = 243 thousand new light-duty vehicles, each driven 12,200 miles
  - = 237 thousand new light trucks, each driven 11,000 miles
  - = 0.13 million new passenger cars, each making 5 round trips from New York to Los Angeles
- the combustion of 188 million gallons of LPG
- the combustion of 107 million gallons of kerosene
- the combustion of 101 million gallons of distillate fuel
- the combustion of 87 million gallons of residual fuel
- 19 minutes of world energy emissions
- 90 minutes of U.S. energy emissions
- 3.9 hours of U.S. buildings energy emissions
- 7 hours of U.S. residential energy emissions
- 8 hours of U.S. commercial energy emissions
- 1 day of U.S. buildings lighting energy emissions
- average annual per capita emissions of 181,000 people in the U.S.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A7, p. 129-130 for consumption, Table A18, p. 147 for emissions, and Table G1, p. 215 for heat rates; EIA, Electric Power Annual 2006, September 2007, Table 2.2, page 19; EIA, International Energy Outlook 2008, June 2008, Table A10, p. 93; EIA, Assumptions to the AEO 2008, June 2008, Table 2, p. 9 for carbon coefficients; and DOC, Statistical Abstract of the United States 2008, Jan. 2008, No. 2, p. 8 and No. 1084, p. 715.

**1.5.4 Average Annual Carbon Dioxide Emissions for Various Functions**

	Annual Unit Energy Consumption	Carbon Emissions	
		(MMT CO <sub>2</sub> )	(lb CO <sub>2</sub> )
Stock Refrigerator	1,249 kWh - Electricity	0.80	1,800
Stock Electric Water Heater	2,549 kWh - Electricity	1.64	3,600
Stock Gas Water Heater	20 million Btu - Natural Gas	1.05	2,300
Stock Oil Water Heater	28 million Btu - Fuel Oil	2.07	4,500
Single-Family Home	107 million Btu	11.86	26,100
Mobile Home	76 million Btu	8.39	18,500
Multi-Family Unit in Large Building	41 million Btu	4.53	10,000
Multi-Family Unit in Small Building	78 million Btu	8.63	19,000
School Building	2,125 million Btu	269	593,300
Office Building	1,376 million Btu	174	384,200
Hospital, In-Patient	60,152 million Btu	7,617	16,794,600
Stock Vehicles			
Passenger Car	541 gallons - Gasoline	4.8	10,503
Van, Pickup Truck, or SUV	686 gallons - Gasoline	6.0	13,324
Heavy Truck	1,414 gallons - Diesel Fuel	12.8	28,334
Tractor Trailer Truck	11,697 gallons - Diesel Fuel	106.3	234,391

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for consumption and Table A18, p. 144 for emissions, and Table G1, p. 215 for gasoline heat rate; EIA, A Look at Residential Energy Consumption in 2001, May 2004, Table CE4-1c for water heater energy consumption, Table HC5-1a for refrigerators and Table CE5-1c for refrigerator energy, and Table CE1-4c for household consumption; EIA, 2003 Commercial Buildings Energy Consumption Survey, June 2006, Table C3, p. 247 for commercial buildings; ORNL, Transportation Energy Data Book: Edition 26, 2007, Table 4.1, p. 4-2, Table 4.2, p. 4-3, Table 5.1, p. 5-2 and Table 5.2, p. 5-3 for vehicles; and EIA, Assumptions to the AEO 2008, June 2008, Table 2, p. 9 for carbon coefficients.

**1.5.5 Cost of a Generic Quad Used in the Buildings Sector (\$2006 Billion) (1)**

	<u>Residential</u>	<u>Commercial</u>	<u>Buildings</u>
1980	9.88	9.56	<b>9.75</b>
1990	9.57	8.52	<b>9.11</b>
2000	9.06	7.70	<b>8.44</b>
<b>2006</b>	<b>10.04</b>	<b>9.59</b>	<b>9.83</b>
2010	9.90	9.56	<b>9.75</b>
2015	9.09	8.78	<b>8.94</b>
2020	9.17	8.85	<b>9.02</b>
2025	9.37	9.01	<b>9.19</b>
2030	9.76	9.36	<b>9.56</b>

Note(s): 1) See Table 1.5.1 for generic quad definition. This table provides the consumer cost of a generic quad in the buildings sector. Use this table to estimate the average consumer cost savings resulting from the savings of a generic (primary) quad in the buildings sector.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 and Table A17, p. 143-144 for energy consumption and Table A3, p. 120-121 for energy prices(2006-2030). EIA, State Energy Data Report 2005, Feb. 2008, Tables 8-12 pages 22-24 and EIA, State Energy Prices and Expenditures 2005 Feb. 2008 Tables 2 and 3(1980-2005)

**1.5.6 Shares of U.S. Buildings Generic Quad (Percent) (1)**

	<u>Natural Gas</u>	<u>Petroleum</u>	<u>Coal</u>	<u>Renewables</u>			<u>Nuclear</u>	<u>Total</u>
				<u>Hydro.</u>	<u>Other</u>	<u>Total</u>		
1980	40%	12%	30%	7%	4%	11%	7%	100%
1990	32%	8%	36%	7%	4%	11%	13%	100%
2000	33%	6%	38%	5%	3%	8%	15%	100%
<b>2006</b>	<b>31%</b>	<b>6%</b>	<b>39%</b>	<b>5%</b>	<b>3%</b>	<b>9%</b>	<b>15%</b>	<b>100%</b>
2010	32%	6%	38%	5%	4%	10%	15%	100%
2015	31%	6%	38%	5%	5%	10%	14%	100%
2020	29%	5%	39%	5%	6%	11%	15%	100%
2025	28%	5%	41%	5%	6%	11%	15%	100%
2030	26%	5%	43%	5%	6%	11%	15%	100%

Note(s): 1) See Table 1.5.1 for generic quad definition. 2) The total 2006 Buildings sector primary energy consumption was 38.77 quads.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 and Table A17, p. 143-144 for energy consumption and EIA, State Energy Data Report, Feb. 2008, table 8 and 9, pages 22-24

Embodied energy is defined as the energy used during the entire life cycle of a product including the energy used for manufacturing, transporting, and disposing of the product. For example, the embodied energy in dimensional lumber includes the energy used to grow, harvest and process the trees into boards, transport the lumber to its final destination, and ultimately dispose of the wood at the end of its useful life. Embodied energy, also called life cycle assessment (LCA), is a useful tool for evaluating the relative environmental impact of various building materials because it takes production, transportation and disposal into account, all things that can have a pronounced environmental impact but are not necessarily reflected in the price.

Due to the complexity of calculations and the wide range of production methods, transportation distances and other variables for some building products, exact figures for embodied energy vary from study to study. Fortunately, precise figures are not necessary. Builders, designers, purchasers and others can make informed decisions based on the embodied energy of a given product relative to its substitutes. It should be noted that when considering the embodied energy of an entire building, the energy embodied in the building materials is small relative to the energy it takes to operate that building over its lifetime. Looking at the embodied energy of a typical home, for example, only 15 percent of that energy is embodied in the materials used to make the home; the other 85 percent is in the operation of the home over its lifetime(1) . Thus, building for efficiency is the best way to lower the embodied energy of a building.

1) Life-Cycle Environmental Performance of Renewable Building Materials. B. Lippke et. al. June, 2004 Journal of Forest Products.

#### 1.6.1 Embodied Energy of Windows in the U.S.

<u>Window Type</u>	<u>Embodied Energy (MMBtu/SF) (1)</u>	<u>CO2 Equivalent Emissions (lbs/SF)</u>
Aluminium	0.59	71.24
PVC-clad Wood	0.37	62.15
Wood	0.33	51.83
Vinyl (PVC)	0.49	82.31
Curtainwall Viewable Glazing	0.27	61.6
<u>Curtainwall</u>		
Opaque glazing (with insulated backpan)	0.18	32.16
Spandrel panel (with insulated backpan)	0.1	9.53

Note(s): 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material.

Assumptions: Assumes a Low rise building. Values are general estimations for the U.S. 60 year building lifetime. Low-e glass.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.2.3. 2007. Available at [www.athenasmi.org/tools/ecoCalculator/index.html](http://www.athenasmi.org/tools/ecoCalculator/index.html)

**1.6.2 Embodied Energy of Studded Exterior Walls in the U.S.**

<u>Exterior Wall Type</u>	<u>R-Value</u>	<u>Embodied Energy (MMBtu/SF) (1)</u>	<u>CO2 Equivalent Emissions (lbs/SF)</u>
<u>2x6 Steel Stud Wall (3)</u>			
16" OC with brick cladding	13.46	0.15	20.68
24" OC with brick cladding	14.96	0.15	19.48
16" OC with wood cladding (pine)	13.47	0.06	7.82
24" OC with wood cladding (pine)	14.97	0.06	6.61
16" OC with steel cladding (26 ga)	13.27	0.17	37.02
<u>2x6 Wood Stud Wall (4)</u>			
16" OC with brick cladding	15.73	0.16	18.88
16" OC with PVC cladding	15.60	0.10	9.63
24" OC with steel cladding	15.54	0.18	35.04
24" OC with stucco cladding	15.04	0.09	8.85
24" OC with wood cladding (pine)	15.74	0.07	5.83
<u>Structural Insulated Panel (SIP) (5)</u>			
with Brick cladding	23.93	0.20	20.73
with Steel cladding	23.74	0.22	37.07
with Stucco cladding	23.24	0.13	10.88
with PVC cladding	23.80	0.14	11.48
with Wood cladding	23.94	0.11	7.86

Note(s): Assumptions: 60 year building lifetime. Low rise building. Values are general estimations for the U.S. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material. 2) Resource Use: The weight of raw materials used in extraction, processing, transportation, construction and disposal of each material. 3) Includes cladding, 1" rigid insulation sheathing, batt insulation, vapor barrier, gypsum board, and latex paint. 4) Includes cladding, wood structural panel (WSP) sheathing, batt insulation, vapor barrier, gypsum board, and latex paint. 5) Includes cladding, vapor barrier, gypsum board, and latex paint.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.2.3. 2007. Available at [www.athenasmi.org/tools/ecoCalculator/index.html](http://www.athenasmi.org/tools/ecoCalculator/index.html)

**1.6.3 Embodied Energy of Concrete Exterior Walls in the U.S.**

<u>Exterior Wall Type</u>	<u>R-Value</u>	<u>Embodied Energy (MMBtu/SF) (1)</u>	<u>CO2 Equivalent Emissions (lbs/SF)</u>
<b>8" Concrete Block</b>			
with Brick cladding + rigid insulation + vapor barrier	21.80	0.22	32.04
+ Gypsum board + latex paint	22.36	0.24	33.08
with Stucco cladding + rigid insulation + vapor barrier + gypsum board + latex paint	21.67	0.16	23.24
<b>6" Cast-In-Place Concrete (3)</b>			
with Brick cladding	21.84	0.22	33.78
with Steel cladding	21.65	0.24	50.12
with Stucco cladding	21.15	0.14	23.93
with 1" rigid insulation + 2x6 steel stud wall (24" OC) + batt insulation	9.64	0.11	20.93
<b>8" Concrete Tilt-Up</b>			
with Steel cladding (3)	21.81	0.24	50.25
with Stucco cladding (3)	21.31	0.15	24.06
with 2x6 steel stud wall (24" OC) + batt insulation	9.80	0.11	21.05
<b>Insulated Concrete Forms</b>			
with Steel cladding + gypsum board + latex paint	20.93	0.28	57.78
with PVC cladding + gypsum board + latex paint	20.99	0.20	32.19
with Wood cladding + gypsum board + latex paint	21.13	0.17	28.57

Note(s): Assumptions: 60 year building lifetime. Low rise building. Values are general estimations for the U.S. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material. 2) Resource Use: The weight of raw materials used in extraction, processing, transportation, construction and disposal of each material. 3) Includes cladding, 4" rigid insulation, vapor barrier, gypsum board, and latex paint unless otherwise described.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.2.3. 2007. Available at [www.athenasmi.org/tools/ecoCalculator/index.html](http://www.athenasmi.org/tools/ecoCalculator/index.html)



**1.6.4 Embodied Energy of Wood-Based Roof Assemblies in the U.S.**

	<u>R-Value</u>	<u>Embodied Energy (MMBtu/SF) (1)</u>	<u>CO2 Equivalent Emissions (lbs/SF)</u>
<u>Glulam Joist with Plank Decking (3)</u>			
with EPMD membrane	40.56	0.20	18.13
with PVC membrane	40.56	0.17	14.93
with Modified bitumen membrane	40.56	0.14	12.88
with 4-Ply built-up roofing	40.89	0.81	63.75
with Steel roofing	41.17	0.16	15.02
<u>Wood I-Joist with WSP Decking (4)</u>			
with PVC membrane	26.38	0.11	8.70
with 4-Ply built-up roofing	26.71	0.75	57.52
<u>Solid Wood Joist with WSP Decking (4)</u>			
with Modified bitumen membrane	26.38	0.10	6.77
<u>Wood Chord / Steel Web Truss with WSP Decking (4)</u>			
with Modified bitumen membrane	26.80	0.10	9.71
<u>Wood Truss (Flat) with WSP Decking (4)</u>			
with Modified bitumen membrane	25.60	0.09	7.10
<u>Wood Truss (4:12 Pitch) with WSP Decking (4)</u>			
with 30-yr Fibreglass Shingles	25.60	0.08	6.97
with Clay Tile	25.60	0.22	22.07

Note(s): Assumptions: 60 year building lifetime. Low rise building. Values are general estimations for the U.S. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material. 2) Resource Use: The weight of raw materials used in extraction, processing, transportation, construction and disposal of each material. 3) Includes membrane, 8" rigid insulation, vapor barrier, and latex paint. 4) Includes membrane, 9.5" batt insulation, vapor barrier, gypsum board, and latex paint. WSP = wood structural panel.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.2.3. 2007. Available at [www.athenasmi.org/tools/ecoCalculator/index.html](http://www.athenasmi.org/tools/ecoCalculator/index.html)

**1.6.5 Embodied Energy of Other Roof Assemblies in the U.S.**

	<u>R-Value</u>	<u>Embodied Energy (MMBtu/SF) (1)</u>	<u>CO2 Equivalent Emissions (lbs/SF)</u>
<u>Concrete Flat Plate Slab (3)</u>			
with EPDM membrane	41.94	0.30	47.55
with PVC membrane	41.94	0.27	44.34
with Modified bitumen membrane	41.94	0.25	42.29
with 4-Ply built-up roofing	42.27	0.91	93.17
with Steel Roofing	42.55	0.26	44.44
<u>Precast Double-T (3)</u>			
with EPDM membrane	40.74	0.18	23.78
with PVC membrane	40.74	0.15	20.57
with Modified bitumen membrane	40.74	0.13	18.52
with 4-Ply built-up roofing	41.07	0.80	69.39
with Steel Roofing	41.35	0.15	20.66
<u>Open-Web Steel Joist (4)</u>			
with Steel decking and EPDM membrane	41.55	0.19	20.29
with Steel decking and modified Bitumen membrane	41.55	0.14	15.03
with Steel decking and 4-ply built-up roofing	41.88	0.81	65.90
with Wood decking and modified bitumen membrane	40.68	0.14	11.89
with Wood decking and 4-ply built-up roofing	41.01	0.80	62.77

Note(s): Assumptions: 60 year building lifetime. Low rise building. Values are general estimations for the U.S. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material. 2) Resource Use: The weight of raw materials used in extraction, processing, transportation, construction and disposal of each material. 3) Includes membrane, 8" rigid insulation, vapor barrier, and latex paint. 4) Includes membrane, 8" rigid insulation, vapor barrier, gypsum board, and latex paint.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.2.3. 2007. Available at [www.athenasmi.org/tools/ecoCalculator/index.html](http://www.athenasmi.org/tools/ecoCalculator/index.html)

**1.6.6 Embodied Energy of Interior Wall Assemblies in the U.S.,**

<u>Interior Wall Type (3)</u>	<u>Embodied Energy (MMBtu/SF) (1)</u>	<u>CO2 Equivalent Emissions (lbs/SF)</u>
Wood stud (16" OC) + gypsum board	0.03	2.49
Wood stud (24" OC) + gypsum board	0.03	2.42
Wood stud (24" OC) + 2 gypsum boards (4)	0.05	4.08
Steel stud (24" OC) + 2 gypsum boards (4)	0.05	4.84
6" Concrete block + gypsum board	0.11	15.89
6" Concrete block	0.09	14.22
Clay brick (4") unpainted	0.11	13.37

Note(s): Assumptions: Values are general estimations for the U.S. 60 year building lifetime. Low rise building. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material. 2) Resource Use: The weight of raw materials used in extraction, processing, transportation, construction and disposal of each material. 3) All interior walls include latex paint on each side unless noted otherwise. 4) Rounding obscures difference in embodied energy figure: wood stud wall is 7% lower than steel stud wall.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.2.3. 2007. Available at [www.athenasmi.org/tools/ecoCalculator/index.html](http://www.athenasmi.org/tools/ecoCalculator/index.html)

**1.6.7 Embodied Energy of Floor Structures in the U.S.**Floor Structure with Interior Ceiling Finish of Gypsum Board, Latex Paint

	<u>Embodied Energy (MMBtu/SF) (1)</u>	<u>CO2 Equivalent Emissions (lbs/SF)</u>
Concrete flat plate and slab column system 25% flyash	0.15	31.98
Precast double-T concrete system	0.08	17.73
Glulam joist and plank decking	0.07	6.41
Wood chord and steel web truss system	0.06	6.49
Wood I-joist and OSB decking system	0.05	3.72
Open web steel joist with steel decking system and concrete topping	0.09	12.67
Wood truss and OSB decking system	0.06	4.35
Open web steel joist with 3/4" OSB flooring system	0.06	5.01

Floor Structure without Interior Ceiling Finish

Concrete flat plate and slab column system 25% flyash	0.14	30.94
Concrete hollow core slab	0.06	14.14
Open web steel joist with 3/4" OSB flooring system	0.05	3.96

Note(s): Assumptions: Values are general estimations for the U.S. 60 year building lifetime. Low rise building. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material. 2) Resource Use: The weight of raw materials used in extraction, processing, transportation, construction and disposal of each material.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.2.3. 2007. Available at [www.athenasmi.org/tools/ecoCalculator/index.html](http://www.athenasmi.org/tools/ecoCalculator/index.html)

**1.6.8 Embodied Energy of Column and Beam Assemblies in the U.S.**

<u>Column Type</u>	<u>Beam Type</u>	<u>Embodied Energy (MMBtu SF) (1)</u>	<u>CO2 Equivalent Emissions (lbs/SF)</u>
Concrete	Concrete	0.13	20.17
Concrete	Steel I-beam	0.09	11.42
Hollow structural steel	Glulam	0.02	1.68
Hollow structural steel	Structural composite lumber	0.02	2.38
Glulam	Glulam	0.03	2.64
Glulam	Structural composite lumber	0.03	1.92
Steel I-beam	Steel I-beam	0.09	8.19
Steel I-beam	Structural composite lumber	0.02	1.64
Built-up softwood	Glulam	0.03	2.41
Built-up softwood	Structural composite lumber	0.02	1.7

Note(s): Assumptions: Values are general estimations for the U.S. 60 year building lifetime. Low rise building. Bay size: 30 by 30 feet. Column Height: 10 feet. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material. 2) Weighted Resource Use: The weight of raw materials used in extraction, processing, transportation, construction and disposal of each material.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.2.3. 2007. Available at [www.athenasmi.org/tools/ecoCalculator/index.html](http://www.athenasmi.org/tools/ecoCalculator/index.html)

Chapter 2 contains data related to the Residential Sector. Energy consumption, expenditure data, and environmental impacts related to residential activity can also be found in this chapter. Additionally, several sections contain details about specific markets and housing types, such as multi-family and low-income housing.

The following pieces of information give some insight into general trends in the Residential Sector:

- The average size of a new, single-family home has risen by 756 square feet since 1980 while the average household size has remained relatively constant.
- In 2006, there were approximately 113 million households in the United States. By 2030, there is expected to be 141 million households.
- Internal gains account for 27 percent of a home's cooling load.
- Average annual energy expenditures per household have increased by 20 percent from 1990.
- For every 1 kWh used in the residential sector, another 2.18 kWh is needed to produce and deliver the electricity.
- In 2006, the residential sector consumed 37 percent of all electricity produced in the United States, making it the largest consuming sector of electricity.
- Space heating continues to dominate residential energy expenditures, accounting for 31.5 percent of total energy expenditures; more than double any other single end-use.
- The amount of carbon dioxide attributed to the residential sector is roughly equivalent to the carbon dioxide emitted by all of Central and South America combined.
- The average price of electricity for residential consumers in 2006 was 10.4 cents per kWh.
- On-site renewable energy accounted for approximately 3 percent of all energy consumed in the residential sector. The majority of this energy was derived from wood combustion and was used for space heating.
- Electricity is expected to be the fast growing site energy source for residential consumers averaging a 1 percent growth rate from 2006 to 2030.

- Approximately 63 percent of residential energy expenditures were spent on electricity.
- In 2006, residential consumers spent approximately 225 billion dollars on energy.
- The average family living in public multi-family housing used 32.2 million Btu's of natural gas energy, or approximately 322 therms.

**2.1.1 Residential Primary Energy Consumption, by Year and Fuel Type (Quadrillion Btu and Percent of Total)**

	<u>Natural Gas</u>		<u>Petroleum (1)</u>		<u>Coal</u>	<u>Renewable(2)</u>		<u>Electricity</u>		<u>Total</u>		<u>TOTAL (2)</u>	<u>Growth Rate</u>		
								<u>Sales</u>	<u>Losses</u>				<u>2006-Year</u>		
1980	4.86	31%	1.75	11%	0.03	0%	0.85	5%	2.45	5.91	8.36	53%	15.84	100%	-
1990	4.52	27%	1.41	8%	0.03	0%	0.64	4%	3.15	7.30	10.45	61%	17.05	100%	-
2000	5.10	25%	1.56	8%	0.01	0%	0.49	2%	4.07	9.26	13.33	65%	20.49	100%	-
<b>2006</b>	<b>4.50</b>	<b>22%</b>	<b>1.25</b>	<b>6%</b>	<b>0.01</b>	<b>0%</b>	<b>0.43</b>	<b>2%</b>	<b>4.61</b>	<b>10.04 (3)</b>	<b>14.65</b>	<b>70%</b>	<b>20.83</b>	<b>100%</b>	-
2010	4.95	22%	1.31	6%	0.01	0%	0.46	2%	4.95	10.59	15.54	70%	22.27	100%	1.7%
2015	5.16	23%	1.33	6%	0.01	0%	0.45	2%	5.02	10.61	15.63	69%	22.59	100%	0.9%
2020	5.30	23%	1.33	6%	0.01	0%	0.45	2%	5.25	11.08	16.34	70%	23.43	100%	0.8%
2025	5.35	22%	1.31	5%	0.01	0%	0.44	2%	5.53	11.57	17.10	71%	24.21	100%	0.8%
2030	5.32	21%	1.29	5%	0.01	0%	0.44	2%	5.88	12.14	18.01	72%	25.08	100%	0.8%

Note(s): 1) Petroleum includes distillate oil, LPG, and kerosene. 2) Includes site -marketed and non-marketed renewable energy. 3) 2006 site -to-source electricity conversion = 3.18.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p.117-119 for 2006-2030 consumption and Table A17, p. 143-144 for non-marketed renewable energy.

**2.1.2 Shares of U.S. Residential Buildings Generic Quad (Percent) (1)**

	<u>Natural Gas</u>	<u>Petroleum</u>	<u>Coal</u>	<u>Renewables</u>			<u>Nuclear</u>	<u>Total</u>
				<u>Hydro</u>	<u>Other</u>	<u>Total</u>		
1980	41%	12%	28%	7%	6%	13%	6%	100%
1990	34%	9%	34%	6%	5%	11%	13%	100%
2000	35%	8%	35%	5%	4%	9%	14%	100%
<b>2006</b>	<b>33%</b>	<b>7%</b>	<b>36%</b>	<b>5%</b>	<b>4%</b>	<b>9%</b>	<b>15%</b>	<b>100%</b>
2010	34%	7%	35%	5%	5%	10%	14%	100%
2015	34%	7%	36%	5%	5%	10%	14%	100%
2020	32%	7%	37%	5%	6%	11%	14%	100%
2025	30%	6%	38%	4%	6%	11%	14%	100%
2030	29%	6%	40%	4%	6%	11%	14%	100%

Note(s): 1) See Table 1.5.1 for generic quad definition.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 and Table A17, p. 143-144 for energy consumption and EIA, State Energy Data Report, Feb. 2008, Table 8 and 9, pages 22-24.

**2.1.3 Residential Site Renewable Energy Consumption (Quadrillion Btu) (1)**

	<u>Wood</u>	<u>Solar Thermal</u>	<u>Solar PV</u>	<u>GSHP</u>	<u>Total</u>	<u>Growth Rate</u>
						<u>2006-Year</u>
1980	0.846	0.000	N.A.	0.000	0.846	-
1990	0.582	0.056	N.A.	0.006	0.644	-
2000	0.430	0.061	N.A.	0.009	0.500	-
<b>2006</b>	<b>0.409</b>	<b>0.013</b>	<b>0.000</b>	<b>0.003</b>	<b>0.426</b>	-
2010	0.440	0.018	0.001	0.004	0.463	2.1%
2015	0.418	0.025	0.001	0.006	0.450	0.6%
2020	0.404	0.032	0.002	0.008	0.446	0.3%
2025	0.390	0.039	0.003	0.011	0.443	0.2%
2030	0.378	0.045	0.007	0.014	0.444	0.2%

Note(s): 1) Does not include renewable energy consumed by electric utilities (including hydroelectric).

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2005; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A17, p. 143-144 for 2006-2030.

**2.1.4 Residential Delivered and Primary Energy Consumption Intensities, by Year**

	Number of Households (millions)	Percent Post-2000 Households (1)	Delivered Energy Consumption		Primary Energy Consumption	
			Total (10 <sup>15</sup> Btu)	Per Household (10 <sup>6</sup> Btu/Hhold)	Total (10 <sup>15</sup> Btu)	Per Household (million Btu/Hhold)
1980	79.6	N.A.	9.93	124.7	15.84	198.8
1990	94.9	N.A.	9.75	102.8	17.05	179.7
2000	105.7	N.A.	11.24	106.3	20.50	193.9
<b>2006</b>	<b>112.5</b>	<b>11%</b>	<b>10.77</b>	<b>95.8</b>	<b>20.83</b>	<b>185.2</b>
2010	116.0	15%	11.66	100.5	22.27	192.0
2015	122.7	22%	11.95	97.3	22.59	184.1
2020	129.2	28%	12.30	95.3	23.43	181.4
2025	135.0	33%	12.58	93.2	24.21	179.3
2030	140.6	38%	12.88	91.6	25.08	178.4

Note(s): 1) Percent of houses built after Dec. 31, 2000.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2005; EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123, and Table A17, p. 143-144 for 2005-2030, and Table A19, p. 146 for households; and DOC, Statistical Abstract of the United States 2008, Jan. 2008, Table No. 945, p. 626 for 1980-2004 households.



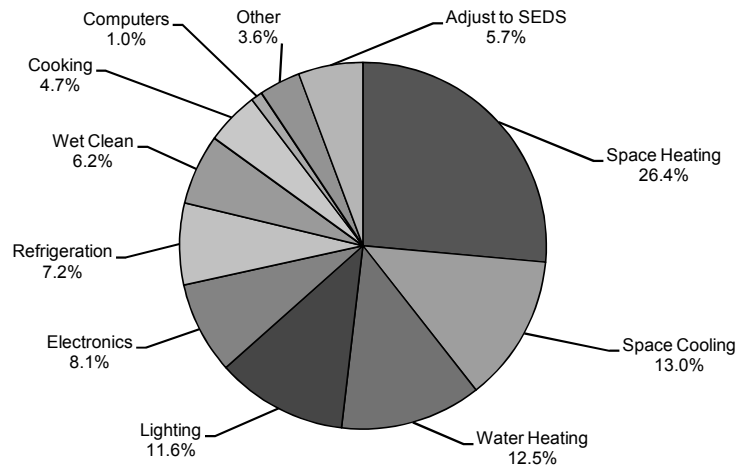
**2.1.5 2006 Residential Energy End-Use Splits, by Fuel Type (Quadrillion Btu)**

	Natural Fuel		Other Renw.		Site	Site		Primary	Primary		
	Gas	Oil	LPG	Fuel(1)	En.(2)	Electric	Total	Percent	Electric (3)	Total	Percent
Space Heating (4)	3.13	0.60	0.23	0.08	0.41	0.33	4.78	44.3%	1.05	5.51	26.4%
Space Cooling	0.00					0.85	0.85	7.9%	2.70	2.70	13.0%
Water Heating	1.08	0.10	0.06		0.01	0.42	1.67	15.5%	1.34	2.59	12.5%
Lighting						0.76	0.76	7.0%	2.41	2.41	11.6%
Electronics (5)						0.53	0.53	4.9%	1.69	1.69	8.1%
Refrigeration (6)						0.47	0.47	4.4%	1.50	1.50	7.2%
Wet Clean (7)	0.07					0.38	0.46	4.2%	1.22	1.30	6.2%
Cooking	0.22		0.03			0.23	0.48	4.4%	0.72	0.98	4.7%
Computers						0.07	0.07	0.6%	0.21	0.21	1.0%
Other (8)	0.00		0.15		0.00	0.19	0.34	3.2%	0.61	0.76	3.6%
Adjust to SEDS (9)						0.37	0.37	3.5%	1.19	1.19	5.7%
<b>Total</b>	<b>4.50</b>	<b>0.70</b>	<b>0.47</b>	<b>0.08</b>	<b>0.43</b>	<b>4.61</b>	<b>10.79</b>	<b>100%</b>	<b>14.65</b>	<b>20.83</b>	<b>100%</b>

Note(s): 1) Kerosene (0.07 quad) and coal (0.01 quad) are assumed attributable to space heating. 2) Comprised of wood space heating solar water heating (0.01 quad), geothermal space heating (less than 0.01 quad), and solar PV (less than 0.01 quad). 3) Site -to-source electricity conversion (due to generation and transmission losses) = 3.18. 4) Includes furnace fans (0.17 quad). 5) Includes color television (1.05 quad) and other office equipment (0.64 quad). 6) Includes refrigerators (1.24 quad) and freezers (0.26 quad). 7) Includes clothes washers (0.11 quad), natural gas clothes dryers (0.07 quad), electric clothes dryers (0.81 quad), and dishwashers (0.30 quad). Does not include water heating energy. 8) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. 9) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 1999, Jan., 1999, Tables A2, p.113-114; EIA, AEO 2008, Mar. 2008, Tables A2, p. 117-119, Table A4, p. 122-123 and Table A17, p. 143-144; and BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A, for residential electric end-uses.

**2006 Residential Primary Energy End Use**



**2.1.6 2010 Residential Energy End-Use Splits, by Fuel Type (Quadrillion Btu)**

	Natural		Fuel		Other		Renw.	Site	Site		Primary	Primary	
	Gas	Oil	LPG	Fuel(1)	En.(2)	Electric	Total	Percent	Electric (3)	Total	Percent		
Space Heating (4)	3.57	0.66	0.24	0.09	0.44	0.37	5.37	46.0%	1.15	6.16	27.6%		
Space Cooling	0.00					0.79	0.79	6.8%	2.48	2.48	11.1%		
Water Heating	1.08	0.09	0.05		0.02	0.38	1.63	13.9%	1.20	2.45	11.0%		
Lighting						0.72	0.72	6.2%	2.26	2.26	10.1%		
Refrigeration (5)						0.45	0.45	3.8%	1.41	1.41	6.3%		
Wet Clean (6)	0.07					0.38	0.45	3.9%	1.19	1.27	5.7%		
Electronics (7)						0.39	0.39	3.4%	1.23	1.23	5.5%		
Cooking	0.22		0.03			0.11	0.36	3.1%	0.34	0.60	2.7%		
Computers						0.10	0.10	0.8%	0.30	0.30	1.3%		
Other (8)	0.00		0.16		0.00	1.26	1.42	12.2%	3.97	4.13	18.5%		
<b>Total</b>	<b>4.95</b>	<b>0.75</b>	<b>0.48</b>	<b>0.09</b>	<b>0.46</b>	<b>4.95</b>	<b>11.68</b>	<b>100%</b>	<b>15.54</b>	<b>22.27</b>	<b>100%</b>		

Note(s): 1) Kerosene (0.08 quad) and coal (0.01 quad) are assumed attributable to space heating. 2) Comprised of wood space heating (0.44 quad), solar water heating (0.02 quad), geothermal space heating (less than 0.01 quad), and solar PV (less than 0.01 quad). 3) Site -to-source electricity conversion (due to generation and transmission losses) = 3.14. 4) Includes furnace fans (0.19 quad). 5) Includes refrigerators (1.16 quad) and freezers (0.25 quad). 6) Includes clothes washers (0.10 quad), natural gas clothes dryers (0.07 quad), electric clothes dryers (0.80 quad), and dishwashers (0.29 quad). Does not include water heating energy. 7) Includes color television (1.23 quad). 8) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Tables A2, p. 117-119, Table A4, p. 122-123 and Table A17, p. 143-144.

**2.1.7 2020 Residential Energy End-Use Splits, by Fuel Type (Quadrillion Btu)**

	Natural		Fuel		Other		Renw.	Site	Site		Primary	Primary	
	Gas	Oil	LPG	Fuel(1)	En.(2)	Electric	Total	Percent	Electric (3)	Total	Percent		
Space Heating (4)	3.83	0.65	0.24	0.09	0.41	0.40	5.61	45.5%	1.23	6.45	27.5%		
Space Cooling	0.00					0.91	0.91	7.4%	2.83	2.83	12.1%		
Water Heating	1.15	0.08	0.05		0.03	0.42	1.73	14.0%	1.31	2.63	11.2%		
Lighting						0.51	0.51	4.1%	1.58	1.58	6.8%		
Refrigeration (5)						0.46	0.46	3.7%	1.43	1.43	6.1%		
Electronics (6)						0.43	0.43	3.5%	1.33	1.33	5.7%		
Wet Clean (7)	0.08					0.39	0.47	3.8%	1.22	1.30	5.6%		
Cooking	0.25		0.03			0.12	0.41	3.3%	0.39	0.67	2.9%		
Computers						0.12	0.12	1.0%	0.38	0.38	1.6%		
Other (8)	0.00		0.20		0.00	1.49	1.70	13.7%	4.63	4.84	20.7%		
<b>Total</b>	<b>5.30</b>	<b>0.73</b>	<b>0.52</b>	<b>0.09</b>	<b>0.45</b>	<b>5.25</b>	<b>12.35</b>	<b>100%</b>	<b>16.34</b>	<b>23.43</b>	<b>100%</b>		

Note(s): 1) Kerosene (0.08 quad) and coal (0.01 quad) are assumed attributable to space heating. 2) Comprised of wood space heating (0.40 quad), solar water heating (0.03 quad), geothermal space heating (0.01 quad), and solar PV (less than 0.01 quad). 3) Site -to-source electricity conversion (due to generation and transmission losses) = 3.11. 4) Includes furnace fans (0.23 quad). 5) Includes refrigerators (1.14 quad) and freezers (0.29 quad). 6) Includes color television (1.33 quad). 7) Includes clothes washers (0.08 quad), natural gas clothes dryers (0.08 quad), electric clothes dryers (0.84 quad), and dishwashers (0.30 quad). Does not include water heating energy. 8) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Tables A2, p. 117-119, Table A4, p. 122-123 and Table A17, p. 143-144.

**2.1.8 2030 Residential Energy End-Use Splits, by Fuel Type (Quadrillion Btu)**

	Natural Gas		Fuel Oil		Other		Renw. En.(2)		Site Electric		Site Total		Primary Electric (3)		Primary Total	
	Gas	Oil	LPG	Fuel(1)	En.(2)	Electric	Total	Percent	Electric (3)	Total	Percent					
Space Heating (4)	3.88	0.59	0.23	0.09	0.39	0.41	5.59	43.2%	1.26	6.44	25.7%					
Space Cooling	0.00					1.04	1.04	8.0%	3.19	3.19	12.7%					
Water Heating	1.09	0.07	0.04		0.05	0.43	1.68	13.0%	1.31	2.56	10.2%					
Electronics (5)						0.55	0.55	4.3%	1.69	1.69	6.8%					
Refrigeration (6)						0.50	0.50	3.9%	1.54	1.54	6.1%					
Lighting						0.49	0.49	3.8%	1.49	1.49	5.9%					
Wet Clean (7)	0.08					0.43	0.51	4.0%	1.31	1.40	5.6%					
Cooking	0.26		0.03			0.14	0.43	3.4%	0.43	0.72	2.9%					
Computers						0.16	0.16	1.2%	0.48	0.48	1.9%					
Other (8)	0.00		0.25		0.01	1.73	1.98	15.3%	5.30	5.56	22.2%					
<b>Total</b>	<b>5.32</b>	<b>0.65</b>	<b>0.55</b>	<b>0.09</b>	<b>0.44</b>	<b>5.88</b>	<b>12.94</b>	<b>100%</b>	<b>18.01</b>	<b>25.08</b>	<b>100%</b>					

Note(s): 1) Kerosene (0.08 quad) and coal (0.01 quad) are assumed attributable to space heating. 2) Comprised of wood space heating (0.38 quad), solar water heating (0.05 quad), geothermal space heating (0.01 quad), and solar PV (0.01 quad). 3) Site -to-source electricity conversion (due to generation and transmission losses) = 3.07. 4) Includes furnace fans (0.24 quad). 5) Includes color television (1.69 quad). 6) Includes refrigerators (1.20 quad) and freezers (0.34 quad). 7) Includes clothes washers (0.08 quad), natural gas clothes dryers (0.08 quad), electric clothes dryers (0.90 quad), and dishwashers (0.33 quad). Does not include water heating energy. 8) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Tables A2, p. 117-119, Table A4, p. 122-123 and Table A17, p. 143-144.

February 2009

**2.1.9 2005 Residential Delivered Energy Consumption Intensities, by Census Region**

Region	Per Square Foot (thousand Btu)	Per Household (million Btu)	Per Household Members (million Btu)	Percent of Total Consumption
Northeast	51.6	120.5	47.0	23%
Midwest	46.9	113.5	46.0	28%
South	37.5	80.9	32.1	31%
West	43.5	77.6	28.1	18%
				<b>100%</b>

Source(s): EIA, A Look at Residential Energy Consumption in 2005, June and October 2008, Table US-1 part 1.

**2.1.10 2005 Residential Delivered Energy Consumption Intensities, by Housing Type**

Type	Per Square Foot (thousand Btu)	Per Household (million Btu)	Per Household Members (million Btu)	Percent of Total Consumption
<b>Single-Family:</b>	<b>52.9</b>	<b>106.6</b>	<b>42.6</b>	<b>80.5%</b>
Detached	39.8	108.3	39.7	73.9%
Attached	47.3	91.7	37.0	6.6%
<b>Multi-Family:</b>	<b>67.6</b>	<b>63.7</b>	<b>29.5</b>	<b>14.8%</b>
2 to 4 units	77.6	84.5	34.9	6.3%
5 or more units	61.7	53.8	26.4	8.5%
<b>Mobile Homes</b>	<b>68.7</b>	<b>72.7</b>	<b>29.4</b>	<b>4.7%</b>
				<b>100%</b>

Source(s): EIA, A Look at Residential Energy Consumption in 2005, June and October 2008, Table HC 1-1-2, Table US-1 part1, and Table US-4.

**2.1.11 2005 Delivered Energy End-Uses for an Average Household, by Region (Million Btu per Household)**

	<u>Northeast</u>	<u>Midwest</u>	<u>South</u>	<u>West</u>	<u>National</u>
Space Heating	69.8	56.5	20.9	25.2	39.3
Space Cooling	4.6	6.3	14.7	7.7	9.8
Water Heating	21.8	20.2	15.8	20.8	19.0
Refrigerator	4.5	5.1	4.9	4.4	4.8
Other Appliances & Lighting	23.7	26.8	25.8	24.9	25.5
<b>Total (1)</b>	<b>120.5</b>	<b>113.5</b>	<b>80.9</b>	<b>77.6</b>	<b>95.0</b>

Note(s): 1) Due to rounding, sums do not add up to totals.

Source(s): EIA, A Look at Residential Energy Consumption in 2005, October 2008, Table US-14.

**2.1.12 2005 Residential Delivered Energy Consumption Intensities, by Vintage**

<u>Year</u>	<u>Per Square Foot (thousand Btu)</u>	<u>Per Household (million Btu)</u>	<u>Per Household Member (million Btu)</u>	<u>Percent of Total Consumption</u>
Prior to 1970	49.3	104.2	41.8	46%
1970 to 1979	44.5	82.9	33.3	15%
1980 to 1989	41.3	82.3	32.7	14%
1990 to 1999	38.6	96.5	34.4	16%
2000 to 2005	34.0	96.1	34.8	8%
Average	43.8	95.0	37.0	

Source(s): EIA, A Look at Residential Energy Consumption in 2005, October 2008, Table US-1 part 1.

September 2008

**2.1.13 1997 Residential Delivered Energy Consumption Intensities, by Ownership of Unit**

<u>Ownership</u>	<u>Per Square Foot (thousand Btu)</u>	<u>Per Household (million Btu)</u>	<u>Per Household Members (million Btu)</u>	<u>Percent of Total Consumption</u>
<b>Owned</b>	<b>58.3</b>	<b>114.7</b>	<b>43.3</b>	<b>77%</b>
<b>Rented</b>	<b>70.3</b>	<b>72.5</b>	<b>29.4</b>	<b>23%</b>
Public Housing	62.7	51.0	25.3	2%
Not Public Housing	70.9	74.8	29.8	22%
				<b>100%</b>

Source(s): EIA, 1997 Residential Energy Consumption Survey.

**2.1.14 Aggregate Residential Building Component Loads as of 1998 (1)**

<u>Component</u>	<u>Loads (quads) and Percent of Total Loads</u>			
	<u>Heating</u>		<u>Cooling</u>	
Roof	-0.65	12%	0.16	14%
Walls	-1.00	19%	0.11	10%
Foundation	-0.76	15%	-0.07	-
Infiltration	-1.47	28%	0.19	16%
Windows (conduction)	-1.34	26%	0.01	1%
Windows (solar gain)	0.43	-	0.37	32%
Internal Gains	0.79	-	0.31	27%
<b>Net Load</b>	<b>-3.99</b>	<b>100%</b>	<b>1.08</b>	<b>100%</b>

Note(s): 1) "Loads" represents the thermal energy losses/gains that when combined will be offset by a building's heating/cooling system to maintain a set interior temperature (which then equals site energy).

Source(s): LBNL, Residential Heating and Cooling Loads Component Analysis, Nov. 1998, Figure P-1, P-1 and Appendix C: Component Loads Data Tables.

**2.1.15 1997 Residential *Delivered* Energy Consumption Intensities, by Principal Building Type and Vintage**

Building Type	Consumption (thousand Btu/SF)		Consumption (million Btu/Hhold)		Consumption (million Btu/Member)	
	Pre-1990	1990-1997	Pre-1990	1990-1997	Pre-1990	1990-1997
<b>Single-Family</b>	<b>60.9</b>	<b>45.1</b>	<b>115.4</b>	<b>108.4</b>	<b>42.6</b>	<b>36.8</b>
Detached	60.2	44.8	118.5	112.8	42.9	36.8
Attached	66.0	48.0	96.1	76.0	40.7	37.3
<b>Multi-Family</b>	<b>69.0</b>	<b>42.6</b>	<b>61.1</b>	<b>40.8</b>	<b>28.8</b>	<b>22.4</b>
2 to 4 units	94.4	50.4	92.8	46.0	41.3	20.1
5 or more units	58.0	41.5	49.3	40.0	23.7	22.8
<b>Mobile Homes</b>	<b>92.2</b>	<b>50.6</b>	<b>81.7</b>	<b>70.9</b>	<b>50.5</b>	<b>45.2</b>

Source(s): EIA, 1997 Residential Energy Consumption Survey.

**2.1.16 Operating Characteristics of Electric Appliances in the Residential Sector**

	Power Draw (W) (1)			Annual Usage (hours/year)			Annual Consumption (kWh/year)	Annual Cost (\$ (2)
	Active	Idle	Off	Active	Idle	Off		
<b>Kitchen</b>								
Coffee Maker	1,000	70	0	38	229	8,493	58	5
Dishwasher (3)	0	0		(4)	365	0	120	11
Microwave Oven	1,500	0	3	70	0	8,690	131	12
Refrigerator-Freezer							660	62
Freezer							470	44
<b>Lighting</b>								
18-W Compact Fluorescent	18	0	0	1,189	0	0	20	2
60-W Incandescent Lamp	60	0	0	672	0	0	40	4
100-W Incandescent Lamp	100	0	0	672	0	0	70	7
Torchiere Lamp-Halogen	300	0	0	1,460	0	0	440	41
<b>Bedroom and Bathroom</b>								
Hair Dryer	710	0	0	50	0	0	40	4
Waterbed Heater	350	0	0	3,051	0	0	1,070	101
<b>Laundry Room</b>								
Clothes Dryer				(4)	359		1,000	94
Clothes Washer (3)	0	0	0	(4)	392	0	(3)	110
<b>Home Electronics</b>								
CPU & Monitor	182/30	0	1,337/632			0	260	24
Stereo Systems	33	30	3	1,510	1,810	5,440	119	11
Television	113		4	1,460		7,300	193	18
Analog, <40"	86			(5)	1,095		184	17
Analog, >40"	156			(5)	1,825		312	29
Digital, ED/HD TV, <40"	150			(5)	1,095		301	28
Digital, ED/HD TV, >40"	234			(5)	1,825		455	43
Set-top box	20	0	20	6,450	0	2,310	178	17
DVD/VCR	17	13	3	170	5,150	3,430	78	7
<b>Heating and Cooling</b>								
Dehumidifier	600	0		1,620	0		970	91
Furnace Fan	295	0		1,350	0		400	38
Ceiling Fan (only fan motor)	35			2,310			81	8
<b>Water Heating</b>								
Water Heater-Family of 4	4,500			(6)	64	N.A.	0	4,770
Water Heater-Family of 2	4,500			(6)	32	N.A.	0	2,340
Portable Spa	4,350	275	0	25	8,735	0	2,525	237
<b>Miscellaneous</b>								
Pool Pump	1,000	0		792	0		790	74
Well Pump	725	0		115	0		80	8
<b>Total Standby</b>	<b>0</b>	<b>57</b>		<b>0</b>	<b>8,760</b>		<b>500</b>	<b>47</b>

Note(s): 1) Power draw will vary due to appliance components and modes of operation. 2) \$0.096/kWh. 3) Excludes electricity for water heating and drying. 4) Cycles/year. 5) TVs <40" are estimated on 3 hours/day and TVs >40" are estimated on 5 hours/day. 6) Gallons/day.

Source(s): BTS/A.D. Little, Electricity Consumption by Small End Uses in Residential Buildings, Aug. 1998, Exhibit 6-8, p. 6-10 for clothes washer, computer, dehumidifier, dishwasher, furnace fan, pool pump, torchiere lamp-halogen, waterbed heater, and well pump; LBNL, Energy Data Sourcebook for the U.S. Residential Sector, LBNL-40297, Sept. 1997, p. 100-102 for clothes dryers, Table 10.2, p. 108 for lighting, and p. 62-67 for water heaters; LBNL, Miscellaneous Electricity Use in the U.S. Residential Sector, LBNL-40295, Apr. 1998, Appendix D for hair dryers; EIA, Supplement to AEO 2008, June 2008, Table 21 for refrigerator and freezer; GAMA, Consumers' Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment, Apr. 2000 for water heater power draw; EIA/TIAX, Commercial and Residential Sector Miscellaneous Electricity Consumption: FY2005 and Projections to 2030, Sept. 2006, p. 41-60 for coffee maker, microwave oven, stereo systems, TVs, set-top box, DVD/VCR, ceiling fan, and portable spa; and LBNL for total standby.

**2.1.17 Operating Characteristics of Natural Gas Appliances in the Residential Sector**

	Average Capacity (thousand Btu/hr)	Appliance Usage	Annual Consumption (million Btu/year)	Annual Cost (\$) <sup>(1)</sup>
Range	10		4	52
Clothes Dryer		359 (2)	4	53
Water Heating				
Water Heater-Family of 4	40	64 (3)	26	320
Water Heater-Family of 2	40	32 (3)	12	152

Note(s): 1) \$1.24/therm. 2) Cycles/year. 3) Gallons/day.

Source(s): A.D. Little, EIA-Technology Forecast Updates - Residential and Commercial Building Technologies - Reference Case, Sept. 2, 1998, p. 30 for range and clothes dryer; LBNL, Energy Data Sourcebook for the U.S. Residential Sector, LBNL-40297, Sept. 1997, p. 62-67 for water heating; GAMA, Consumers' Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment, Apr. 2002, for water heater capacity; and AGA, Gas Facts 1998, Dec. 1999, www.aga.org for range and clothes dryer consumption.

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**2.1.18 Residential Buildings Share of U.S. Natural Gas Consumption (Percent)**

	Site Consumption				Primary Consumption			U.S. Natural Gas Total (quads)
	Residential	Industry	Electric Gen.	Transportation	Residential	Industry	Transportation	
1980	24%	41%	19%	3%	30%	49%	3%	20.38
1990	23%	43%	17%	3%	29%	49%	3%	19.75
2000	21%	40%	22%	3%	29%	47%	3%	23.80
<b>2006(1)</b>	<b>20%</b>	<b>35%</b>	<b>29%</b>	<b>3%</b>	<b>31%</b>	<b>43%</b>	<b>3%</b>	<b>22.30</b>
2010	21%	35%	29%	3%	31%	43%	3%	23.93
2015	21%	35%	28%	3%	31%	42%	3%	24.35
2020	22%	35%	25%	3%	31%	41%	3%	24.01
2025	23%	36%	23%	3%	31%	41%	3%	23.66
2030	23%	36%	22%	3%	31%	41%	3%	23.39

Note(s): 1) Buildings accounted for 58% (or \$97 billion) of total U.S. natural gas expenditures.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 consumption, Table A3, p. 120-121 for 2006 expenditures.

**2.1.19 Residential Buildings Share of U.S. Petroleum Consumption (Percent)**

	Site Consumption				Primary Consumption			U.S. Petroleum Total (quads)
	Residential	Industry	Electric Gen.	Transportation	Residential	Industry	Transportation	
1980	5%	28%	8%	56%	8%	31%	56%	34.2
1990	4%	25%	4%	64%	6%	26%	64%	33.6
2000	4%	24%	3%	67%	5%	25%	67%	38.4
<b>2006</b>	<b>3%</b>	<b>25%</b>	<b>2%</b>	<b>69%</b>	<b>4%</b>	<b>25%</b>	<b>69%</b>	<b>40.1</b>
2010	3%	24%	1%	70%	4%	24%	70%	40.5
2015	3%	23%	1%	71%	4%	23%	71%	41.8
2020	3%	22%	1%	72%	4%	22%	72%	42.2
2025	3%	21%	1%	73%	4%	22%	73%	42.8
2030	3%	21%	1%	73%	3%	21%	73%	44.0

Note(s): 1) Buildings accounted for an estimated 7.3% (or \$30 billion) of total U.S. petroleum expenditures.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 consumption, Table A3, p. 120-121 for 2006 expenditures.

**2.2.1 Total Number of Households and Buildings, Floorspace, and Household Size, by Year**

	Households (millions)	Percent Post- 2000 Households (1)	Floorspace (billion SF)	U.S. Population (millions)	Average Household Size (2)
1980	80	N.A.	142	227	2.9
1990	94	N.A.	169	250	2.6
2000	106	N.A.	N.A.	282	2.7
<b>2006</b>	<b>113</b>	<b>11%</b>	<b>N.A.</b>	<b>299</b>	<b>2.7</b>
2010	116	15%	N.A.	309	2.7
2015	123	22%	N.A.	322	2.6
2020	129	28%	N.A.	336	2.6
2025	135	33%	N.A.	349	2.6
2030	141	38%	N.A.	364	2.6

Note(s): 1) Percent built after Dec. 31, 2000. 2) Number of residents. 3) Number of buildings and floorspace in 1997; for comparison, 1997 households = 101.5 million; percentage of floorspace: 85% single-family, 11% multi-family, and 4% manufactured housing. 2001 households = 107.2 million; percentage of floorspace: 83% single-family, 13% multi-family, and 4% manufactured housing.

Source(s): DOC, Statistical Abstract of the U.S. 2008, Oct. 2007, No. 948, p. 626, 1980-2000 households, No. 2-3, p. 7-8 for population; EIA, Annual Energy Outlook 2008, Mar. 2008, Table A4, p. 142-143 for 2005-2030 households and Table A19, p. 165 for housing starts; EIA, Buildings and Energy in the 1980's, June 1995, Table 2.1, p. 23 for residential buildings and floorspace in 1980 and 1990; EIA, RECS 1997 for 1997 buildings and floorspace; and EIA RECS 2001 for 2001 households and floorspace.

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**2.2.2 Share of Households, by Housing Type and Type of Ownership, as of 2005 (Percent)**

Housing Type	Owned	Rented	Total
<b>Single-Family:</b>	<b>61.5%</b>	<b>10.3%</b>	<b>71.8%</b>
Detached	57.7%	7.2%	65.0%
Attached	3.8%	3.1%	6.8%
<b>Multi-Family:</b>	<b>3.7%</b>	<b>18.3%</b>	<b>22.0%</b>
2 to 4 units	1.6%	5.3%	6.9%
5 or more units	2.1%	13.0%	15.0%
<b>Mobile Homes</b>	<b>5.1%</b>	<b>1.1%</b>	<b>6.2%</b>
<b>Total</b>	<b>70.4%</b>	<b>29.6%</b>	<b>100%</b>

Source(s): EIA, A Look at Residential Energy Consumption in 2005, July 2008, Table HC3-1 and HC4-1.

**2.2.3 Share of Households, by Census Region and Vintage, as of 2005 (Percent)**

Region	Prior to 1970	1970 to 1979	1980 to 1989	1990 to 1999	2000 to 2005	Total
Northeast	11.8%	2.4%	2.1%	1.4%	0.8%	18.5%
Midwest	11.5%	3.6%	2.5%	3.7%	1.6%	23.0%
South	11.0%	6.4%	7.6%	7.5%	4.3%	36.8%
West	8.0%	4.5%	4.6%	3.1%	1.5%	21.7%
						100%

Source(s): EIA, A Look at Residential Energy Consumption in 2005, July 2008, Table HC10-1.



**2.2.4 Residential Floorspace (Heated Square Feet), as of 2005 (Percent of Total Households)**

<u>Floorspace</u>	
Fewer than 500	6%
500 to 999	26%
1,000 to 1,499	24%
1,500 to 1,999	16%
2,000 to 2,499	9%
2,500 to 2,999	7%
<u>3,000 or more</u>	<u>11%</u>
Total	100%

Source(s): EIA, A Look at Residential Energy Consumption in 2005, July 2008, Table HC1-3.

**2.2.5 Housing Vintage, as of 2005**

<u>Vintage</u>	
Before 1940	13%
1940 to 1949	7%
1950 to 1959	11%
1960 to 1969	11%
1970 to 1979	17%
1980 to 1989	17%
1990 to 1999	16%
<u>2000 to 2005</u>	<u>8%</u>
Total	100%

Source(s): EIA, A Look at Residential Energy Consumption in 2005, July 2008, Table HC5-1.

**2.2.6 Construction Statistics of New Homes Completed/Placed**

	Single-Family		Multi-Family		Mobile Homes	Total
	Thousand Units	Average SF	Thousand Units	Average SF	Thousand Units	Thousand Units
1980	957	1,700	545	979	234	1,736
1985	1,072	1,760	631	922	283	1,986
1990	966	2,050	342	1,005	195	1,503
1995	1,066	2,050	247	1,080	319	1,632
2000	1,242	2,265	332	1,039	281	1,855
2005	1,636	2,414	296	1,143	123	2,055
2006	1,654	2,456	325	1,172	112	2,091

Source(s): DOC, 2007 Characteristics of New Housing, June 2008, p. 4 for single-family completions, p. 260 for single-family average SF; NAHB, Housing Economics, Mar. 1995; NAHB, Facts, Figures and Trends, 1997, Characteristics of New Multi-Family Homes, 1971-1995, p. 7; DOC, Current Construction Reports, Characteristics of New Housing, C25/98-A, Table 18, p. 44; DOC, Placements of New Manufactured Homes by Region and Size of Home, 1974-1988; and DOC, Placements of New Manufactured Homes by Region and Size of Home, 1980-2006.

**2.2.7 2007 New Homes Completed/Placed, by Census Region (Thousand Units and Percent of Total Units) (1)**

Region	Single-Family Units		Multi-Family Units		Mobile Homes Units		Total
Northeast	105	9%	40	14%	7	7%	192
Midwest	189	15%	34	12%	11	11%	267
South	632	52%	135	47%	59	62%	960
West	294	24%	76	27%	18	19%	463
<b>Total</b>	<b>1,219</b>	<b>100%</b>	<b>284</b>	<b>100%</b>	<b>95</b>	<b>100%</b>	<b>1,882</b>

Note(s) 1) Preliminary.

Source(s): DOC, Manufacturing, Mining and Construction Statistics: New Residential Construction: New Privately Owned Housing Units Completed, for single- and multi-family; and DOC, Manufacturing, Mining and Construction Statistics: Manufactured Homes Placements by Region and Size of Home, Mar. 2008 for mobile home placements.

**2.2.8 2007 Construction Method of Single-Family Homes, by Region (Thousand Units and Percent of Total Units)**

Region	Stick Built Units		Modular Units		Panelized/Precut Units		Total
Northeast	91	8%	9	29%	5	23%	105
Midwest	173	15%	10	32%	5	23%	189
South	613	53%	8	26%	10	45%	631
West	288	25%	4	13%	2	9%	294
<b>Total</b>	<b>1,165</b>	<b>100%</b>	<b>31</b>	<b>100%</b>	<b>22</b>	<b>100%</b>	<b>1,219</b>

Source(s): DOC, Manufacturing, Mining and Construction Statistics, New Residential Construction: Type of Construction Method of New One-Family Houses Completed, Mar. 2008.

**2.2.9 2007 HUD-Code (Mobile) Home Placements, by Census Region and Top Five States (Percent of National Total)**

Region		Top Five States	
Northeast	7%	Texas	11%
Midwest	11%	Florida	7%
South	62%	Louisiana	7%
West	19%	California	6%
Total	100%	Arizona	3%

Source(s): DOC, Manufactured Housing Statistics, 2007 New Manufactured Homes Placed by Size of Home, by State, Apr. 2008.

**2.2.10 Materials Used in the Construction of a 2,272 Square-Foot Single-Family Home, 2000**

13,837 board-feet of lumber	12 interior doors
13,118 square feet of sheathing	6 closet doors
19 tons of concrete	2 garage doors
3,206 square feet of exterior siding material	1 fireplace
3,103 square feet of roofing material	3 toilets, 2 bathtubs, 1 shower stall
3,061 square feet of insulation	3 bathroom sinks
6,050 square feet of interior wall material	15 kitchen cabinets, 5 other cabinets
2,335 square feet of interior ceiling material	1 kitchen sink
226 linear feet of ducting	1 range, 1 refrigerator, 1 dishwasher, 1 garbage disposal, 1 range hood
19 windows	1 washer, 1 dryer
4 exterior doors (3 hinged, 1 sliding)	1 heating and cooling system
2,269 square feet of flooring material	

Source(s): NAHB, 2004 Housing Facts, Figures and Trends, Feb. 2004, p. 7; D&R International for appliances and HVAC.

**2.2.11 Characteristics of a Typical Single-Family Home (1)**

Year Built	mid 1970s	<u>Building Equipment</u>	<u>Type</u>	<u>Fuel</u>	<u>Age (5)</u>
Occupants	3	Space Heating	Central Warm-Air Furnace	Natural Gas	12
Floorspace		Water Heating	49 Gallons	Natural Gas	8
Heated Floorspace (SF)	1,934	Space Cooling	Central Air Conditioner		8
Cooled Floorspace (SF)	1,495				
Garage	2-Car	<u>Appliances</u>	<u>Type / Fuel / Number</u>	<u>Size</u>	<u>Age (5)</u>
Stories	1	Refrigerator	2-Door Top and Bottom	19 Cubic Feet	8
Foundation	Concrete Slab	Clothes Dryer	Electric		
Total Rooms (2)	6	Clothes Washer	Top-Loading		
Bedrooms	3	Range/Oven	Electric		
Other Rooms	3	Microwave Oven			
Full Bathroom	2	Dishwasher			
Half Bathroom	0	Color Televisions	3		
Windows		Ceiling Fans	3		
Area (3)	222	Computer	2		
Number (4)	15	Printer			
Type	Double-Pane				
Insulation: Well or Adequate					

Note(s): 1) This is a weighted-average house that has combined characteristics of the Nation's stock homes. Although the population of homes with similar traits may be few, these are likely to be the most common. 2) Excludes bathrooms. 3) 11.5% of floorspace. 4) Based on a nominal 3' X 5' window. 5) Years.

Source(s): EIA, 2005 Residential Energy Consumption Survey: Characteristics, April 2008, Tables HC 1.1.1, HC1.1.3, HC 2.1, HC 2.2, HC 2.3, HC 2.4, HC 2.5, HC 2.6.

**2.3.1 Residential Energy Prices, by Year and Major Fuel Type (\$2006 per Million Btu)**

	<u>Electricity</u>	<u>Natural Gas</u>	<u>Petroleum (1)</u>	<u>Avg.</u>
1980	33.86	7.77	15.66	16.35
1990	32.78	8.04	12.49	17.32
2000	28.12	8.90	13.45	16.85
<b>2006</b>	<b>30.52</b>	<b>13.40</b>	<b>19.68</b>	<b>21.78</b>
2010	31.37	12.15	20.05	21.56
2015	30.04	11.20	17.90	20.19
2020	30.20	11.39	18.09	20.45
2025	30.33	11.94	18.95	21.04
2030	30.63	12.91	20.14	22.00

Note(s): 1) Residential petroleum products include distillate fuel, LPG, and kerosene.

Source(s): EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, Tables 2-3, p. 24-25 for 1980-2005 and prices for note, Tables 8-9, p. 18-19 for 1980-2005 consumption; EIA, Annual Energy Outlook 2008 Mar. 2008, Table A2, p. 117-119, Table A3, p. 120-121, Table A12, p. 138, and Table A13, p. 139 for 2006-2030 consumption and prices; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**2.3.2 Residential Energy Prices, by Year and Fuel Type (\$2006)**

	<u>Electricity</u> <u>(¢/kWh)</u>	<u>Natural Gas</u> <u>(¢/therm)</u>	<u>Distillate Oil</u> <u>(\$/gal)</u>	<u>LPG</u> <u>(\$/gal)</u>
1980	11.55	77.68	1.46	2.10
1990	11.18	80.38	1.34	1.59
2000	9.59	89.00	1.45	1.61
<b>2006</b>	<b>10.41</b>	<b>133.99</b>	<b>1.98</b>	<b>2.49</b>
2010	10.70	121.52	2.16	2.39
2015	10.25	112.02	2.07	1.98
2020	10.30	113.94	2.08	1.98
2025	10.35	119.35	2.11	2.10
2030	10.45	129.12	2.18	2.26

Source(s): EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. Tables 2-3, p. 24-25 for 1980-2005; EIA, Annual Energy Outlook 2008, Mar. 2008, Table A3, p. 120-121 for 2006-2030 and Table G1, p. 215 for fuels' heat content; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**2.3.3 Residential Aggregate Energy Expenditures, by Year and Major Fuel Type (\$2006 Billion) (1)**

	<u>Electricity</u>	<u>Natural Gas</u>	<u>Petroleum (2)</u>	<u>Total</u>
1980	82.9	37.7	27.4	148.0
1990	103.3	36.3	17.6	157.2
2000	114.4	45.4	21.0	180.8
<b>2006</b>	<b>140.8</b>	<b>60.3</b>	<b>24.5</b>	<b>225.6</b>
2010	155.2	60.2	26.3	241.7
2015	150.9	57.8	23.9	232.6
2020	158.7	60.4	24.1	243.2
2025	167.7	63.8	24.9	256.3
2030	180.0	68.7	26.0	274.7

Note(s): 1) Expenditures exclude wood and coal. 2006 U.S. energy expenditures were 1.14 trillion. 2) Residential petroleum products include distillate fuel oil, LPG, and kerosene.

Source(s): EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 24-25 for 1980-2005; EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 and Table A3, p. 120-121 for 2006-2030; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**2.3.4 Cost of a Generic Quad Used in the Residential Sector (\$2006 Billion) (1)**

1980	9.88
1990	9.57
2000	9.06
<b>2006</b>	<b>10.04</b>
2010	9.90
2015	9.09
2020	9.17
2025	9.37
2030	9.76

Note(s): 1) See Table 1.5.1 for generic quad definition. This table provides the consumer cost of a generic quad in the buildings sector. Use this table to estimate the average consumer cost savings resulting from the savings of a generic (primary) quad in the buildings sector.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2007, Table A2, p. 117-119 and Table A17, p. 143-144 for energy consumption and Table A3, p. 120-121 for energy prices(2006-2030). EIA, State Energy Data Report 2005, Feb. 2008, Tables 8-12 pages 22-24 and EIA, State Energy Prices and Expenditures 2005 Feb. 2008 Tables 2 and 3(1980-2005); EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price inflators.

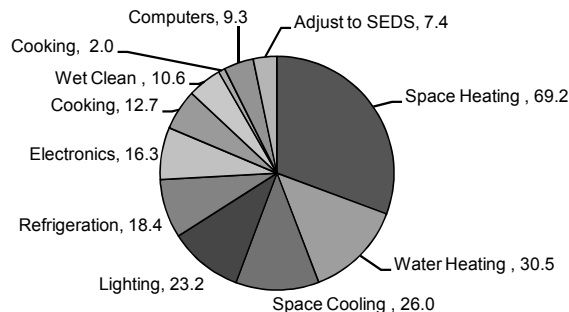
**2.3.5 2006 Residential Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion) (1)**

	Natural	Petroleum				Coal	Electricity	Total	Percent
	Gas	Distil.	LPG	Kerosene	Total				
Space Heating (2)	41.9	10.8	5.3	1.1	17.1	0.01	10.1	69.2	30.7%
Water Heating (3)	14.5	1.9	1.3		3.2		12.9	30.5	13.5%
Space Cooling (4)	0.0						26.0	26.0	11.5%
Lighting							23.2	23.2	10.3%
Refrigeration (5)							18.4	18.4	8.2%
Electronics (6)							16.3	16.3	7.2%
Wet Clean (7)	1.0						11.7	12.7	5.6%
Cooking	2.9		0.7		0.7		7.0	10.6	4.7%
Computers							2.0	2.0	0.9%
Other (8)	-		3.5		3.5		5.8	9.3	4.1%
Adjust to SEDS (9)							7.4	7.4	3.3%
<b>Total</b>	<b>60.3</b>	<b>12.6</b>	<b>10.8</b>	<b>1.1</b>	<b>24.5</b>	<b>0.01</b>	<b>140.8</b>	<b>225.6</b>	<b>100%</b>

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes furnace fans (\$1.7 billion). 3) Includes residential recreational water heating (\$1.3 billion). 4) Fan energy use included. 5) Includes refrigerators (\$14.1 billion) and freezers (\$4.0 billion). 6) Includes color televisions (\$10.1 billion) and other electronics (\$6.3 billion). 7) Includes clothes washers (\$1.1 billion), natural gas clothes dryers (\$1.0 billion), electric clothes dryers (\$7.7 billion), and dishwashers (\$2.9 billion). 8) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. 9) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential building sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 and Table A4, p. 122-123 for energy, Table A3, p. 120-121 for prices; EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 24 for coal price; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators; and BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses.

**2006 Residential Energy End-Use Expenditures Splits (\$2006 Billion)**



**2.3.6 2010 Residential Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion) (1)**

	Natural	Petroleum				Coal	Electricity	Total	Percent
	Gas	Distil.	LPG	Kerosene	Total				
Space Heating (2)	43.4	11.3	6.0	1.3	18.6	0.0	11.5	73.6	30.4%
Water Heating	13.1	1.6	1.2		2.9		12.0	28.0	11.6%
Space Cooling (3)	0.0						24.8	24.8	10.3%
Lighting							22.5	22.5	9.3%
Refrigeration (4)							14.1	14.1	5.8%
Wet Clean (5)	0.9						11.9	12.8	5.3%
Electronics (6)							12.3	12.3	5.1%
Cooking	2.7		0.8		0.8		3.4	6.9	2.9%
Computers							3.0	3.0	1.2%
Other (7)	-		4.0		4.0		39.6	43.7	18.1%
<b>Total</b>	<b>60.2</b>	<b>13.0</b>	<b>12.1</b>	<b>1.3</b>	<b>26.3</b>	<b>0.0</b>	<b>155.2</b>	<b>241.7</b>	<b>100%</b>

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes furnace fans (\$2.0 billion). 3) Fan energy use included. 4) Includes refrigerators (\$11.5 billion) and freezers (\$2.5 billion). 5) Includes clothes washers (\$1.0 billion), natural gas clothes dryers (\$0.9 billion), electric clothes dryers (\$8.0 billion), and dishwashers (\$2.9 billion). 6) Includes color televisions (\$12.3 billion). 7) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2007, Table A2, p. 117-119 and Table A4, p. 122-123 for energy, Table A3, p. 120-121 for prices; EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 24 for coal price; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**2.3.7 2020 Residential Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion) (1)**

	Natural	Petroleum				Coal	Electricity	Total	Percent
	Gas	Distil.	LPG	Kerosene	Total				
Space Heating (2)	43.6	9.2	5.7	1.1	16.0	0.0	12.0	71.7	29.5%
Water Heating	13.1	1.2	1.1		2.3		12.8	28.2	11.6%
Space Cooling (3)	0.0						27.4	27.4	11.3%
Lighting							15.4	15.4	6.3%
Refrigeration (4)							13.9	13.9	5.7%
Electronics (5)							12.9	12.9	5.3%
Wet Clean (6)	0.9						11.9	12.8	5.3%
Cooking	2.8		0.8		0.8		3.8	7.4	3.0%
Computers							3.7	3.7	1.5%
Other (7)	-		4.9		4.9		45.0	49.9	20.5%
<b>Total</b>	<b>60.4</b>	<b>10.4</b>	<b>12.6</b>	<b>1.1</b>	<b>24.1</b>	<b>0.0</b>	<b>158.7</b>	<b>243.2</b>	<b>100%</b>

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes furnace fans (\$2.2 billion). 3) Fan energy use included. 4) Includes refrigerators (\$11.1 billion) and freezers (\$2.8 billion). 5) Includes color televisions (\$12.9 billion). 6) Includes clothes washers (\$0.8 billion), natural gas clothes dryers (\$0.9 billion), electric clothes dryers (\$8.2 billion), and dishwashers (\$2.9 billion). 7) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2007, Table A2, p. 117-119 and Table A4, p. 122-123 for energy, Table A3, p. 120-121 for prices; EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 24 for coal price; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators;

**2.3.8 2030 Residential Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion) (1)**

	Natural	Petroleum				Coal	Electricity	Total	Percent
	Gas	Distil.	LPG	Kerosene	Total				
Space Heating (2)	50.2	9.5	5.8	1.3	16.7	0.0	12.6	79.4	28.9%
Space Cooling (3)	0.0						31.9	31.9	11.6%
Water Heating	14.1	1.1	1.1		2.2		13.1	29.4	10.7%
Electronics (4)							16.9	16.9	6.2%
Refrigeration (5)							15.4	15.4	5.6%
Lighting							14.9	14.9	5.4%
Wet Clean (6)	1.1						13.1	14.2	5.2%
Cooking	3.4		0.9		0.9		4.3	8.5	3.1%
Computers							4.8	4.8	1.8%
Other (7)	-		6.2		6.2		53.0	59.3	21.6%
<b>Total</b>	<b>68.7</b>	<b>10.6</b>	<b>14.0</b>	<b>1.3</b>	<b>26.0</b>	<b>0.0</b>	<b>180.0</b>	<b>274.7</b>	<b>100%</b>

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes furnace fans (\$2.4 billion). 3) Fan energy use included. 4) Includes color televisions (\$16.9 billion). 5) Includes refrigerators (\$12.0 billion) and freezers (\$3.4 billion). 6) Includes clothes washers (\$0.8 billion), natural gas clothes dryers (\$1.1 billion), electric clothes dryers (\$9.0 billion), and dishwashers (\$3.3 billion). 7) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2007, Table A2, p. 117-119 and Table A4, p. 122-123 for energy, Table A3, p. 120-121 for prices; EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 24 for coal price; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**2.3.9 Average Annual Energy Expenditures per Household, by Year (\$2006)**

Year	Total Expenditure
1980	1,858
1990	1,669
2000	1,710
<b>2006</b>	<b>2,003</b>
2010	2,084
2015	1,895
2020	1,883
2025	1,899
2030	1,954

Source(s): EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 24 for 1980-2005; EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123 for consumption, Table A3, p. 120-121 for prices 2006-2030; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators; and DOC, Statistical Abstract of the United States Historical Data for 1980-2005 occupied units.

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**2.3.10 2005 Energy End-Use Expenditures for an Average Household, by Region (\$2006)**

	Northeast	Midwest	South	West	National
Space Heating	978	672	345	328	536
Air-Conditioning	186	163	425	244	290
Water Heating	347	274	292	296	298
Refrigerators	180	135	136	143	146
Other Appliances and Lighting	770	620	666	667	675
<b>Total (1)</b>	<b>2,379</b>	<b>1,840</b>	<b>1,835</b>	<b>1,542</b>	<b>1,873</b>

Note(s): 1) Due to rounding, end-uses do not sum to totals.

Source(s): EIA, A Look at Residential Energy Consumption in 2005, October 2008, Table US-15; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**2.3.11 2005 Energy Expenditures per Household, by Housing Type and Square Footage (\$2006)**

	<u>Per Household</u>	<u>Per Square Foot</u>
<b>Single-Family</b>		
Detached	2,126	0.78
Attached	1,672	0.87
<b>Multi-Family</b>		
2 to 4 units	1,610	1.47
5 or more units	1,116	1.28
<b>Mobile Home</b>	<b>1,592</b>	<b>1.51</b>

Source(s): EIA, A Look at Residential Energy Consumption in 2005, Oct. 2008, Table US-1 part 1; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price inflators.

**2.3.12 2005 Energy Expenditures per Household, by Census Region (\$2006)**

<u>Region</u>	
Northeast	2,379
Midwest	1,840
South	1,835
West	1,542

Source(s): EIA, A Look at Residential Energy Consumption in 2005, Oct. 2008, Tables US-1 part 1; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price inflators.

**2.3.13 2005 Household Energy Expenditures, by Vintage (\$2006)**

<u>Year</u>	<u>Per Household</u>	<u>Per Square Foot</u>	<u>Per Household Member</u>	<u>Percent of Residential Sector Expenditures</u>
Prior to 1970	1,909	0.87	765	43%
1970 to 1979	1,706	0.92	686	15%
1980 to 1989	1,755	0.88	697	16%
1990 to 1999	2,000	0.80	713	17%
2000 to 2005	2,024	0.71	733	9%
<b>Average</b>	<b>1,873</b>	<b>0.81</b>	<b>1,770</b>	<b>Total 100%</b>

Source(s): EIA, A Look at Residential Energy Consumption in 2005, Oct. 2008, Tables US-1 part 1; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price inflators.

**2.3.14 2005 Households and Energy Expenditures, by Income Level**

<u>Household Income</u>	<u>Households (10<sup>6</sup>)</u>		<u>Energy Expenditures by</u>		<u>Mean Individual Energy Burden (1)</u>
			<u>Household</u>	<u>Household Member</u>	
Less than \$9,999	9.9	9%	1,357	706	21%
\$10,000 to \$14,999	8.5	8%	1,419	685	11%
\$15,000 to \$19,999	8.4	8%	1,462	668	8%
\$20,000 to \$29,999	15.1	14%	1,580	645	6%
\$30,000 to \$39,999	13.6	12%	1,677	641	5%
\$40,000 to \$49,999	11.0	10%	1,821	685	4%
\$50,000 to \$74,999	19.8	18%	1,916	695	3%
\$75,000 to \$99,999	10.6	10%	2,220	773	3%
\$100,000 or more	14.2	13%	2,528	828	3%
<b>Total</b>	<b>111.1</b>	<b>100%</b>			<b>6%</b>

Note(s): 1) See Tables 2.3.15 for more on energy burdens. 2) A household is defined as a family, an individual, or a group of up to nine unrelated individuals occupying the same housing unit.

Source(s): EIA, A Look at Residential Energy Consumption in 2005, Oct. 2008, Tables US-1 part 2; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price inflators.



**2.3.15 Energy Burden Definitions and Residential Energy Burdens, by Weatherization Eligibility and Year (1)**

Energy burden is an important statistic for policy makers who are considering the need for energy assistance. Energy burden can be defined broadly as the burden placed on household incomes by the cost of energy, or more simply the ratio of energy expenditures to income for a household. However, there are different ways to compute energy burden, and different interpretations and uses of the energy burden statistics. DOE Weatherization primarily uses mean individual burden and mean group burden since these statistics provide data on how an "average" individual household fares against an "average" group of households (that is, how burdens are distributed for the population). DOE Weatherization (and HHS) also uses the median individual burden which shows the burden of a "typical" individual.

	1987	1990		FY 2000 (2)			FY 2005 (3)		
	Mean Group	Mean Indvdl	Mean Group	Mean Indvdl	Mdn Indvdl	Mean Group	Mean Indvdl	Mdn Indvdl	Mean Group
Total U.S. Households	4.0%	6.8%	3.2%	6.1%	3.5%	2.4%	6.8%	3.7%	2.9%
<b>Federally Eligible</b>	<b>13.0%</b>	<b>14.4%</b>	<b>10.1%</b>	<b>12.1%</b>	<b>7.9%</b>	<b>7.7%</b>	<b>14.6%</b>	<b>8.6%</b>	<b>9.1%</b>
Federally Ineligible	4.0%	3.5%	N.A.	3.0%	2.6%	2.0%	3.2%	2.8%	2.3%
Below 125% Poverty Line	13.0%	N.A.	N.A.	N.A.	N.A.	N.A.	20.2%	13.7%	12.8%

Note(s): 1) See Section 7.1 for more on low-income housing. 2) Data are derived from RECS 1997, adjusted to reflect FY 2000, HDD, CDD, 3) Data are derived from RECS 2001, adjusted to reflect FY 2005, HDD, CDD, and fuel prices.

Source(s): HHS, LIHEAP Home Energy Notebook for Fiscal Year 2005, May 2007, Tables A-2a, A-2b, and A-2c, p. 59-61 for FY 2005; HHS, LIHEAP Home Energy Notebook for FY 2000, April 2002, Tables A-2a, A-2b, and A-2c, p. 48-50 for FY 2000; HHS, LIHEAP Report to Congress FY 1995, Aug. 1997, p. 55 for energy burden definitions; HHS, Characterizing the Impact of Energy Expenditures on Low-Income Households: An Analysis of Alternative National Energy Burden Statistics, November 1994, p. vii-ix for burdens; ORNL, Scope of the of the Weatherization Assistance Program: Profile of the Population in Need, Mar. 1994, p. xii for mean individual and mean group burdens and p. xi for 1990 Federally ineligible mean individual burden; and EIA, Household Energy Consumption and Expenditures 1987, Oct. 1989, Table 13, p. 48-50 for 1987 mean group burdens.

**2.3.16 1998 Cost Breakdown of a 2,150-Square-Foot, New Single-Family Home (\$2006) (1)**

	Cost	
<b>Finished Lot</b>	<b>64,626</b>	<b>24%</b>
<b>Construction Cost</b>		
Inspection/Fees	4,223	2%
Shell/Frame		
Framing	30,927	11%
Windows/Doors	10,272	4%
Exterior Finish	11,304	4%
Foundation	16,131	6%
Wall/Finish Trim	28,212	10%
Flooring	7,211	3%
Equipment		
Plumbing	8,837	3%
Electrical Wiring	5,638	2%
Lighting Fixtures	1,560	1%
HVAC	6,171	2%
Appliances	2,165	1%
Property Features	17,567	6%
<b>Financing</b>	<b>5,152</b>	<b>2%</b>
<b>Overhead &amp; General Expenses</b>	<b>15,645</b>	<b>6%</b>
<b>Marketing</b>	<b>3,840</b>	<b>1%</b>
<b>Sales Commission</b>	<b>9,238</b>	<b>3%</b>
<b>Profit</b>	<b>25,163</b>	<b>9%</b>
<b>Total</b>	<b>273,882</b>	<b>100%</b>

Note(s): 1) Based on a NAHB Survey asking builders to provide a detailed breakdown of the cost of constructing a 2,150 SF house with 3 or 4 bedrooms on a 7,500- to 10,000SF lot. Average sales price of a new home in 42 surveyed markets was \$226,680 (in \$1998).

Source(s): NAHB, The Truth About Regulatory Barriers to Housing Affordability, 1999, p. 4; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price inflators.

**2.4.1 Carbon Dioxide Emissions for U.S. Residential Buildings, by Year (million metric tons) (1)**

	Residential				U.S.		Res.% of Total U.S.	Res.% of Total Global
	Site	Electricity	Total	Growth Rate 2006-Year	Total	Growth Rate 2006-Year		
	Fossil							
1980	385	525	909	-	4723	-	19%	5.0%
1990	342	620	962	-	5012	-	19%	4.5%
2000	380	802	1182	-	5847	-	20%	5.0%
<b>2006</b>	<b>326</b>	<b>866</b>	<b>1192</b>	-	<b>5890</b>	-	<b>20%</b>	<b>4.3%</b>
2010	355	904	1259	1.4%	6011	0.5%	21%	4.0%
2015	367	913	1281	0.8%	6226	0.6%	21%	3.7%
2020	374	949	1324	0.8%	6384	0.6%	21%	3.6%
2025	375	1004	1379	0.8%	6571	0.6%	21%	3.5%
2030	372	1079	1451	0.8%	6851	0.6%	21%	3.4%

Note(s): 1) Excludes emissions of buildings-related energy consumption in the industrial sector. Emissions assume complete combustion from energy consumption and exclude energy production activities such as gas flaring, coal mining, and cement production. 2) Carbon emissions calculated from EIA, Assumptions to the AEO 2008 and differs from EIA, AEO 2008, Table A18. Buildings sector total varies by 0.7% for year 2006 from EIA, AEO 2008. 3) U.S. buildings emissions approximately equal the combined carbon emissions of Japan, France, and the United Kingdom.

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 1985-1990, Sept. 1993, Appendix B, Tables B1-B5, p. 73-74 for 1980; EIA, Emissions of Greenhouse Gases in the U.S. 2003, Dec. 2004, Tables 7-11, p. 29-31 for 1990 and 2000; EIA, Assumptions to the Annual Energy Outlook 2008, June 2008, Table 2, p. 9 for carbon coefficients; EIA, AEO 2008, Mar. 2008, Table A2, p. 137-139 for 2006-2030 energy consumption and Table A18, p. 164 for 2006-2030 emissions; EIA, International Energy Outlook 2007, May 2007, Table A10, p. 93 for 2004-2030 global emissions; and EIA, International Energy Annual 2007, July 2008, Table H1, www.eia.doe.gov for 1980-2000 global emission.

**2.4.2 2001 End-Use Carbon Dioxide Emissions Splits for an Average Household, by Region (Pounds of CO<sub>2</sub>)**

	<u>Northeast</u>	<u>Midwest</u>	<u>South</u>	<u>West</u>	<u>National</u>
Space Heating	9,143	8,731	4,906	4,483	6,505
Space Cooling	1,467	2,063	4,742	2,170	3,197
Water Heating	2,952	2,634	3,140	2,538	2,922
Refrigerator	1,444	2,041	2,463	1,796	2,068
<u>Other Appliances &amp; Lighting</u>	<u>6,960</u>	<u>8,697</u>	<u>9,226</u>	<u>7,127</u>	<u>8,179</u>
<b>Total</b>	<b>21,966</b>	<b>24,165</b>	<b>24,477</b>	<b>18,114</b>	<b>22,871</b>

Source(s): EIA, A Look at Residential Energy Consumption in 2001, Apr. 2004, Tables CE(2-5)-(9-12)c; EIA, Annual Energy Outlook 2007, Feb. 2007, Table A2, p. 137-139, Table A17, p. 163 for consumption data, and Table A18, p. 164 for emissions data; and EIA, Assumptions to the AEO 2007, Feb. 2007, Table 2, p. 9 for coefficients.

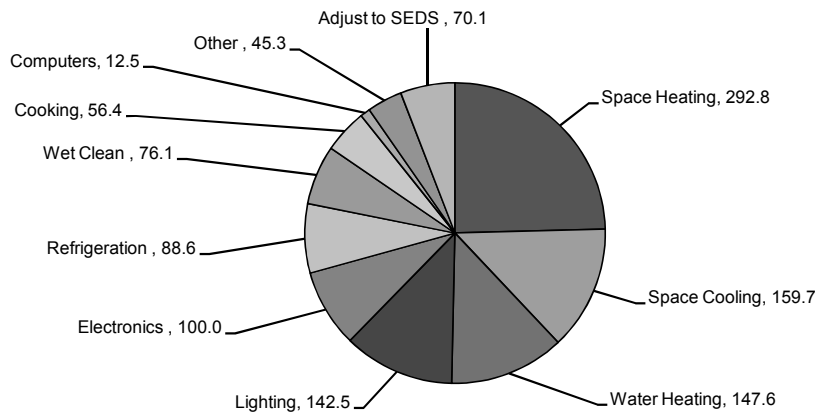
**2.4.3 2006 Residential Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)**

	Natural	Petroleum				Coal	Electricity (3)	Total	Percent	
	Gas	Distil.	Resid.	LPG	Oth(2)					Total
Space Heating (4)	166.0	43.9		14.4	5.4	63.7	0.8	62.3	292.8	24.6%
Space Cooling	0.0							159.7	159.7	13.4%
Water Heating	57.3	7.7		3.5		11.2		79.2	147.6	12.4%
Lighting								142.5	142.5	12.0%
Electronics (5)								100.0	100.0	8.4%
Refrigeration (6)								88.6	88.6	7.4%
Wet Clean (7)	3.9							72.2	76.1	6.4%
Cooking	11.6			2.0		2.0		42.8	56.4	4.7%
Computers								12.5	12.5	1.0%
Other (8)				9.6		9.6		35.8	45.3	3.8%
Adjust to SEDS (9)								70.1	70.1	5.9%
<b>Total</b>	<b>238.7</b>	<b>51.5</b>		<b>29.5</b>	<b>5.4</b>	<b>86.4</b>	<b>0.8</b>	<b>865.6</b>	<b>1,191.5</b>	<b>100%</b>

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. Carbon emissions calculated from EIA, Assumptions to the AEO 2008 and differs from AEO 2008, Table A18. Buildings sector total varies by 0.7% from AEO 2008. 2) Includes kerosene space heating (5.4 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (10.1 MMT). 5) Includes color television (62.2 MMT) and other office equipment(11.9 MMT). 6) Includes refrigerators (73.1 MMT) and freezers (15.6 MMT). 7) Includes clothes washers (6.7 MMT), natural gas clothes dryers (3.9 MMT), electric clothes dryers (47.7 MMT), and dishwashers (17.9 MMT). Does not include water heating energy. 8) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. 9) Emissions related to a discrepancy between data sources. Energy attributable to the residential sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123 and Table A5, p. 124-125 for energy consumption, and Table A18, p. 144 for emissions; EIA, Assumptions to the AEO 2008, June 2008, Table 2, p. 10 for emission coefficients; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses; EIA, AEO 1999, Dec. 1998, Table A4, p. 118-119

**2006 Residential Buildings Energy End-Use Carbon Dioxide Emissions Splits (Million Metric Tons)**



**2.4.4 2010 Residential Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)**

	Natural	Petroleum				Coal	Electricity (3)	Total	Percent	
	Gas	Distil.	Resid.	LPG	Oth(2)					Total
Space Heating (4)	189.4	48.2		15.1	5.8	69.1	0.8	67.1	326.5	25.9%
Space Cooling	0.0							144.5	144.5	11.5%
Water Heating	57.4	6.9		3.1		10.0		70.1	137.4	10.9%
Lighting								131.4	131.4	10.4%
Refrigeration (5)								81.9	81.9	6.5%
Wet Clean (6)	3.9							69.4	73.3	5.8%
Electronics (7)								71.7	71.7	5.7%
Cooking	11.9			2.0		2.0		19.8	33.7	2.7%
Computers								17.4	17.4	1.4%
Other (8)				10.1		10.1		230.9	241.0	19.1%
<b>Total</b>	<b>262.6</b>	<b>55.1</b>		<b>30.3</b>	<b>5.8</b>	<b>91.2</b>	<b>0.8</b>	<b>904.1</b>	<b>1,258.8</b>	<b>100%</b>

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (5.8 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (11.6 MMT). 5) Includes refrigerators (67.1 MMT) and freezers (14.8 MMT). 6) Includes clothes washers (6.0 MMT), natural gas clothes dryers (3.9 MMT), electric clothes dryers (46.5 MMT), and dishwashers (16.9 MMT). Does not include water heating energy. 7) Includes color television (71.7 MMT). 8) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123 and Table A5, p. 124-125 for energy consumption, and Table A18, p. 144 for emissions; EIA, Assumptions to the AEO 2008, June 2008, Table 2, p. 10 for emission coefficients.

**2.4.5 2020 Residential Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)**

	Natural	Petroleum				Coal	Electricity (3)	Total	Percent	
	Gas	Distil.	Resid.	LPG	Oth(2)					Total
Space Heating (4)	203.1	47.3		14.9	6.1	68.3	0.8	71.7	344.0	26.0%
Space Cooling	0.0							164.2	164.2	12.4%
Water Heating	61.0	6.0		2.9		9.0		76.4	146.4	11.1%
Lighting								91.9	91.9	6.9%
Refrigeration (5)								83.0	83.0	6.3%
Electronics (6)								77.3	77.3	5.8%
Wet Clean (8)	4.2							71.0	75.2	5.7%
Cooking	13.1			2.1		2.1		22.6	37.8	2.9%
Computers								22.0	22.0	1.7%
Other (9)				12.9		12.9		269.3	282.1	21.3%
<b>Total</b>	<b>281.5</b>	<b>53.4</b>		<b>32.7</b>	<b>6.1</b>	<b>92.3</b>	<b>0.8</b>	<b>949.4</b>	<b>1,323.9</b>	<b>100%</b>

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (5.7 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (13.2 MMT). 5) Includes refrigerators (66.4 MMT) and freezers (16.6 MMT). 6) Includes color television (77.3 MMT). 8) Includes clothes washers (4.8 MMT), natural gas clothes dryers (4.2 MMT), electric clothes dryers (48.9 MMT), and dishwashers (17.3 MMT). Does not include water heating energy. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123 and Table A5, p. 124-125 for energy consumption, and Table A18, p. 144 for emissions; EIA, Assumptions to the AEO 2008, June 2008, Table 2, p. 10 for emission coefficients.

**2.4.6 2030 Residential Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)**

	Natural Gas	Petroleum				Coal	Electricity (3)	Total	Percent	
		Distil.	Resid.	LPG	Oth(2)					Total
Space Heating (4)	206.1	42.8		14.5	6.1	63.4	0.7	75.4	345.6	23.8%
Space Cooling	0.0							191.0	191.0	13.2%
Water Heating	58.1	4.9		2.7		7.6		78.8	144.4	10.0%
Electronics (5)								101.5	101.5	7.0%
Refrigeration (6)								92.3	92.3	6.4%
Lighting								89.4	89.4	6.2%
Wet Clean (7)	4.4							78.7	83.1	5.7%
Cooking	13.9			2.2		2.2		25.5	41.5	2.9%
Computers								28.9	28.9	2.0%
Other (8)				15.5		15.5		317.8	333.3	23.0%
<b>Total</b>	<b>282.5</b>	<b>47.7</b>		<b>34.8</b>	<b>6.1</b>	<b>88.6</b>	<b>0.7</b>	<b>1,079.1</b>	<b>1,450.9</b>	<b>100%</b>

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (5.7 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (14.6 MMT). 5) Includes color television 101.5 MMT. 6) Includes refrigerators (71.8 MMT) and freezers (20.5 MMT). 7) Includes clothes washers (5.0 MMT), natural gas clothes dryers (4.4 MMT), electric clothes dryers (54.2 MMT), and dishwashers (19.5 MMT). Does not include water heating energy. 8) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123 and Table A5, p. 124-125 for energy consumption, and Table A18, p. 144 for emissions; EIA, Assumptions to the AEO 2008, June 2008, Table 2, p. 10 for emission coefficients.

**2.4.7 2006 Methane Emissions for U.S. Residential Buildings Energy Production, by Fuel Type (MMT CO2 Equivalent) (1)**

Fuel Type	
Petroleum	1.0
Natural Gas	30.8
Coal	0.0
Wood	2.3
Electricity (2)	38.2
<b>Total</b>	<b>72.3</b>

Note(s): 1) Sources of emissions include oil and gas production, processing, and distribution; coal mining; and utility and site combustion. Carbon Dioxide equivalent units are calculated by converting methane emissions to carbon dioxide emissions (methane's global warming potential is 23 times that of carbon dioxide). 2) Emissions of electricity generators attributable to the buildings sector.

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 2006, Nov. 2007, Table 15, p. 22 for energy production emissions; EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, April 2008, Table 3-16, p. 3-25 for stationary combustion emissions; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for energy consumption.

**2.4.8 Characteristics of U.S. Construction Waste**

- Two to seven tons of waste (a rough average of four pounds of waste per square foot) are generated during the construction of a new single-family detached house.
- 15 to 70 pounds of hazardous waste are generated during the construction of a detached, single-family house. Hazardous wastes include paint, caulk, roofing cement, aerosols, solvents, adhesives, oils, and greases.
- Each year, U.S. builders produce between 30 and 35 million tons of construction, renovation, and demolition (C&D) waste.
- Annual C&D debris accounts for roughly 24% of the municipal solid waste stream.
- Wastes include wood (27% of total) and other (73% of total, including cardboard and paper; drywall/plaster; insulation; siding; roofing; metal; concrete, asphalt, masonry, bricks, and dirt rubble; waterproofing materials; and landscaping material).
- As much as 95% of buildings-related construction waste is recyclable, and most materials are clean and unmixed.

Source(s): First International Sustainable Construction Conference Proceedings, Construction Waste Management and Recycling Strategies in the U.S., Nov. 1994, p. 689; Fine Homebuilding, Construction Waste, Feb./Mar. 1995, p. 70-75; NAHB, Housing Economics, Mar. 1995, p. 12-13; and Cost Engineering, Cost-Effective Waste Minimization for Construction Managers, Vol. 37/No. 1, Jan. 1995, p. 31-39.

**2.4.9 Typical Construction Waste Estimated for a 2,000 Square-Foot Home (1)**

<u>Material</u>	<u>Weight (pounds)</u>		<u>Volume (cu. yd.) (2)</u>
Solid Sawn Wood	1,600	20%	6
Engineered Wood	1,400	18%	5
Drywall	2,000	25%	6
Cardboard (OCC)	600	8%	20
Metals	150	2%	1
Vinyl (PVC) (3)	150	2%	1
Masonry (4)	1,000	13%	1
Hazardous Materials	50	1%	-
Other	1,050	13%	11
<b>Total (5)</b>	<b>8,000</b>	<b>100%</b>	<b>50</b>

Note(s): 1) See Table 2.2.7 for materials used in the construction of a new single-family home. 2) Volumes are highly variable due to compressibility and captured air space in waste materials. 3) Assuming 3 sides of exterior clad in vinyl siding. 4) Assuming a brick veneer on home's front facade. 5) Due to rounding, sum does not add up to total.

Source(s): NAHB, Residential Construction Waste: From Disposal to Management, Oct. 1996, [www.nahb.org](http://www.nahb.org).

**2.5.1 2006 Five Largest Residential Homebuilders**

<u>Homebuilder</u>	<u>Number of Home Closings (1)</u>	<u>Gross Revenue (\$million)</u>	<u>Market Share of Total New Home Closings (%) (2)</u>
D.R. Horton	53,410	15,016	5.0%
Pulte Homes	49,568	16,267	4.7%
Lennar Homes	41,487	14,274	3.9%
Centex Corporation	37,539	14,400	3.5%
KB Home	32,124	11,004	3.0%
<b>Total of Top Five</b>	<b>214,128</b>	<b>70,961</b>	<b>20.2%</b>
Habitat for Humanity (3)	4,862	357	0.5%

Note(s): 1) 2006 total U.S. new home closings were 1.06 million (only single-family). 2) Total share of closings of top 20 builders was 35%. Total share of the top 100 builders was 47%. 3) Habitat for Humanity built more than 400 homes during the week of May 31, 2007; Habitat for Humanity has built over 1,000 homes in the New Orleans area since Hurricane Katrina. Habitat for Humanity's 2,100 worldwide affiliates have completed more than 200,000 homes since 1976, providing more than 1,000,000 with housing.

Source(s): Builder Magazine, May 2007, Builder 100; e-mail correspondence with Habitat for Humanity for relevant data, Aug. 2007; and Habitat for Humanity, <http://www.habitat.org/>, for note 3.

**2.5.2 Value of New Building Construction, by Year (\$2006 Billion)**

	<u>Residential</u>	<u>GDP</u>
1980	154.4	6,013
1985	198.5	7,053
1990	194.1	8,286
1995	166.9	9,357
2000	258.0	11,437
2003	341.6	12,114
2004	411.8	12,437
2005	473.6	12,819
2006	462.3	13,187

Source(s): DOC, Current Construction Reports: Value of New Construction Put in Place, C30, Aug. 2003, Table 1 for 1980-1990; DOC, Annual Value of Construction Put in Place, July 2007 for 1995-2006; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**2.6.1 Value of Residential Building Improvements and Repairs, by Sector (\$2006 Billion) (1)**

	<u>Improvements</u>	<u>Maintenance and Repairs</u>	<u>Total</u>
1980	67.2	32.7	99.9
1985	76.5	60.7	137.2
1990	85.1	79.7	164.8
1995	98.6	59.5	158.1
2000	129.0	49.2	178.2
2003	145.4	48.3	193.7
2004	157.4	53.9	211.3
2005	166.7	55.6	222.3
2006	174.8	53.4	228.2

Note(s): 1) Improvements includes additions, alterations, reconstruction, and major replacements. Repairs include maintenance.

Source(s): DOC, Expenditures for Residential Improvements and Repairs by Property Type, Quarterly, May 2005 for 1980-1990; DOC, Current Construction Reports: Expenditures for Nonresidential Improvements and Repairs: 1992, CSS/92, Sept. 1994, Table A, p. 2 for 1986-1990 expenditures; DOC, 1997 Census of Construction Industries: Industry Summary, Jan. 2000, Table 7, p. 15; DOC, Annual Value of Private Construction Put in Place, May 2008 for 1995-2006; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for GDP and price deflators.

**2.6.2 2005 Professional and Do-It-Yourself Improvements, by Project (\$2006)**

<u>Repair/Improvement</u>	<u>Professional Installation</u>			<u>Do-It-Yourself Installation</u>		
	<u>Homeowners</u>	<u>Total</u>	<u>Mean</u>	<u>Homeowners</u>	<u>Total</u>	<u>Mean</u>
	<u>(millions)</u>	<u>(\$billion)</u>	<u>(\$)</u>	<u>(thousands)</u>	<u>(\$billion)</u>	<u>(\$)</u>
Disaster Repairs	0.61	9.0	14,398	0.20	1.3	6,698
Kitchen Remodeled	1.13	13.4	11,550	1.05	5.7	5,411
Additions Built	1.27	30.4	23,212	1.38	9.3	6,767
Bathroom Remodeled or Added	1.13	8.8	7,527	1.34	3.8	2,852
Exterior Improvements	3.85	23.7	5,983	3.11	7.9	2,527
Siding Replaced or Added	0.82	5.3	6,322	0.39	1.0	2,583
Roof Replacement	2.67	14.5	5,281	0.81	1.9	2,366
HVAC Replacement	2.44	7.3	2,895	0.51	1.5	2,909
Windows/Doors Installed	2.53	7.8	2,995	1.72	2.6	1,501
Flooring/Paneling/Ceiling Replacement	4.65	12.7	2,661	3.48	4.2	1,221
Electric System Replacement	1.35	1.6	1,144	0.89	0.4	451
Plumbing Replacement	0.84	1.5	1,726	2.08	1.0	467
Insulation Added	0.59	1.4	2,361	0.72	1.1	1,513
Appliance/Major Equipment Replacement	3.59	2.4	657	2.49	1.0	385

Note(s): Expenditures are \$39.1 billion higher in Table 2.6.1. This discrepancy is due to sampling methods used by HUD for the American Housing Survey and DOC in the Survey of Expenditures for Residential Improvements and Repairs.

Source(s): Joint Center for Housing Studies of Harvard University, Improving America's Housing 2007, Feb. 2007, Table A-2, p. 28.

**2.6.3 Single-Family Residential Renovations, by Project and Vintage**

	<u>Year Home was Built</u>					
	<u>Pre-1946</u>	<u>1946-60</u>	<u>1961-73</u>	<u>1974-80</u>	<u>1981-98</u>	<u>1999 or later</u>
Kitchen Remodeled	60%	57%	54%	60%	44%	8%
Bathroom Remodeled	59%	52%	59%	55%	40%	4%
Add Room(s)	29%	18%	14%	24%	21%	15%
Exterior Improvement	21%	15%	15%	16%	9%	4%
Basement Room Finished	14%	10%	6%	12%	16%	65%
Redesign/Restructure	14%	8%	11%	10%	5%	4%
Bathroom Added	8%	7%	6%	7%	6%	27%
Sun room Added	4%	6%	3%	4%	5%	8%

Note(s): Data based on a nationwide study of 819 consumers who remodeled their homes in the past 12 months or will in the next 12 months.

Source(s): Professional Remodeler, Consumer Research: What Consumers Want, Sept. 2002, p.44-50.



**2.6.4 2007 National Professional Remodeling Cost and Amount Recouped in Resale Value (\$Thousand)**

<u>Envelope</u>	<u>Job Cost</u>	<u>Resale Value</u>	<u>Cost Recouped</u>
Siding Replacement - Vinyl	9.9	8.2	83%
Siding Replacement - Foam-backed vinyl	12.1	9.7	80%
Siding Replacement - Fiber-cement	13.2	11.6	88%
Window Replacement - Vinyl	10.4	8.3	79%
Window Replacement - Wood	11.4	9.2	81%
Roofing Replacement - Asphalt	18.0	12.2	67%
Roofing Replacement - Steel	33.2	21.8	66%
<u>Remodel</u>			
Minor Kitchen Remodel	21.2	17.6	83%
Major Kitchen Remodel	55.5	43.4	78%
Bathroom Remodel	15.8	12.4	78%
Attic Bedroom Remodel	46.7	35.8	77%
Basement Remodel	59.4	44.7	75%
Home Office Remodel	27.2	15.5	57%
<u>Additions</u>			
Deck Addition - Wood	10.3	8.8	85%
Deck Addition - Composite	15.0	11.7	78%
Bathroom Addition	37.2	24.6	66%
Garage Addition	53.9	37.5	70%
Sunroom Addition	69.8	41.2	59%
Family Room Addition	79.0	54.1	69%
Master Suite Addition	98.9	68.2	69%
Two-Story Addition	139.3	103.0	74%
Back-Up Power Generator	13.4	7.7	58%

Note(s): Job cost includes labor, material, subtrades, contractor overhead and profit. Resale value based on a survey of appraisers, sales agents, and brokers. The survey asked for the estimated increase in resale value of standardized remodeling projects. Definitions of remodeling projects are available at [costvalue.remodelingmagazine.com](http://costvalue.remodelingmagazine.com)

Source(s): © 2007 Hanley Wood, LLC. Reproduced by permission. Complete regional and city data from the Remodeling 2007 Cost vs. Value Report can be downloaded for free at [costvalue.remodelingmagazine.com](http://costvalue.remodelingmagazine.com).

**2.7.1 Delivered Energy Consumption Intensities of Public Multi-Family Buildings, by Fuel and Region (Thousand Btu/SF)**

<u>Region</u>	<u>Electricity</u>	<u>Natural Gas</u>	<u>Fuel Oil</u>	<u>Total</u>
Northeast	27.7	45.9	39.9	71.5
Midwest	22.5	49.9	N.A.	70.3
South	53.5	27.9	N.A.	65.9
West	22.0	25.3	N.A.	46.2
<b>National Average</b>	<b>33.0</b>	<b>43.4</b>		<b>68.3</b>

Source(s): HUD, Benchmarking Utility Usage in Public Housing, December 2007, <http://www.hud.gov/offices/pih/programs/ph/phecc/finbnchrpt.doc>.

**2.7.2 Delivered Energy Consumption Intensities of Public Multi-Family Buildings, by Fuel and Region (Million Btu/Household)**

<u>Region</u>	<u>Electricity</u>	<u>Natural Gas</u>	<u>Fuel Oil</u>	<u>Total</u>
Northeast	21.2	34.9	36.2	54.7
Midwest	16.6	36.6	N.A.	51.8
South	39.4	20.0	N.A.	48.5
West	16.6	19.3	N.A.	34.8
<b>National Average</b>	<b>24.6</b>	<b>32.2</b>		<b>51.0</b>

Source(s): HUD, Benchmarking Utility Usage in Public Housing, December 2007, <http://www.hud.gov/offices/pih/programs/ph/phecc/finbnchrpt.doc>.

**2.8.1 2007 Top Five Manufacturers of Factory-Built Housing Units (1)**

<u>Company</u>	<u>Units Produced</u>	<u>Gross Sales Volume (\$million)</u>	<u>Market Share of Top 25 Company Sales (2)</u>
CMH Manufacturing	31,100	1,327.8	20%
Champion Enterprises, Inc.	21,126	1,286.6	19%
Palm Harbor Homes, Inc.	8,911	679.1	10%
Fleetwood Enterprises, Inc.	15,137	600.0	9%
Skyline Corporation	8,207	376.4	6%

Note(s): 1) Data based on mail-in surveys from manufacturers which may not be entirely complete. 2) Market shares based on total gross sales volume of the factory-built home producers included in the list of the top 25 factory-built producers responding to the survey. In 2007, surveyed factory-built home sales were estimated at \$6.6 billion and 133,361 units.

Source(s): HousingZone.com, 2007 Factory Built Housing Results, <http://www.housingzone.com/factory.html>.

**2.8.2 2007 Top Five Manufacturers of Modular/3D Housing Units (1)**

<u>Company</u>	<u>Units Produced</u>	<u>Gross Sales Volume (\$million)</u>	<u>Market Share of Top 25 Company Sales (2)</u>
Champion Enterprises, Inc.	4,653	438.7	27%
CMH Manufacturing	3,200	228.8	14%
All American Homes, LLC	1,689	165.4	10%
Palm Harbor Homes, Inc.	1,614	162.9	10%
Excel Homes LLC	1,200	110.6	7%

Note(s): 1) Data based on mail-in surveys from manufacturers, which may not be entirely complete. 2) Market shares based on total gross sales volume of the Modular/3D home producers included in the list of the top 25 factory-built producers responding to the survey. In 2007, surveyed Modular/3D home sales were estimated at \$1.6 billion and 20,601 units.

Source(s): HousingZone.com, 2007 Factory Built Housing Results, <http://www.housingzone.com/factory.html>.

**2.8.3 2007 Top Five Manufacturers of HUD-Code (Mobile) Homes (1)**

<u>Company</u>	<u>Units Produced</u>	<u>Gross Sales Volume (\$million)</u>	<u>Market Share of Top 25 Company Sales (2)</u>
CMH Manufacturing	27,900	1,099	23%
Champion Enterprises, Inc.	16,473	848	18%
Fleetwood Enterprises, Inc.	15,137	600	12%
Palm Harbor Homes	7,297	516	11%
Skyline Corporation	8,207	376	8%

Note(s): 1) Data based on mail-in surveys from manufacturers, which may not be entirely complete. 2) Market shares based on total gross sales volume of the HUD-Code home producers included in the list of the top 25 factory-built producers responding to the survey. In 2007, surveyed HUD-Code home sales were estimated at \$4.83 billion and 109,320 units.

Source(s): HousingZone.com, 2007 Factory Built Housing Results, <http://www.housingzone.com/factory.html>.

**2.8.4 2004 Top Five Manufacturers of Factory-Fabricated Components (Trusses, Wall Panels, Doors) (1)**

<u>Company</u>	<u>Gross Sales Volume (\$million)</u>	<u>Market Share of Top 26 Company Sales (2)</u>	<u>Number of Employees (3)</u>
Carpenter Contractors	175.0	26%	1,130
Automated Building Company	102.5	15%	702
Landmark Truss	45.0	7%	425
Southern Building Products	25.9	4%	180
Dolan Lumber & Truss	25.1	4%	260

Note(s): 1) Data based on mail-in surveys from manufacturers, which may not be entirely complete. 2) Market shares based on total gross sales volume of producers of only components included in the list of the top 26 IH producers responding to the survey. In 2004, surveyed component sales was estimated at \$665.1 million. 3) The top 26 companies employ over 4,970 people at their plants.

Source(s): Automated Builder Magazine, Sept. 2005, p. 40-41.

**2.8.5 2004 Number of Industrialized Housing Manufacturers Versus Production Companies (Stick-Builders)**

<u>Type</u>	<u>Number of Companies</u>
Panelized	3,500
Modular (1)	200
HUD-Code	90
Production Builders	7,000
Component Manufacturers	2,200
Special (Commercial) Units	170

Note(s): 1) 170 of these companies also produce panelized homes.

Source(s): Automated Builder Magazine, Mar. 2005, p. 34-35; Automated Builder Magazine, Jan. 2004, p. 16 for Note 1.

**2.9.1 Program Definitions**

**DOE Weatherization:** Department of Energy's Weatherization Assistance Program

**DOE Weatherization Eligible Households:** Households with incomes at or below 125% of the Federal poverty level, which varies by family size; however, a State may instead elect to use the LIHEAP income standard if its State LIHEAP income standard is at least 125% of the Federal poverty level. Data listed in this chapter include previously weatherized units. DOE Weatherization Eligible Households are a subset of Federally Eligible Households.

**DOE Weatherization Recipient Households:** Households that have received weatherization under DOE Weatherization funding.

**Federally Eligible Households:** Households with incomes below the Federal maximum standard of 150% to 200% of the poverty line or 60% of the State median income, whichever is higher.

**HHS:** Department of Health and Human Services

**LIHEAP:** HHS's Low-Income Home Energy Assistance Program

**LIHEAP Eligible Households:** Households with incomes below the Federal maximum poverty income level, i.e., 150% of the Federal poverty guidelines or 75%(1) of State median income, whichever is higher.

**LIHEAP Recipient Households:** Households that received fuel subsidies for home heating, cooling, or energy crisis benefits in the year previous to a particular household survey.

Note(s): 1) For fiscal year 2009 only; normally 60%.

Source(s): ORNL, Scope of the Weatherization Assistance Program: Profile of the Population in Need, Mar. 1994, p. 1.2 for Weatherization eligible, Weatherization recipient, and LIHEAP eligible households; EIA, Housing Characteristics 1993, June 1995, p. 336 for Federally eligible for weatherization; HHS, LIHEAP Report to Congress FY 2001, Feb. 2003, Table E-1, p. 105 and Figure 1, p. iii for LIHEAP recipient household; Department of Energy, What is the Weatherization Program, p. 2, February 2009; U.S Department of Health and Human Services, Low Income Home Energy Assistance Program Guidance, Policy, and Procedures, February 2009.

**2.9.2 Energy Burden Definitions**

Energy burden is an important statistic for policy makers who are considering the need for energy assistance. Energy burden can be defined broadly as the burden placed on household incomes by the cost of energy, or more simply, the ratio of energy expenditures to household income. However, there are different ways to compute energy burden, and different interpretations and uses of the energy burden statistics. DOE Weatherization primarily uses mean individual burden and mean group burden since these statistics provide data on how an "average" individual household fares against an "average" group of households (that is, how burdens are distributed for the population). DOE Weatherization (and HHS) also uses the median individual burden which shows the burden of a "typical" individual.

**Mean Individual Burden:** This statistic is calculated by first computing the energy burden for each household using RECS data and then taking a mean of the household-level energy burden estimates. It furnishes the most complete information about how a burden is distributed for the population.

**Mean Group Burden:** This statistic calculates energy expenditures for all households in the group and divides by the average of all incomes for the group. This statistic is calculated as the ratio between aggregate energy expenditures of a group (from RECS and CPS) and aggregate group income (from CPS).

**Median Individual Burden:** This statistic is computed by taking a median of the RECS household-level energy burden estimates (the point at which 50% of households have a higher burden value and 50% have a lower value).

Source(s): HHS, LIHEAP Report to Congress FY 2000, Apr. 2002, p. 45 for energy burden definition; HHS, Characterizing the Impact of Energy Expenditures on Low-Income Households: An Analysis of Alternative National Energy Burden Statistics, Nov. 1994, p. vii and ix for burdens; and ORNL, Scope of the Weatherization Assistance Program: Profile of the Population in Need, Mar. 1994, p. xii for mean individual and mean group burdens.

**2.9.3 Households, by Weatherization Eligibility and Year (Million) (1)**

	Weatherization Recipient			Federally	Federally	Below 125%	Total
	<u>DOE</u>	<u>Other</u>	<u>Total</u>	<u>Eligible (2)</u>	<u>Ineligible</u>	<u>Poverty Line</u>	<u>Households</u>
1977	0.03	-	0.03	N.A.	N.A.	N.A.	74.8
1980	0.18	-	0.18	N.A.	N.A.	N.A.	79.6
1985	0.13	0.17	0.30	N.A.	N.A.	N.A.	87.9
1987	0.10	0.21	0.31	N.A.	N.A.	18.2	90.5
1990	0.09	0.16	0.25	27.9	66.1	18.2	94.2
1991	0.11	0.13	0.23	N.A.	N.A.	N.A.	95.3
1992	0.11	0.12	0.22	N.A.	N.A.	N.A.	96.4
1993	0.09	0.12	0.21	30.7	65.9	19.4	96.6
1994	0.10	0.15	0.25	N.A.	N.A.	N.A.	98.7
1995	0.10	0.13	0.23	N.A.	N.A.	N.A.	100.0
1996	0.06	0.09	0.15	N.A.	N.A.	N.A.	101.0
1997	0.07	0.08	0.15	34.1	67.4	19.7	101.5
1998	0.07	0.09	0.16	N.A.	N.A.	N.A.	102.8
1999	0.07	0.09	0.16	N.A.	73.2	N.A.	104.1
2000	0.08	0.11	0.19	N.A.	N.A.	N.A.	105.2
2001	0.08	0.13	0.20	33.8	73.2	20.1	107.0
2002	0.10	0.10	0.20	N.A.	N.A.	N.A.	110.5
2003	0.10	0.09	0.19	N.A.	N.A.	N.A.	112.0
2004	0.10	0.07	0.17	N.A.	N.A.	N.A.	113.6
2005	0.09	0.08	0.17	N.A.	N.A.	N.A.	115.4
<b>1977-2005</b>	<b>2.91</b>	<b>2.93</b>	<b>5.84</b>	<b>N.A.</b>	<b>N.A.</b>	<b>N.A.</b>	<b>N.A.</b>

Note(s): 1) Year of receiving funding follows DOE Weatherization's Program Year of Apr. 1-Mar. 31. 2) Federally eligible for DOE and HHS (LIHEAP) Weatherization. Includes previously weatherized units.

Source(s): DOE for weatherization recipients; EIA, Housing Characteristics 1987, May 1989, Table 9, p. 20 for 1987 data; EIA, Housing Characteristics 1990, May 1992, Table 17, p. 54-55 for 1990 data; EIA, Housing Characteristics 1993, June 1995, Table 3.3a, p. 38-42 for 1993 data; EIA, Annual Energy Outlook (AEO) 1996, Jan. 1996, Table A4, p. 82-83 for 1992 and 1994 households; EIA, AEO 1998, Dec. 1997, Table A4, p. 106-107 for 1995-1996 households; EIA, AEO 2001, Dec. 2000, Table A4, p. 133-134 for 1998-2000 households; EIA, AEO 2005, Feb. 2005, Table A4, p. 125-126 for 2002 households; EIA, AEO 2006, Feb. 2006, Table A4, p. 139-140 for 2003-2004 households; EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table HC1-3a, p. 38-39; EIA, RECS 1997 for eligible households; EIA, Residential Energy Consumption 2001, Apr. 2004, Table HC2-3a for 2001 eligible households; National Association for State Community Services programs: Weatherization Assistance Program PY 2005 Funding Survey for 2005 data; EIA, RECS 2001 for eligible households; and DOC, Income, Poverty, and Valuation of Noncash Benefits: 1994, Apr. 1996, Table B-1, for 1991 households.

**2.9.4 Weatherization Population Facts**

- Roughly 25% of Federally eligible households move in and out of poverty "classification" each year.
- The average income of Federally eligible households in FY 2005 was \$16,264, based on RECS and Bureau of the Census' Current Population Survey (CPS) data.
- States target the neediest, especially the elderly, persons with disabilities, and families with children.
- Since the inception of the Weatherization Assistance Program in 1976, over 5.8 million households have received weatherization services.
- In FY 2005, the energy burden on Federally eligible households was more than four and a half times the burden on Federally ineligible households (14.6% versus 3.2%).
- DOE weatherization saves an average of 13-34% on home energy bills (depending on main heating fuel). This equates to \$1.54 in energy benefits being produced for every \$1.00 invested. These services reduce average annual energy costs by \$358 per household.

Note(s): For weatherization eligibility terminology, see Table 7.1.10. For acronyms, see Key Terminology.

Source(s): ORNL, Weatherization Works: Final Report on the National Weatherization Evaluation, Sept. 1994, p. 1 for migrating poor; ORNL, 1996 for targeting; HHS, LIHEAP Home Energy Notebook for FY 2005, May 2007, Table A-2a, p. 59 for Federally eligible average income and Table A-2b, p. 60 for energy burdens; ORNL, Progress Report of the National Weatherization Assistance Program, Sept. 1997, DOE, Weatherization Works, Progress Report of the National Weatherization Assistance Program, Feb. 1998; and EERE/OWIP, Weatherization Assistance Program Briefing Book, May 2006 for weatherization savings.

**2.9.5 Weatherization Program Facts**

- PY 2005 weatherization funding breakdown: DOE 36%, LIHEAP 36%, others 28%. (1)
- The Federal Government's outlay for fuel subsidies runs from \$4.0 to 4.4 billion per year. The major two agencies dispensing fuel subsidies are HUD and HHS (through LIHEAP).
- HUD spends over \$1.48 billion annually to pay all or part of the total utility bills (including water/sewer) for 1.2 million low-income households. Approximately 22% of public housing authorities' expenditures are for utilities (including water). In addition, HUD estimates tenant expenditures on utilities (excluding water) at about \$278 million in 1997.
- LIHEAP spends 85% of its funding on direct fuel subsidies and weatherization. Up to 15% can be spent for weatherization activities and the remainder is spent on fuel subsidies. A maximum of 25% of funding is available for weatherization activities if HHS approves a waiver. LIHEAP weatherization funding has ranged from 8-19% of total LIHEAP funds. Since 2002, LIHEAP weatherization funding has been about 12% of total funds.

Note(s): 1) Program year is Apr. 1 - Mar. 31.

Source(s): National Association for State Community Services programs: Weatherization Assistance Program PY 2005 Funding Survey for spending; HHS, LIHEAP Report to Congress FY 1995, Aug. 1997, p. vii for LIHEAP weatherized households and Table 5, p. 15 for LIHEAP cost splits; HUD, Public Housing Operating Cost Study, June 2003, p. 67-68 for public housing utility costs; and HUD, Congressional Justifications for 2007 Estimates: Public Housing Operating Fund, Mar. 2006 for HUD spending.

**2.9.6 Weatherization Costs and Savings**

- DOE Weatherization program requires that States spend no more than an average of \$2,885 per household in PY 2007. All States are using energy audits to determine the most cost-effective weatherization measures.
- In spite of funding reductions that reduced production, technical advances have produced 80% higher energy savings on a per-dwelling basis. Increases in energy savings were achieved through improvements in: diagnostic technology and techniques, weatherization materials and installation techniques, training, and audit tools.
- DOE weatherization creates an average energy savings of \$358 per household, reduces household annual gas heating consumption 31% with a benefit-cost ratio of 1.53.

Source(s): EERE/OWIP, Weatherization Program Notice 07-1, Dec. 1, 2006 for average expenditures; ORNL, Weatherization Plus Progress Report: Poised to Move Forward, June 2001; and EERE/OWIP, Weatherization Assistance Program Briefing Book, May 2007 for savings.

**2.9.7 Residential Energy Burdens, by Weatherization Eligibility and Year**

	1987		1990		FY 2000 (1)			FY 2005 (2)		
	Mean	Group	Mean	Group	Mean	Mdn	Group	Mean	Mdn	Group
	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl
Total U.S. Households	4.0%		6.8%	3.2%	6.1%	3.5%	2.4%	6.8%	3.7%	2.9%
<b>Federally Eligible</b>	<b>13.0%</b>		<b>14.4%</b>	<b>10.1%</b>	<b>12.1%</b>	<b>7.9%</b>	<b>7.7%</b>	<b>14.6%</b>	<b>8.6%</b>	<b>9.1%</b>
Federally Ineligible	4.0%		3.5%	N.A.	3.0%	2.6%	2.0%	3.2%	2.8%	2.3%
Below 125% Poverty Line	13.0%		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Note(s): 1) Data are derived from RECS 1997, adjusted to reflect FY 2000 HDD, CDD, and fuel prices. 2) Data are derived from RECS 2001, adjusted to reflect FY 2004 HDD, CDD, and fuel prices.

Source(s): EIA, Household Energy Consumption and Expenditures 1987, Oct. 1989, Table 13, p. 48-50 for 1987 mean group burdens; ORNL, The Scope of the Weatherization Program: Profile of the Population in Need, Mar. 1994, p. xi. for 1990 Federally ineligible mean individual burden; HHS, Characterizing the Impact of Energy Expenditures on Low-Income Households: An Analysis of Alternative National Energy Burden Statistics, Nov. 1994, p. viii for 1990 total U.S. Households and Federally eligible burdens; HHS, LIHEAP Home Energy Notebook for FY 2000, Apr. 2000, Tables A-2a, A-2b, and A-2c, p. 48-50 for FY 2000; and HHS, LIHEAP Home Energy Notebook for FY 2005, May 2007, Tables A-2a, A-2b, and A-2c, p. 59-61.

**2.9.8 FY 2005 Residential Energy Burdens, by Region (1)**

	Northeast			South			Midwest			West		
	Mean	Mdn	Group	Mean	Mdn	Group	Mean	Mdn	Group	Mean	Mdn	Group
	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl	Indvdl
Total U.S. Households	8.9%	4.6%	3.3%	7.1%	3.9%	3.0%	6.6%	3.8%	3.1%	4.7%	2.8%	2.0%
<b>Federally Eligible</b>	<b>18.9%</b>	<b>10.2%</b>	<b>10.6%</b>	<b>15.7%</b>	<b>9.6%</b>	<b>9.9%</b>	<b>14.3%</b>	<b>8.9%</b>	<b>10.0%</b>	<b>9.4%</b>	<b>5.4%</b>	<b>6.0%</b>
Federally Ineligible	3.8%	3.4%	2.6%	3.2%	2.9%	2.5%	3.3%	3.0%	2.4%	2.5%	2.2%	1.7%

Note(s): 1) Data are derived from RECS 2001, adjusted to reflect FY 2004 HDD, CDD, and fuel prices.

Source(s): HHS, LIHEAP Home Energy Notebook for FY 2005, May 2007, Tables A-2a, A-2b, and A-2c, p. 59-61.

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**2.9.9 2005 Housing Unit Ownership, by Income Level and Weatherization Eligibility (in Millions)**

2005 Household Income	Single-Family		Multi-Family Unit		Mobile Home	
	Own	Rent	Own	Rent	Own	Rent
Less than \$15,000	6.1	2.4	0.3	7.1	1.6	N.A.
\$15,000 to \$30,000	11.0	3.0	0.4	5.8	2.2	0.3
\$30,000 to \$49,999	15.7	2.5	N.A.	3.9	1.2	N.A.
All Households	67.9	10.9	1.8	20.1	5.6	0.3
<b>Federally Eligible</b>	<b>15.7</b>	<b>5.9</b>	<b>1.4</b>	<b>11.7</b>	<b>3.1</b>	<b>0.8</b>
Federally Ineligible	52.5	5.6	2.7	8.6	2.6	0.4
Below 100% Poverty Line	5.3	2.5	0.8	6.1	1.5	0.4

Source(s): EIA, 2005 Residential Energy Consumption Survey: Housing Characteristics Tables, June 2008, Table HC 3-3 and Table HC 4-3.

**2.9.10 2005 Average Energy Expenditures per Household Member and per Square Foot, by Weatherization Eligibility (\$2006)**

	Per Household Member		Members/ Hhold		Per Square Foot		Square Feet/ Hhold	
Total U.S. Households	729		2.6		0.87		2,171	
<b>Federally Eligible</b>	<b>604</b>		<b>2.7</b>		<b>1.01</b>		<b>1,598</b>	
Federally Ineligible	800		2.5		0.81		2,475	
Below 100% Poverty Line	564		2.7		1.09		1,400	

Source(s): EIA, 2005 Residential Energy Consumption Survey: Household Energy Consumption and Expenditures Tables, Oct. 2008, Table US1 part2.



Chapter 3 contains information related to the Commercial Sector. Energy consumption, expenditure data, and environmental impacts related to energy consumption and construction activity are also examined. The remaining sections provide data on specific building types such as offices, hotels, and education facilities.

The following pieces of information give some insight into general trends in the Commercial Sector:

- Floor space devoted to commercial activity totaled 74.8 billion square feet in 2006. Commercial floor space is expected to reach 100.8 billion square feet by 2030.
- Commercial floor space located in the south represents 37 percent of the total floor space, the largest amount of any region.
- In 2006, lighting used 24.8 percent of primary energy attributed to the commercial sector. This is approximately twice the energy used for space cooling, the next closest end-use.
- Lighting accounts for 42 percent of a commercial building's cooling load.
- In 2003, the most energy intensive buildings were those related to food sales using 535.5 thousand Btus per square foot. The building type with the lowest energy intensity (excluding vacant buildings) was religious worship buildings using 77.0 Btu's per square foot.
- Electricity accounted for 74 percent of all energy expenditures in the commercial sector.
- 80 percent of all carbon dioxide attributed to the commercial sector comes from electricity consumption.
- The carbon dioxide attributed to the commercial sector is roughly equivalent to all the carbon dioxide emitted by Australia, New Zealand, and South Korea combined.
- In 2003, buildings devoted to office space consumed 19 percent of primary energy attributable to commercial buildings, the most of any building type.
- In 2003, 35 percent of all commercial floor space was found in only 2.2 percent of the commercial building stock.

- The most expensive city to operate a commercial building in terms of energy costs was New York City, where the average energy cost was \$3.99 per square foot annually.
- Hotels consumed on average 110 thousand Btus per square foot in 2003.
- The average price of electricity for a commercial consumer in 2006 was 9.5 cents per kWh.

**3.1.1 Commercial Primary Energy Consumption, by Year and Fuel Type (Quadrillion Btu and Percent of Total)**

	Natural Gas		Petroleum (1)		Coal		Renewable(2)		Electricity		Total(2)	Growth Rate 2006-Year		
	Quadrillion Btu	Percent	Quadrillion Btu	Percent	Quadrillion Btu	Percent	Quadrillion Btu	Percent	Sales	Losses			Total	
1980	2.67	25.2%	1.29	12.2%	0.12	1.1%	0.02	0.2%	1.91	4.60	6.51	61.4%	10.60	-
1990	2.70	20.2%	0.95	7.1%	0.12	0.9%	0.10	0.7%	2.86	6.62	9.48	71.0%	13.36	-
2000	3.25	18.9%	0.76	4.4%	0.09	0.5%	0.13	0.7%	3.96	9.00	12.96	75.4%	17.18	-
<b>2006</b>	<b>2.92</b>	<b>16.3%</b>	<b>0.68</b>	<b>3.8%</b>	<b>0.08</b>	<b>0.5%</b>	<b>0.16</b>	<b>0.9%</b>	<b>4.43</b>	<b>9.66</b>	<b>14.09</b>	<b>78.6%</b>	<b>17.93</b>	-
2010	3.04	16.2%	0.63	3.4%	0.08	0.4%	0.16	0.8%	4.73	10.12	14.85	79.1%	18.77	1.1%
2015	3.29	16.2%	0.67	3.3%	0.08	0.4%	0.16	0.8%	5.19	10.98	16.17	79.4%	20.37	1.4%
2020	3.47	15.8%	0.68	3.1%	0.08	0.4%	0.16	0.7%	5.67	11.96	17.63	80.1%	22.02	1.5%
2025	3.63	15.4%	0.68	2.9%	0.08	0.4%	0.16	0.7%	6.15	12.87	19.02	80.7%	23.58	1.5%
2030	3.78	15.1%	0.68	2.7%	0.08	0.3%	0.17	0.7%	6.62	13.68	20.30	81.2%	25.02	1.4%

Note(s): 1) Petroleum includes distillate and residual fuels, liquefied petroleum gas, kerosene, and motor gasoline.

2) Includes site -marketed and non-marketed renewable energy. 3) 2006 site -to-source electricity conversion = 3.18.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2005; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 and Table A17, p. 143-144 for non-marketed renewable energy.

**3.1.2 Commercial Site Renewable Energy Consumption (Quadrillion Btu) (1)**

	Wood (2)	Solar Thermal (3)	Solar PV(3)	GHP	Total	Growth Rate 2006-Year
1980	0.021	N.A.	N.A.	0.000	0.021	-
1990	0.094	N.A.	N.A.	0.003	0.096	-
2000	0.119	N.A.	N.A.	0.008	0.126	-
<b>2006</b>	<b>0.129</b>	<b>0.025</b>	<b>0.001</b>	<b>N.A.</b>	<b>0.155</b>	-
2010	0.129	0.025	0.003	N.A.	0.157	0.4%
2015	0.129	0.027	0.003	N.A.	0.159	0.3%
2020	0.129	0.027	0.005	N.A.	0.161	0.3%
2025	0.129	0.027	0.007	N.A.	0.164	0.3%
2030	0.129	0.028	0.010	N.A.	0.167	0.3%

Note(s): 1) Does not include renewable energy consumed by electric utilities (including hydroelectric). 2) Includes wood and wood waste, municipal solid waste, and other biomass used by the commercial sector to cogenerate electricity. 3) Includes only solar energy.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2005; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A17, p. 143-144 for 2006-2030.

**3.1.3 Commercial Delivered and Primary Energy Consumption Intensities, by Year**

	Percent		Delivered Energy Consumption		Primary Energy Consumption	
	Floorspace (million SF)	Post-2000 Floorspace (1)	Total (10 <sup>15</sup> Btu)	Consumption per SF (thousand Btu/SF)	Total (10 <sup>15</sup> Btu)	Consumption per SF (thousand Btu/SF)
1980	50.9	N.A.	6.00	117.8	10.60	208.2
1990	64.3	N.A.	6.73	104.8	13.36	207.8
2000	(2) 68.5	N.A.	8.18	119.4	17.18	250.8
<b>2006</b>	<b>(2) 74.8</b>	<b>15%</b>	<b>8.27</b>	<b>110.6</b>	<b>17.93</b>	<b>239.7</b>
2010	(2) 78.8	24%	8.64	109.7	18.77	238.1
2015	(2) 83.9	33%	9.40	112.0	20.37	242.8
2020	(2) 89.3	41%	10.06	112.7	22.02	246.7
2025	(2) 94.8	49%	10.71	112.9	23.58	248.6
2030	(2) 100.8	56%	11.34	112.5	25.02	248.3

Note(s): 1) Percent built after Dec. 31, 2000. 2) Excludes parking garages and commercial buildings on multi-building manufacturing facilities.

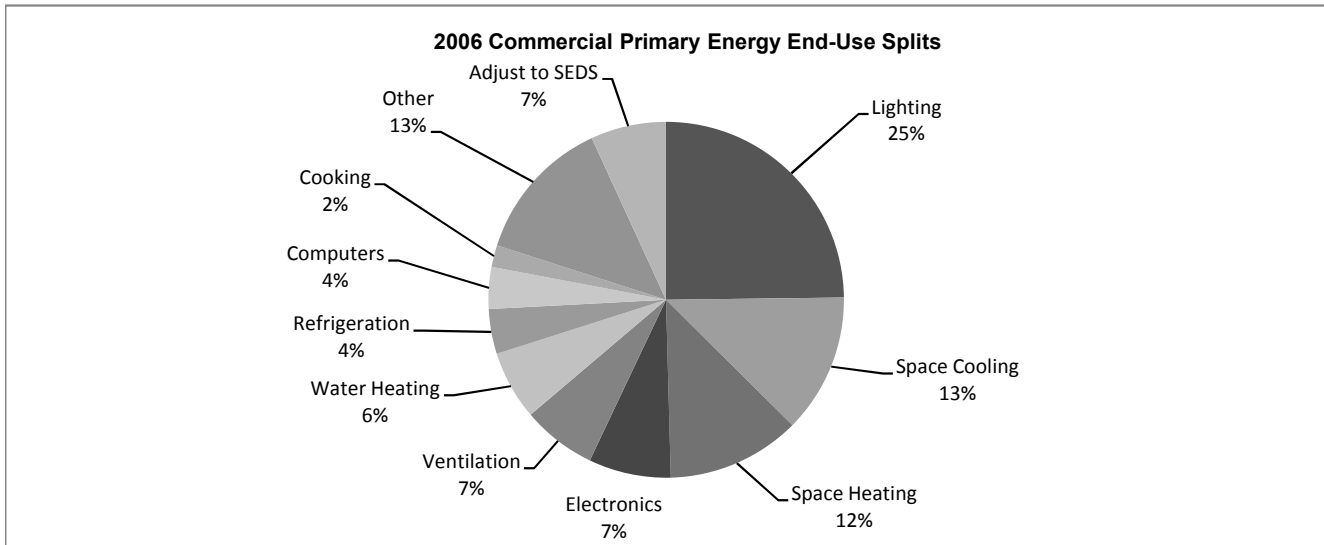
Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2000; DOE for 1980 floorspace; EIA, Annual Energy Outlook 1994, Jan. 1994, Table A5, p. 62 for 1990 floorspace; EIA, AEO 2003, Jan. 2003, Table A5, p. 127 for 2000 floorspace; and EIA, AEO 2008, Mar. 2008, Table A2, p. 117-119, Table A5, p. 124-125, and Table A17, p.143-144 for 2006-2030.

**3.1.4 2006 Commercial Energy End-Use Splits, by Fuel Type (Quadrillion Btu)**

	Natural Fuel		LPG	Other Fuel(2)	Renw. En.(3)	Site Electric	Site		Primary Electric (4)	Primary	
	Gas	Oil (1)					Total	Percent		Total	Percent
Lighting						1.40	1.40	16.9%	4.45	4.45	24.8%
Space Cooling	0.02					0.71	0.73	8.8%	2.25	2.27	12.6%
Space Heating	1.18	0.24		0.10		0.21	1.73	20.9%	0.65	2.17	12.1%
Electronics						0.42	0.42	5.1%	1.34	1.34	7.5%
Ventilation						0.38	0.38	4.6%	1.21	1.21	6.7%
Water Heating	0.55	0.05			0.02	0.16	0.78	9.4%	0.50	1.13	6.3%
Refrigeration						0.23	0.23	2.8%	0.73	0.73	4.1%
Computers						0.21	0.21	2.6%	0.68	0.68	3.8%
Cooking	0.23					0.04	0.27	3.3%	0.12	0.35	2.0%
Other (5)	0.27	0.03	0.08	0.05	0.13	0.57	1.12	13.6%	1.81	2.36	13.2%
Adjust to SEDS (6)	0.67	0.22				0.11	1.00	12.1%	0.34	1.23	6.9%
<b>Total</b>	<b>2.92</b>	<b>0.53</b>	<b>0.08</b>	<b>0.15</b>	<b>0.16</b>	<b>4.43</b>	<b>8.27</b>	<b>100%</b>	<b>14.09</b>	<b>17.93</b>	<b>100%</b>

Note(s): 1) Includes (0.42 quad) distillate fuel oil and (0.11 quad) residual fuel oil. 2) Kerosene (0.02 quad) and coal (0.08 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of (0.13 quad) biomass, (0.03 quad) solar water heating, and (less than 0.01 quad) solar PV. 4) Site -to-source electricity conversion (due to generation and transmission losses) = 3.18. 5) Includes service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 6) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Tables A2, p. 117-119, Table A5, p. 124-125, and Table A17, p. 143-144; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2 and 5-25 - 5-26; EIA, AEO 1998, Dec. 1997, Table A5, p. 108-109 for 1995 ventilation; and BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, Sept. 2002, Table 8-2, p. 63; EIA, Supplement to the AEO 2008, April 2008, Table 22.



**3.1.5 2010 Commercial Energy End-Use Splits, by Fuel Type (Quadrillion Btu)**

	Natural Fuel		LPG	Other Fuel(2)	Renw. En.(3)	Site Electric	Site		Primary Electric (4)	Primary	
	Gas	Oil (1)					Total	Percent		Total	Percent
Lighting						1.12	1.12	13.0%	3.53	3.53	18.8%
Space Heating	1.29	0.23		0.10		0.14	1.76	20.4%	0.43	2.06	11.0%
Electronics						0.55	0.55	6.4%	1.73	1.73	9.2%
Space Cooling	0.02					0.50	0.52	6.0%	1.56	1.58	8.4%
Water Heating	0.54	0.04			0.03	0.15	0.76	8.8%	0.48	1.09	5.8%
Computers						0.25	0.25	2.9%	0.80	0.80	4.3%
Refrigeration						0.23	0.23	2.7%	0.73	0.73	3.9%
Ventilation						0.19	0.19	2.2%	0.60	0.60	3.2%
Cooking	0.24					0.04	0.28	3.3%	0.12	0.36	1.9%
Other (5)	0.22	0.02	0.09	0.05	0.13	0.76	1.26	14.6%	2.38	2.89	15.4%
Adjust to SEDS (6)	0.73	0.19				0.79	1.71	19.7%	2.49	3.40	18.1%
<b>Total</b>	<b>3.04</b>	<b>0.48</b>	<b>0.09</b>	<b>0.15</b>	<b>0.16</b>	<b>4.73</b>	<b>8.64</b>	<b>100%</b>	<b>14.85</b>	<b>18.77</b>	<b>100%</b>

Note(s): 1) Includes (0.38 quad) distillate fuel oil and (0.10 quad) residual fuel oil. 2) Kerosene (0.02 quad) and coal (0.08 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of (0.13 quad) biomass, (0.03 quad) solar water heating, and (less than 0.01 quad) solar PV. 4) Site -to-source electricity conversion (due to generation and transmission losses) = 3.14. 5) Includes service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 6) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Tables A2, p. 117-119, Table A5, p. 124-125, and Table A17, p. 143-144; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; EIA, Supplement to the AEO 2008, April 2008, Table 22.

**3.1.6 2020 Commercial Energy End-Use Splits, by Fuel Type (Quadrillion Btu)**

	Natural Fuel		LPG	Other Fuel(2)	Renw. En.(3)	Site Electric	Site		Primary Electric (4)	Primary	
	Gas	Oil (1)					Total	Percent		Total	Percent
Lighting						1.22	1.22	12.1%	3.79	3.79	17.2%
Electronics						0.79	0.79	7.9%	2.46	2.46	11.2%
Space Heating	1.40	0.25		0.10		0.14	1.90	18.8%	0.45	2.20	10.0%
Space Cooling	0.02					0.55	0.57	5.6%	1.70	1.72	7.8%
Water Heating	0.65	0.05			0.03	0.16	0.89	8.8%	0.50	1.23	5.6%
Computers						0.30	0.30	3.0%	0.93	0.93	4.2%
Refrigeration						0.25	0.25	2.5%	0.79	0.79	3.6%
Ventilation						0.21	0.21	2.1%	0.65	0.65	3.0%
Cooking	0.29					0.04	0.33	3.3%	0.12	0.41	1.8%
Other (5)	0.28	0.02	0.09	0.05	0.13	1.13	1.70	16.9%	3.51	4.09	18.6%
Adjust to SEDS (6)	0.83	0.20				0.88	1.90	18.9%	2.74	3.76	17.1%
<b>Total</b>	<b>3.47</b>	<b>0.52</b>	<b>0.09</b>	<b>0.15</b>	<b>0.16</b>	<b>5.67</b>	<b>10.06</b>	<b>100%</b>	<b>17.63</b>	<b>22.02</b>	<b>100%</b>

Note(s): 1) Includes (0.41 quad) distillate fuel oil and (0.10 quad) residual fuel oil. 2) Kerosene (0.02 quad) and coal (0.08 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of (0.16 quad) biomass, (0.03 quad) solar water heating, and (less than 0.01 quad) solar PV. 4) Site -to-source electricity conversion (due to generation and transmission losses) = 3.11. 5) Includes service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 6) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Tables A2, p. 117-119, Table A5, p. 124-125, and Table A17, p. 143-144; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; EIA, Supplement to the AEO 2008, April 2008, Table 22.

**3.1.7 2030 Commercial Energy End-Use Splits, by Fuel Type (Quadrillion Btu)**

	Natural Gas		Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	Site Electric	Site		Primary Electric (4)	Primary	
	Gas	Oil (1)						Total	Percent		Total	Percent
Lighting							1.34	1.34	11.9%	4.12	4.12	16.5%
Electronics							0.92	0.92	8.1%	2.81	2.81	11.2%
Space Heating	1.42	0.25			0.10		0.15	1.92	16.9%	0.45	2.22	8.9%
Space Cooling	0.02						0.61	0.63	5.6%	1.88	1.90	7.6%
Water Heating	0.73	0.05				0.03	0.16	0.97	8.6%	0.50	1.31	5.2%
Computers							0.35	0.35	3.1%	1.08	1.08	4.3%
Refrigeration							0.28	0.28	2.5%	0.86	0.86	3.4%
Ventilation							0.23	0.23	2.0%	0.71	0.71	2.8%
Cooking	0.33						0.04	0.36	3.2%	0.11	0.43	1.7%
Other (5)	0.41	0.02	0.09		0.05	0.14	1.57	2.28	20.1%	4.80	5.52	22.1%
Adjust to SEDS (6)	0.89	0.19					0.97	2.05	18.1%	2.99	4.06	16.2%
<b>Total</b>	<b>3.78</b>	<b>0.52</b>	<b>0.09</b>	<b>0.15</b>	<b>0.17</b>	<b>0.17</b>	<b>6.62</b>	<b>11.34</b>	<b>100%</b>	<b>20.30</b>	<b>25.02</b>	<b>100%</b>

Note(s): 1) Includes (0.41 quad) distillate fuel oil and (0.10 quad) residual fuel oil. 2) Kerosene (0.02 quad) and coal (0.08 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of (0.17 quad) biomass, (0.03 quad) solar water heating, and (0.01 quad) solar PV. 4) Site -to-source electricity conversion (due to generation and transmission losses) = 3.07. 5) Includes service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 6) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Tables A2, p. 117-119, Table A5, p. 124-125, and Table A17, p. 143-144; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; EIA, Supplement to the AEO 2008, April 2008, Table 22.

**3.1.8 Commercial Delivered Energy Consumption Intensities, by Vintage**

Year Constructed	Consumption per Square Foot (thousand Btu/SF)	
Prior to 1960	84.4	23%
1960 to 1969	91.5	12%
1970 to 1979	97.0	18%
1980 to 1989	100.0	19%
1990 to 1999	90.3	19%
2000 to 2003	81.6	8%
Average	91.0	

Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, Oct. 2006, Table C1a.

**3.1.9 2003 Commercial Delivered Energy Consumption Intensities, by Principal Building Type and Vintage (1)**

Building Type	Consumption (thousand Btu/SF)			Building Type	Consumption (thousand Btu/SF)		
	Pre-1959	1960-1989	1990-2003		Pre-1959	1960-1989	1990-2003
Health Care	178.1	216.0	135.7	Education	77.7	88.3	80.6
Inpatient	230.3	255.3	253.8	Service	62.4	86.0	74.8
Outpatient	91.6	110.4	84.4	Food Service	145.2	290.1	361.2
Food Sales	205.8	197.6	198.3	Religious Worship	46.6	39.9	43.3
Lodging	88.2	111.5	88.1	Public Order & Safety	N.A.	101.3	110.6
Office	93.6	94.4	88.0	Warehouse & Storage	N.A.	38.9	33.3
Mercantile	80.4	91.8	94.4	Public Assembly	61.9	107.6	119.7
Retail (Non-Malls)	74.1	63.7	86.4	Vacant	21.4	23.1	N.A.
Retail (Malls)	N.A.	103.9	99.5	Other	161.3	204.9	125.3

Note(s): 1) See Table 3.1.3 for primary versus delivered energy consumption.

Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, Oct. 2006, Table C12a.

**3.1.10 2003 Commercial Primary Energy Consumption Intensities, by Principal Building Type**

<u>Building Type</u>	<u>Consumption (thousand Btu/SF)</u>	<u>Percent of Total Consumption</u>	<u>Building Type</u>	<u>Consumption (thousand Btu/SF)</u>	<u>Percent of Total Consumption</u>
Health Care	345.9	8%	Education	159.0	11%
Inpatient	438.8	6%	Service	151.6	4%
Outpatient	205.9	2%	Food Service	522.4	6%
Food Sales	535.5	5%	Religious Worship	77.0	2%
Lodging	193.1	7%	Public Order and Safety	221.1	2%
Office	211.7	19%	Warehouse and Storage	94.3	7%
Mercantile	223.6	18%	Public Assembly	180.0	5%
Retail (Non-Malls)	172.6	5%	Vacant	33.1	1%
Enclosed & Strip Malls	255.6	13%	Other	318.8	4%

Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, Oct. 2006, Table C1a.

**3.1.11 2003 Commercial Delivered Energy Consumption Intensities, by Ownership of Unit (1)**

<u>Ownership</u>	<u>Consumption (thousand Btu/SF)</u>	
<b>Nongovernment Owned</b>	<b>85.1</b>	<b>72%</b>
Owner-Occupied	87.3	35%
Nonowner-Occupied	88.4	36%
<b>Government Owned</b>	<b>105.3</b>	<b>28%</b>
		100%

Note(s): 1) Mall buildings are no longer included in most CBECs tables; therefore, some data is not directly comparable to past CBECs.

Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, June 2006, Table C3.

**3.1.12 Aggregate Commercial Building Component Loads as of 1998 (1)**

<u>Component</u>	<u>Loads (quads) and Percent of Total Loads</u>			
	<u>Heating</u>		<u>Cooling</u>	
Roof	-0.103	12%	0.014	1%
Walls (2)	-0.174	21%	-0.008	-
Foundation	-0.093	11%	-0.058	-
Infiltration	-0.152	18%	-0.041	-
Ventilation	-0.129	15%	-0.045	-
Windows (conduction)	-0.188	22%	-0.085	-
Windows (solar gain)	0.114	-	0.386	32%
Internal Gains				
Lights	0.196	-	0.505	42%
Equipment (electrical)	0.048	-	0.207	17%
Equip. (non-electrical)	0.001	-	0.006	1%
People	0.038	-	0.082	7%
<b>NET Load</b>	<b>-0.442</b>	<b>100%</b>	<b>0.963</b>	<b>100%</b>

Note(s): 1) Loads represents the thermal energy losses/gains that, when combined, will be offset by a building's heating/cooling system to maintain a set interior temperature (which then equals site energy). 2) Includes common interior walls between buildings.

Source(s): LBNL, Commercial Heating and Cooling Loads Component Analysis, June 1998, Table 24, p. 45 and Figure 3, p. 61.

**3.1.13 2003 Commercial Buildings Delivered Energy End-Use Intensities, by Building Activity (Thousand Btu per SF) (1)**

	<u>Education</u>	<u>Food Sales</u>	<u>Food Service</u>	<u>Health Care</u>	<u>Inpatient</u>	<u>Outpatient</u>	<u>Lodging</u>
Space Heating	39.4	28.9	43.1	70.4	91.8	38.1	22.2
Cooling	8.0	9.8	17.4	14.1	18.6	7.2	4.9
Ventilation	8.4	5.9	14.8	13.3	20.0	3.3	2.7
Water Heating	5.8	2.9	40.4	30.2	48.4	2.5	31.4
Lighting	11.5	36.7	25.4	33.1	40.1	22.6	24.3
Cooking	0.8	8.6	63.5	3.5	5.6	N.A.	3.2
Refrigeration	1.6	94.8	42.1	2.6	2.0	3.5	2.3
Office Equipment	0.4	1.6	1.0	1.2	1.1	1.3	N.A.
Computers	3.4	1.9	1.4	3.4	3.9	2.6	1.3
<u>Other</u>	4.0	9.1	9.5	16.1	18.1	13.2	7.0
Total	83.1	199.7	258.3	187.7	249.2	94.6	100.0
	<u>Mercantile</u>	<u>Service</u>	<u>Retail (No Mall)</u>	<u>Enclosed and Strip Malls</u>	<u>Office</u>	<u>Public Assembly</u>	<u>Public Order and Safety</u>
Space Heating	24.0	35.9	24.8	23.6	32.8	49.7	49.9
Cooling	9.9	3.8	5.9	12.4	8.9	9.6	8.9
Ventilation	6.0	6.0	3.7	7.5	5.2	15.9	9.5
Water Heating	5.1	1.0	1.1	7.7	2.0	1.0	14.0
Lighting	27.5	15.6	25.7	28.6	23.1	7.0	16.5
Cooking	2.3	N.A.	0.6	3.4	0.3	0.8	1.3
Refrigeration	4.4	2.1	5.0	4.0	2.9	2.2	2.9
Office Equipment	0.7	0.3	0.6	0.8	2.6	N.A.	0.6
Computers	1.1	1.0	1.0	1.1	6.1	N.A.	1.6
<u>Other</u>	10.3	11.4	5.6	13.2	9.0	6.5	10.6
Total	91.3	77.0	73.9	102.2	92.9	93.9	115.8
	<u>Religious Worship</u>	<u>Warehouse and Storage</u>	<u>Other</u>	<u>Vacant</u>			
Space Heating	26.2	19.3	79.4	14.4			
Cooling	2.9	1.3	10.5	0.6			
Ventilation	1.4	2.0	6.1	0.4			
Water Heating	0.8	0.6	2.1	0.1			
Lighting	4.4	13.1	34.1	1.7			
Cooking	0.8	N.A.	N.A.	N.A.			
Refrigeration	1.7	3.5	6.0	N.A.			
Office Equipment	0.1	0.2	N.A.	N.A.			
Computers	0.3	0.6	3.0	N.A.			
<u>Other</u>	4.9	4.8	18.9	3.1			
Total	43.5	45.2	164.4	20.9			

Note(s): 1) Due to rounding, end-uses do not sum to total.

Source(s): EIA, 2003 Commercial Building Energy Consumption Survey, Energy End-Uses, Oct 2008, Table E.2A.



**3.1.14 Commercial Buildings Share of U.S. Natural Gas Consumption (Percent)**

	Site Consumption				Primary Consumption			U.S. Natural Gas
	Commercial	Industry	Electric Gen.	Transportation	Commercial	Industry	Transportation	Total (quads)
1980	13%	41%	19%	3%	18%	49%	3%	20.38
1990	14%	43%	17%	3%	19%	49%	3%	19.75
2000	14%	40%	22%	3%	21%	47%	3%	23.80
<b>2006(1)</b>	<b>13%</b>	<b>35%</b>	<b>29%</b>	<b>3%</b>	<b>23%</b>	<b>43%</b>	<b>3%</b>	<b>22.30</b>
2010	13%	35%	29%	3%	23%	43%	3%	23.93
2015	14%	35%	28%	3%	24%	42%	3%	24.35
2020	14%	35%	25%	3%	24%	41%	3%	24.01
2025	15%	36%	23%	3%	25%	41%	3%	23.66
2030	16%	36%	22%	3%	25%	41%	3%	23.39

Note(s): 1) Buildings accounted for 58% (or \$97 billion) of total U.S. natural gas expenditures.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 consumption, Table A3, p. 120-121 for 2006 expenditures.

**3.1.15 Commercial Buildings Share of U.S. Petroleum Consumption (Percent)**

	Site Consumption				Primary Consumption			U.S. Petroleum
	Buildings	Industry	Electric Gen.	Transportation	Buildings	Industry	Transportation	Total (quads)
1980	4%	28%	8%	56%	6%	31%	56%	34.2
1990	3%	25%	4%	64%	4%	26%	64%	33.6
2000	2%	24%	3%	67%	3%	25%	67%	38.4
<b>2006</b>	<b>2%</b>	<b>25%</b>	<b>2%</b>	<b>69%</b>	<b>2%</b>	<b>25%</b>	<b>69%</b>	<b>40.1</b>
2010	2%	24%	1%	70%	2%	24%	70%	40.5
2015	2%	23%	1%	71%	2%	23%	71%	41.8
2020	2%	22%	1%	72%	2%	22%	72%	42.2
2025	2%	21%	1%	73%	2%	22%	73%	42.8
2030	2%	21%	1%	73%	2%	21%	73%	44.0

Note(s): 1) Buildings accounted for an estimated 7.3% (or \$30 billion) of total U.S. petroleum expenditures.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 consumption, Table A3, p. 120-121 for 2006 expenditures.

**3.2.1 Total Commercial Floorspace and Number of Buildings, by Year**

	Commercial Sector Floorspace (10 <sup>9</sup> square feet)	Percent Post- 2000 Floorspace (2)	Buildings (10 <sup>6</sup> )
1980	50.9 (1)	N.A.	3.1 (3)
1990	64.3	N.A.	4.5 (3)
2000 (4)	68.5	N.A.	4.7 (5)
<b>2006 (4)</b>	<b>74.8</b>	<b>15%</b>	N.A.
2010 (4)	78.8	24%	N.A.
2015 (4)	83.9	33%	N.A.
2020 (4)	89.3	41%	N.A.
2025 (4)	94.8	49%	N.A.
2030 (4)	100.8	56%	N.A.

Note(s): 1) Based on PNNL calculations. 2) Percent built after Dec. 31, 2000. 3) Actually for previous year. 4) EIA now excludes parking garages and commercial buildings on multi-building manufacturing facilities from the commercial building sector. 5) Data is from 1999. In 1999, commercial building floorspace = 67.3 billion square feet.

Source(s): EIA, Annual Energy Outlook 1994, Jan. 1994, Table A5, p. 62 for 1990 floorspace; EIA, AEO 2003, Jan. 2003, Table A5, p. 127-128 for 2000 floorspace; EIA, AEO 2008, Mar. 2008, Table A5, p. 124-142 for 2005-2030 floorspace; EIA Commercial Building Characteristics 1989, June 1991, Table A4, p. 17 for 1990 number of buildings; EIA, Commercial Building Characteristics 1999, Aug. 2002, Table 3 for 1999 number of buildings and floorspace; and EIA, Buildings and Energy in the 1980s, June 1995, Table 2.1, p. 23 for number of buildings in 1980.

**3.2.2 Principal Commercial Building Types, as of 2003 (Percent of Total Floorspace) (1)**

	Total Floorspace	Total Buildings	Primary Energy Consumption
Office	17%	17%	19%
Mercantile	16%	14%	18%
Retail	6%	9%	5%
Enclosed & Strip Malls	10%	4%	13%
Education	14%	8%	11%
Warehouse and Storage	14%	12%	7%
Lodging	7%	3%	7%
Service	6%	13%	4%
Public Assembly	5%	6%	5%
Religious Worship	5%	8%	2%
Health Care	4%	3%	8%
Inpatient	3%	0%	6%
Outpatient	2%	2%	2%
Food Sales	2%	5%	5%
Food Service	2%	6%	6%
Public Order and Safety	2%	1%	2%
Other	2%	2%	4%
Vacant	4%	4%	1%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Note(s): 1) For primary energy intensities by building type, see Table 3.1.13. Total CBECs 2003 commercial building floorspace is 71.7 billion SF.

Source(s): EIA, 2003 Commercial Buildings Energy Consumption Survey: Consumption and Expenditures Tables, Oct. 2006, Table C1A.

**3.2.3 Number of Floors and Type of Ownership, as of 2003 (Percent of Total Floorspace)**

<u>Floors</u>		<u>Ownership</u>	
One	40%	<b>Nongovernment Owned</b>	<b>76%</b>
Two	25%	Owner-Occupied	36%
Three	12%	Nonowner-Occupied	37%
Four to Nine	16%	Unoccupied	3%
Ten or More	8%	<b>Government Owned</b>	<b>24%</b>
Total	100%	Federal	3%
		State	5%
		Local	15%
		Total	100%

Source(s): EIA, Commercial Building Characteristics 2003, June 2006, Table C1.

**3.2.4 Share of Commercial Floorspace, by Census Region and Vintage, as of 2003 (Percent)**

<u>Region</u>	<u>Prior to 1960</u>	<u>1960 to 1989</u>	<u>1990 to 2003</u>	<u>Total</u>
Northeast	9%	8%	3%	20%
Midwest	8%	11%	6%	25%
South	5%	18%	14%	37%
West	3%	9%	5%	18%
				100%

Source(s): EIA, 2003 Commercial Buildings Energy Consumption Survey: Building Characteristics Tables, Oct. 2006, Table A2, p. 3-4.

**3.2.5 Commercial Building Size, as of 2003 (Number of Buildings and Percent of Total Floorspace)**

<u>Square Foot Range</u>	<u>Number of Buildings (thousands)</u>	
1,001 to 5,000	2,586	10%
5,001 to 10,000	948	10%
10,001 to 25,000	810	18%
25,001 to 50,000	261	13%
50,001 to 100,000	147	14%
100,001 to 200,000 (2)	74	14%
200,001 to 500,000 (2)	26	10%
<u>Over 500,000 (2)</u>	8	11%
<b>Total</b>	<b>4,859</b>	<b>100%</b>

Note(s): 1) 35% of commercial floorspace is found in 2.2% of commercial buildings that are larger than 100,000 square feet.

Source(s): EIA, 2003 Commercial Buildings Energy Consumption Survey: Building Characteristics Tables, Oct. 2006, Table A1, p. 1-2.

**3.2.6 Commercial Building Vintage, as of 2003**

	<u>Percent of Total Floorspace</u>
1919 or Before	5%
1920 to 1945	10%
1946 to 1959	10%
1960 to 1969	12%
1970 to 1979	17%
1980 to 1989	17%
1990 to 1999	20%
<u>2000 to 2003</u>	9%
Total	100%

Source(s): EIA, 2003 Commercial Buildings Energy Consumption Survey: Building Characteristics Tables, Oct. 2006, Table A1, p. 1-2.

**3.2.7 Commercial Building Median Lifetimes (Years)**

Building Type	Median (1)	66% Survival (2)	33% Survival (2)
Health Care	65	48	88
Food Sales	65	49	86
Food Service	65	49	86
Lodging	69	49	98
Mercantile & Service	65	44	96
Assembly	80	54	118
Large Office	73	52	103
Small Office	73	52	103
Education	80	61	104
Warehouse	80	52	123
Other	75	57	99

Note(s): 1) PNNL estimates the median lifetime of commercial buildings is 70-75 years. 2) Number of years after which the building survives. For example, a third of the office buildings constructed today will survive 103 years later.

Source(s): EIA, Assumptions for the Annual Energy Outlook 2008, June 2008, Table 12, p. 32; EIA, Model Documentation Report: Commercial Sector Demand Module of the National Energy Modeling System, Apr. 2008, p. 30-35; and PNNL, Memorandum: New Construction in the Annual Energy Outlook 2003, Apr. 24, 2003 for Note 2.

**3.2.8 2003 Average Commercial Building Floorspace, by Principal Building Type and Vintage**

Building Type	Average Floorspace/Building (thousand SF)			
	1959 or Prior	1960 to 1989	1990 to 2003	All
Education	27.5	26.9	21.7	25.6
Food Sales	N.A.	N.A.	N.A.	5.6
Food Service	6.4	4.4	5.0	5.6
Health Care	18.5	37.1	N.A.	24.5
Inpatient	N.A.	243.6	N.A.	238.1
Outpatient	N.A.	11.3	11.6	10.4
Lodging	9.9	36.1	36.0	35.9
Retail (Other Than Mall)	6.2	9.3	17.5	9.7
Office	12.4	16.4	14.2	14.8
Public Assembly	13.0	13.8	17.3	14.2
Public Order and Safety	N.A.	N.A.	N.A.	15.4
Religious Worship	8.7	9.6	15.6	10.1
Service	6.1	6.5	6.8	6.5
Warehouse and Storage	19.7	17.2	15.4	16.9
Other	N.A.	N.A.	N.A.	22.0
Vacant	N.A.	N.A.	N.A.	14.1

Source(s): EIA, 2003 Commercial Buildings Energy Consumption Survey: Building Characteristics Tables, June 2006, Table B8, p. 63-69, and Table B9, p. 70-76.

**3.3.1 Commercial Energy Prices, by Year and Major Fuel Type (\$2006 per Million Btu)**

	<u>Electricity</u>	<u>Natural Gas</u>	<u>Petroleum (2)</u>	<u>Average</u>
1980	34.62	7.16	12.17	17.19
1990	30.27	6.71	8.49	17.32
2000	25.07	7.64	9.43	16.46
<b>2006</b>	<b>27.75</b>	<b>11.50</b>	<b>14.75</b>	<b>20.75</b>
2010	27.89	10.59	15.48	20.69
2015	25.52	9.68	13.29	18.93
2020	25.64	9.91	13.64	19.25
2025	25.71	10.47	14.24	19.67
2030	26.17	11.43	15.22	20.47

Note(s): 1) Residential petroleum products include distillate fuel, LPG, and kerosene. 2) Commercial petroleum products include distillate fuel, LPG, kerosene, motor gasoline, and residual fuel.

Source(s): EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, Tables 2-3, p. 24-25 for 1980-2005 and prices for note, Tables 8-9, p. 18-19 for 1980-2005 consumption; EIA, Annual Energy Outlook 2008 Mar. 2008, Table A2, p. 117-119, Table A3, p. 120-121, Table A12, p. 138, and Table A13, p. 139 for 2006-2030 consumption and prices; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**3.3.2 Commercial Energy Prices, by Year and Fuel Type (\$2006)**

	<u>Electricity</u> <u>(¢/kWh)</u>	<u>Natural Gas</u> <u>(¢/therm)</u>	<u>Distillate Oil</u> <u>(\$/gal)</u>	<u>Residual Oil</u> <u>(\$/gal)</u>
1980	11.81	71.63	1.33	1.93
1990	10.33	67.12	0.73	1.18
2000	8.55	76.39	0.78	1.21
<b>2006</b>	<b>9.47</b>	<b>115.03</b>	<b>1.29</b>	<b>2.02</b>
2010	9.52	105.95	1.51	2.11
2015	8.71	96.75	1.19	1.79
2020	8.75	99.06	1.19	1.84
2025	8.77	104.67	1.29	1.92
2030	8.93	114.32	1.38	2.08

Source(s): EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. Tables 2-3, p. 24-25 for 1980-2005; EIA, Annual Energy Outlook 2008, Mar. 2008, Table A3, p. 120-121 for 2006-2030 and Table G1, p. 215 for fuels' heat content; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**3.3.3 Buildings Aggregate Energy Expenditures, by Year and Major Fuel Type (\$2006 Billion) (1)**

	<u>Electricity</u>	<u>Natural Gas</u>	<u>Petroleum (2)</u>	<u>Total</u>
1980	66.0	19.1	15.7	100.7
1990	86.6	18.1	8.1	112.8
2000	99.2	24.9	7.1	131.2
<b>2006</b>	<b>123.1</b>	<b>33.6</b>	<b>10.0</b>	<b>166.7</b>
2010	131.9	32.3	9.8	173.9
2015	132.6	31.9	8.9	173.3
2020	145.3	34.4	9.2	188.9
2025	158.1	38.0	9.7	205.8
2030	173.3	43.2	10.4	226.9

Note(s): 1) Expenditures exclude wood and coal. 2006 U.S. energy expenditures were 1.14 trillion. 2) Commercial petroleum products include distillate fuel oil, LPG, kerosene, motor gasoline, and residual fuel.

Source(s): EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 24-25 for 1980-2005; EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 and Table A3, p. 120-121 for 2006-2030; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

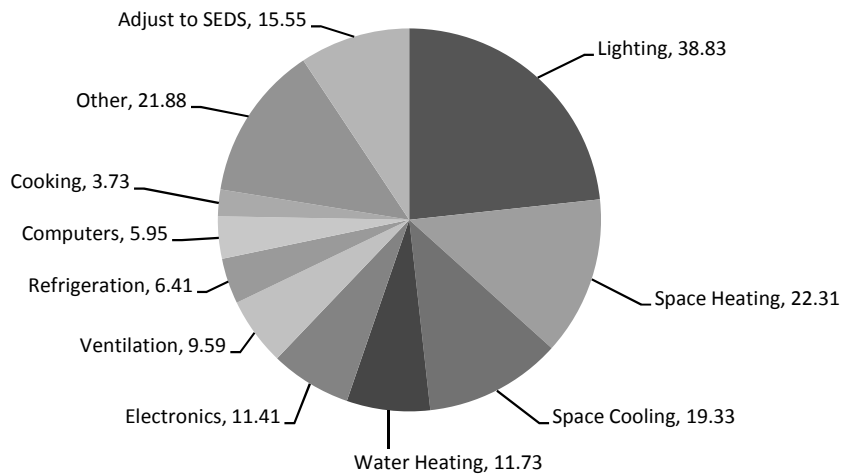
**3.3.4 2006 Commercial Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion) (1)**

	Natural Gas	Petroleum					Coal (3)	Electricity	Total	Percent
		Distil.	Resid.	LPG	Oth(2)	Total				
Lighting							38.8	38.8	23.3%	
Space Heating	13.6	1.8	1.0		0.3	3.1	0.1	5.5	22.3	13.4%
Space Cooling	0.2							19.1	19.3	11.6%
Electronics							11.7	11.7	7.0%	
Water Heating	6.3	0.7				0.7	4.4	11.4	6.8%	
Ventilation							9.6	9.6	5.7%	
Refrigeration							6.4	6.4	3.8%	
Computers							6.0	6.0	3.6%	
Cooking	2.6						1.1	3.7	2.2%	
Other (4)	3.1	0.3		1.6	1.0	3.0		15.8	21.9	13.1%
Adjust to SEDS (5)	7.7	3.2				3.2		4.6	15.6	9.3%
<b>Total</b>	<b>33.6</b>	<b>6.0</b>	<b>1.0</b>	<b>1.6</b>	<b>1.3</b>	<b>9.9</b>	<b>0.1</b>	<b>123.0</b>	<b>166.7</b>	<b>100%</b>

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating (\$0.3 billion) and motor gasoline other uses (\$1.0 billion). 3) Coal average price is from AEO 2008, all users price. 4) Includes service station equipment, ATMs, medical equipment, telecommunications equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 5) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A3, p. 120-121 for prices, and Table A5, p. 124-125 for energy consumption; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 25 for coal price; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators; BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation Oct. 1999, p. 1-2, 5-25 and 5-26 for ventilation; and BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, Sept. 2002, Table 8-2, p. 63.; EIA, Supplement to the AEO 2008, April 2008, Table 22.

**2006 Commercial Energy End-Use Expenditures (\$2006 Billion)**



**3.3.5 2010 Commercial Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion) (1)**

	Natural	Petroleum					Coal (3)	Electricity	Total	Percent
	Gas	Distil.	Resid.	LPG	Oth(2)	Total				
Lighting							31.3	31.3	18.0%	
Space Heating	13.7	2.0	1.0		0.3	3.3	0.2	3.8	21.0	12.0%
Electronics							15.4	15.4	8.8%	
Space Cooling	0.2						13.9	14.1	8.1%	
Water Heating	5.7	0.7				0.7	4.3	10.6	6.1%	
Computers							7.1	7.1	4.1%	
Refrigeration							6.5	6.5	3.7%	
Ventilation							5.3	5.3	3.0%	
Cooking	2.6						1.1	3.7	2.1%	
Other (4)	2.3	0.3		1.8	1.1	3.1		21.1	26.5	15.2%
Adjust to SEDS (5)	7.7	2.8				2.8		22.1	32.6	18.7%
<b>Total</b>	<b>32.3</b>	<b>5.8</b>	<b>1.0</b>	<b>1.8</b>	<b>1.3</b>	<b>9.8</b>	<b>0.2</b>	<b>131.9</b>	<b>174.1</b>	<b>100%</b>

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating (\$0.3 billion) and motor gasoline other uses (\$1.1 billion). 3) Coal average price is from AEO 2008, all users price. 4) Includes service station equipment, ATMs, medical equipment, telecommunications equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 5) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A3, p. 120-121 for prices, and Table A5, p. 124-125 for energy consumption; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators; EIA, Supplement to the AEO 2008, April 2008, Table 22.

**3.3.6 2020 Commercial Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion) (1)**

	Natural	Petroleum					Coal (3)	Electricity	Total	Percent
	Gas	Distil.	Resid.	LPG	Oth(2)	Total				
Lighting							31.2	31.2	16.5%	
Space Heating	13.9	2.0	0.8		0.2	3.0	0.1	3.7	20.7	11.0%
Electronics							20.3	20.3	10.7%	
Space Cooling	0.2						14.0	14.2	7.5%	
Water Heating	6.5	0.6				0.6	4.1	11.2	5.9%	
Computers							7.7	7.7	4.1%	
Refrigeration							6.5	6.5	3.4%	
Ventilation							5.4	5.4	2.8%	
Cooking	2.9						1.0	3.8	2.0%	
Other (4)	2.8	0.3		1.7	1.0	3.0		28.9	34.7	18.3%
Adjust to SEDS (5)	8.2	2.6				2.6		22.6	33.4	17.7%
<b>Total</b>	<b>34.4</b>	<b>5.5</b>	<b>0.8</b>	<b>1.7</b>	<b>1.3</b>	<b>9.2</b>	<b>0.1</b>	<b>145.3</b>	<b>189.1</b>	<b>100%</b>

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating (\$0.2 billion) and motor gasoline other uses (\$1.0 billion). 3) Coal average price is from AEO 2008, all users price. 4) Includes service station equipment, ATMs, medical equipment, telecommunications equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 5) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A3, p. 120-121 for prices, and Table A5, p. 124-125 for energy consumption; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators; EIA, Supplement to the AEO 2008, April 2008, Table 22.

**3.3.7 2030 Commercial Energy End-Use Expenditure Splits, by Fuel Type (\$2006 Billion) (1)**

	Natural Gas	Petroleum				Coal (3)	Electricity	Total	Percent	
		Distil.	Resid.	LPG	Oth(2)					Total
Lighting							35.2	35.2	15.5%	
Electronics							24.0	24.0	10.6%	
Space Heating	16.2	2.3	0.9		0.3	3.5	0.1	3.9	23.7	10.4%
Space Cooling	0.2							16.0	16.2	7.2%
Water Heating	8.4	0.8				0.8		4.2	13.4	5.9%
Computers								9.2	9.2	4.1%
Refrigeration								7.3	7.3	3.2%
Ventilation								6.1	6.1	2.7%
Cooking	3.7							0.9	4.7	2.0%
Other (4)	4.6	0.3		1.9	1.1	3.3		41.0	48.9	21.5%
Adjust to SEDS (5)	10.1	2.9				2.9		25.5	38.5	16.9%
<b>Total</b>	<b>43.2</b>	<b>6.2</b>	<b>0.9</b>	<b>1.9</b>	<b>1.4</b>	<b>10.4</b>	<b>0.1</b>	<b>173.3</b>	<b>227.1</b>	<b>100%</b>

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating (\$0.3 billion) and motor gasoline other uses (\$1.1 billion). 3) Coal average price is from AEO 2008, all users price. 4) Includes service station equipment, ATMs, medical equipment, telecommunications equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 5) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A3, p. 120-121 for prices, and Table A5, p. 124-125 for energy consumption; EIA, National Energy Modeling System for AEO 2008, March 2008; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators; EIA, Supplement to the AEO 2008, April 2008, Table 22.

**3.3.8 Average Annual Energy Expenditures per Square Foot of Commercial Floorspace, by Year (\$2006)**

Year	(\$/SF)
1980(1)	1.96
1990	1.83
2000	1.91
<b>2006</b>	<b>2.30</b>
2010	2.28
2015	2.13
2020	2.18
2025	2.24
2030	2.32

Note(s): 1) End of year 1979.

Source(s): EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, p. 25 for 1980-2005; EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 and Table A5, p. 124-125 for consumption, Table A3, p. 120-121 for prices for 2006-2030; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators; EIA, AEO 1994, Jan. 1994, Table A5, p. 62 for 1990 floorspace; and PNNL for 1980 floorspace.

**3.3.9 2003 Energy Expenditures per Square Foot of Commercial Floorspace and per Building, by Building Type (\$2006) (1)**

	Per Building			Per Building	
	Per Square Foot	(thousand)		Per Square Foot	(thousand)
Food Service	4.54	25.3	Mercantile	2.08	35.5
Food Sales	4.36	24.2	Education	1.34	34.1
Health Care	2.57	63.3	Service	1.29	8.4
Public Order and Safety	1.93	29.8	Warehouse and Storage	0.74	12.6
Office	1.87	27.7	Religious Worship	0.71	7.2
Public Assembly	1.61	22.9	Vacant	0.32	4.5
Lodging	1.60	57.3	Other	2.78	61.0

Note(s): 1) Mall buildings are no longer included in most CBECs tables; therefore, some data is not directly comparable to past CBECs.

Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, Oct. 2006, Table 4; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.



**3.3.10 2003 Energy Expenditures per Square Foot of Commercial Floorspace, by Vintage (\$2006)**

<u>Vintage</u>	<u>(\$/SF)</u>
Prior to 1960	1.35
1960 to 1969	1.58
1970 to 1979	1.75
1980 to 1989	1.94
1990 to 1999	1.75
2000 to 2003	1.60
<b>Average</b>	<b>1.65</b>

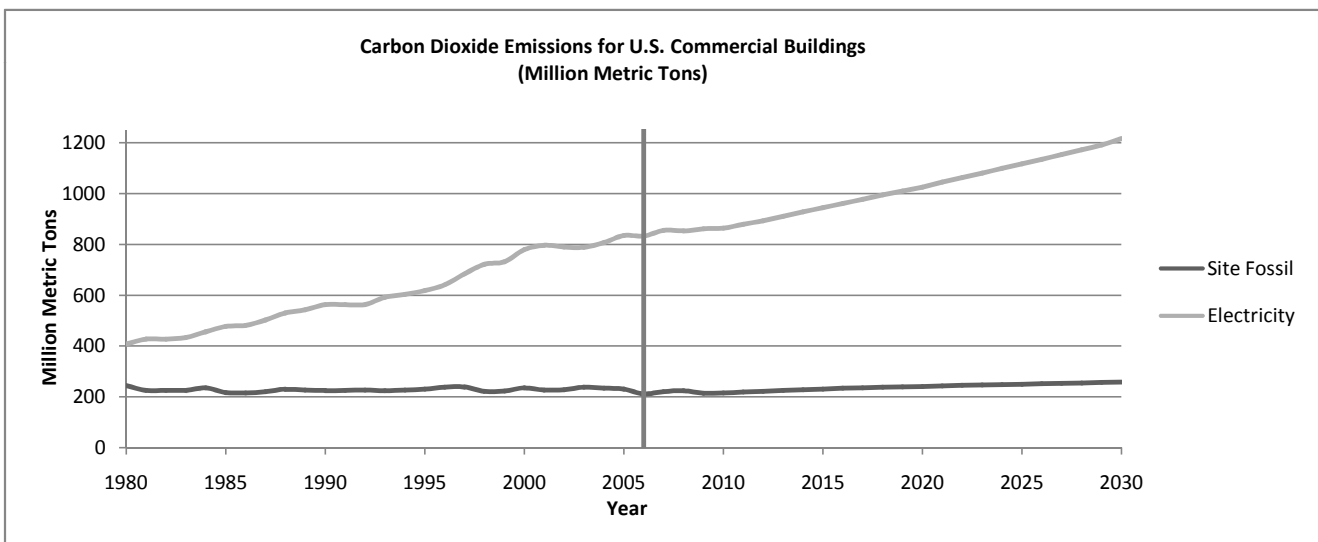
Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, Table C4; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price inflators.

**3.4.1 Carbon Dioxide Emissions for U.S. Commercial Buildings, by Year (Million Metric Tons) (1)**

	Commercial				U.S.		Com.% of Total U.S.	Com.% of Total Global
	Site Fossil	Electricity	Total	Growth Rate 2006-Year	Total	Growth Rate 2006-Year		
1980	245	409	653	-	4723	-	14%	3.6%
1990	225	563	788	-	5012	-	16%	3.7%
2000	235	780	1015	-	5847	-	17%	4.3%
<b>2006 (2)</b>	<b>212</b>	<b>832</b>	<b>1045</b>	-	<b>5890</b>	-	<b>18%</b>	<b>3.7%</b>
2010	215	864	1079	0.8%	6011	0.5%	18%	3.5%
2015	231	945	1176	1.3%	6226	0.6%	19%	3.5%
2020	241	1024	1265	1.4%	6384	0.6%	20%	3.4%
2025	250	1117	1367	1.4%	6571	0.6%	21%	3.4%
2030	258	1216	1474	1.4%	6851	0.6%	22%	3.4%

Note(s): 1) Excludes emissions of buildings-related energy consumption in the industrial sector. Emissions assume complete combustion from energy consumption and exclude energy production activities such as gas flaring, coal mining, and cement production. 2) Carbon emissions calculated from EIA, Assumptions to the AEO 2008 and differs from EIA, AEO 2008, Table A18. Buildings sector total varies by 0.7% from EIA, AEO 2008.

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 1985-1990, Sept. 1993, Appendix B, Tables B1-B5, p. 73-74 for 1980; EIA, Emissions of Greenhouse Gases in the U.S. 2003, Dec. 2004, Tables 7-11, p. 29-31 for 1990 and 2000; EIA, Assumptions to the Annual Energy Outlook 2008, April 2008, Table 2, p. 10 for carbon coefficients; EIA, AEO 2008, Mar. 2008, Table A2, p. 137-139 for 2005-2030 energy consumption and Table A18, p. 164 for 2005-2030 emissions; EIA, International Energy Outlook 2008, July 2008, Table A10, p. 93 for 2004-2030 global emissions; and EIA, International Energy Annual 2006, July 2006, Table H1, www.eia.doe.gov for 1980-2000 global emission.



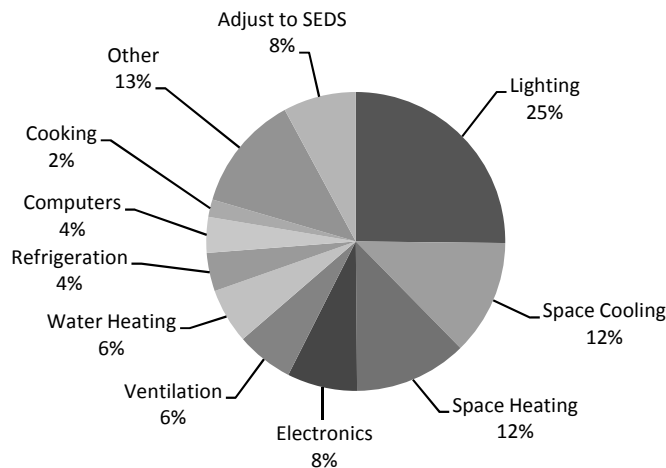
**3.4.2 2006 Commercial Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)**

	Natural Gas	Petroleum					Coal	Electricity (3)	Total	Percent
		Distil.	Resid.	LPG	Oth(2)	Total				
Lighting							263.1	263.1	25.2%	
Space Cooling	1.1						129.2	130.3	12.5%	
Space Heating	62.7	9.2	8.9		1.2	19.4	8.1	37.3	127.4	12.2%
Electronics							79.3	79.3	7.6%	
Ventilation							64.9	64.9	6.2%	
Water Heating	29.1	3.5				3.5	29.8	62.4	6.0%	
Refrigeration							43.4	43.4	4.2%	
Computers							40.3	40.3	3.9%	
Cooking	12.2						7.4	19.6	1.9%	
Other (4)	14.2	1.9		5.1	3.5	10.4		107.0	131.6	12.6%
Adjust to SEDS (5)	35.6	16.1				16.1		30.8	82.5	7.9%
<b>Total</b>	<b>154.9</b>	<b>30.6</b>	<b>8.9</b>	<b>5.1</b>	<b>4.7</b>	<b>49.3</b>	<b>8.1</b>	<b>832.4</b>	<b>1,044.7</b>	<b>100%</b>

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. Carbon emissions calculated from EIA, Assumptions to the AEO 2008 and differs from EIA, AEO 2008, Table A18. Buildings sector total varies by 0.7% from EIA, AEO 2008. 2) Includes kerosene space heating (1.2 MMT) and motor gasoline other uses (3.5 MMT). 3) Excludes electric imports by utilities. 4) Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 5) Emissions related to a discrepancy between data sources. Energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123 and Table A5, p. 134-135 for energy consumption, and Table A18, p. 143-144 for emissions; EIA, National Energy Modeling System for AEO 2008, Mar. 2008; EIA, Assumptions to the AEO 2008, April 2008, Table 2, p. 10 for emission coefficients; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses; BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2; BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, Sept. 2002, Table 8-2, p.63; and EIA, AEO 1999, Dec. 1998, Table A4, p. 118-119 and Table A5, p. 120-121 for 1996 data.

**2006 Commercial Building Energy End-Use Carbon Dioxide Emissions Splits**



**3.4.3 2010 Commercial Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)**

	Natural Gas	Petroleum				Coal	Electricity (3)	Total	Percent	
		Distil.	Resid.	LPG	Oth(2)					Total
Lighting							205.4	205.4	19.0%	
Space Heating	68.7	9.7	7.7		1.3	18.6	7.9	25.2	120.4	11.2%
Electronics								100.6	100.6	9.3%
Space Cooling	1.1							90.8	91.8	8.5%
Water Heating	28.6	3.2				3.2		28.0	59.8	5.5%
Computers								46.5	46.5	4.3%
Refrigeration								42.7	42.7	4.0%
Ventilation								34.6	34.6	3.2%
Cooking	13.0							6.9	19.9	1.8%
Other (4)	11.6	1.3		5.7	3.5	10.5		138.5	160.6	14.9%
Adjust to SEDS (5)	38.6	13.7				13.7		144.7	197.0	18.2%
<b>Total</b>	<b>161.6</b>	<b>27.8</b>	<b>7.7</b>	<b>5.7</b>	<b>4.8</b>	<b>46.0</b>	<b>7.9</b>	<b>863.9</b>	<b>1,079.3</b>	<b>100%</b>

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (1.3 MMT) and motor gasoline other uses (3.5 MMT). 3) Excludes electric imports by utilities. 4) Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 5) Emissions related to a discrepancy between data sources. Energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123 and Table A5, p. 134-135 for energy consumption, and Table A18, p. 143-144 for emissions; EIA, National Energy Modeling System for AEO 2008, Feb. 2008; EIA, Assumptions to the AEO 2008, April 2008, Table 2, p. 10 for emission coefficients.

**3.4.4 2020 Commercial Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)**

	Natural Gas	Petroleum				Coal	Electricity (3)	Total	Percent	
		Distil.	Resid.	LPG	Oth(2)					Total
Lighting								220.0	220.0	17.4%
Electronics								143.1	143.1	11.3%
Space Heating	74.3	10.9	8.1		1.3	20.3	7.9	25.9	128.4	10.1%
Space Cooling	1.1							98.9	100.0	7.9%
Water Heating	34.6	3.6				3.6		29.0	67.1	5.3%
Computers								54.2	54.2	4.3%
Refrigeration								45.6	45.6	3.6%
Ventilation								37.7	37.7	3.0%
Cooking	15.5							6.7	22.2	1.8%
Other (4)	14.8	1.4		5.8	3.7	11.0		203.9	229.7	18.2%
Adjust to SEDS (5)	43.8	14.4				14.4		159.3	217.5	17.2%
<b>Total</b>	<b>184.0</b>	<b>30.3</b>	<b>8.1</b>	<b>5.8</b>	<b>4.9</b>	<b>49.2</b>	<b>7.9</b>	<b>1,024.3</b>	<b>1,265.4</b>	<b>100%</b>

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (1.2 MMT) and motor gasoline other uses (3.7 MMT). 3) Excludes electric imports by utilities. 4) Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 5) Emissions related to a discrepancy between data sources. Energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123 and Table A5, p. 134-135 for energy consumption, and Table A18, p. 143-144 for emissions; EIA, National Energy Modeling System for AEO 2008, Feb. 2008; EIA, Assumptions to the AEO 2008, April 2008, Table 2, p. 10 for emission coefficients;

**3.4.5 2030 Commercial Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)**

	Natural Gas	Petroleum				Coal	Electricity (3)	Total	Percent	
		Distil.	Resid.	LPG	Oth(2)					Total
Lighting							246.9	246.9	16.7%	
Electronics							168.2	168.2	11.4%	
Space Heating	75.1	11.0	8.1		1.3	20.5	7.9	27.2	130.7	8.9%
Space Cooling	1.1							112.4	113.4	7.7%
Water Heating	38.8	3.7						29.7	72.2	4.9%
Computers								64.8	64.8	4.4%
Refrigeration								51.4	51.4	3.5%
Ventilation								42.4	42.4	2.9%
Cooking	17.3							6.6	23.8	1.6%
Other (4)	21.5	1.6		5.9	3.8	11.3		287.8	320.6	21.7%
Adjust to SEDS (5)	47.0	13.9				13.9		179.0	239.9	16.3%
<b>Total</b>	<b>200.7</b>	<b>30.3</b>	<b>8.1</b>	<b>5.9</b>	<b>5.1</b>	<b>49.4</b>	<b>7.9</b>	<b>1,216.3</b>	<b>1,474.3</b>	<b>100%</b>

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (1.3 MMT) and motor gasoline other uses (3.8 MMT). 3) Excludes electric imports by utilities. 4) Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 5) Emissions related to a discrepancy between data sources. Energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, Table A4, p. 122-123 and Table A5, p. 134-135 for energy consumption, and Table A18, p. 143-144 for emissions; EIA, National Energy Modeling System for AEO 2008, Feb. 2008; EIA, Assumptions to the AEO 2008, April 2008, Table 2, p. 10 for emission coefficients.

**3.4.6 2006 Methane Emissions for U.S. Commercial Buildings Energy Production, by Fuel Type (MMT CO2 Equivalent) (1)**

<u>Fuel Type</u>	
Petroleum	0.5
Natural Gas	20.0
Coal	0.2
Wood	0.4
Electricity (2)	36.7
<b>Total</b>	<b>57.9</b>

Note(s): 1) Sources of emissions include oil and gas production, processing, and distribution; coal mining; and utility and site combustion. Carbon Dioxide equivalent units are calculated by converting methane emissions to carbon dioxide emissions (methane's global warming potential is 23 times that of carbon dioxide). 2) Emissions of electricity generators attributable to the buildings sector.

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 2006, Nov. 2007, Table 15, p. 22 for energy production emissions; EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, April 2008, Table 3-16, p. 3-25 for stationary combustion emissions; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for energy consumption.

**3.5.1 Value of New Commercial Building Construction, by Year (\$2006 Billion)**

1980	148.7
1985	210.4
1990	211.7
1995	192.0
2000	300.8
2003	277.7
2004	288.0
2005	294.7
2006	307.1

Note(s): 1) In 2006, new building construction accounted for 5.9% of the \$13.2 trillion U.S. GDP.

Source(s): DOC, Current Construction Reports: Value of New Construction Put in Place, C30, Aug. 2003, Table 1 for 1980-1990; DOC, Annual Value of Construction Put in Place, May 2008 for 1995-2006; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**3.5.2 Value of Building Improvements and Repairs, by Sector (\$2006 Billion) (1)**

	<u>Improvements</u>	<u>Maintenance and Repairs</u>	<u>Total</u>
1980	N.A.	N.A.	N.A.
1985	82.6	47.8	130.4 (2)
1990	82.8	49.8	132.6 (3)
1995	105.8	34.9	140.6
2000	142.6	44.0	186.6
2003	131.7	40.6	172.3
2004	136.6	42.1	178.7
2005	139.8	43.1	182.9
2006	145.6	44.9	190.5

Note(s): 1) Improvements includes additions, alterations, reconstruction, and major replacements. Repairs include maintenance.  
2) 1986. 3) 1989.

Source(s): DOC, Current Construction Reports: Expenditures for Nonresidential Improvements and Repairs: 1992, CSS/92, Sept. 1994, Table A, p. 2 for 1986-1990 expenditures; DOC, 1997 Census of Construction Industries: Industry Summary, Jan. 2000, Table 7, p. 15; DOC, Annual Value of Private Construction Put in Place, May 2008 for 1995-2006; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for GDP and price deflators.

**3.6.1 2006 Energy Consumption per Square Foot of Office Floorspace by Vintage (Thousand Btu/SF) (1)**

<u>Vintage</u>	<u>Energy Intensity</u>		
1997-2006	90.9		
1987-1996	79.3		
1977-1986	78.6		
1967-1976	76.8		
1957-1966	N.A.	Buildings providing consumption data:	415
Pre-1957	80.7		

Note(s): 1) Commercial office buildings sampled include the following: Class A, B, C.

Source(s): BOMA International, Experience Exchange Report 2007, August 2007.

**3.6.2 Energy Expenditures per Square Foot of Office Floorspace by Building Age (\$2006) (1)**

<u>Age (years)</u>	<u>2006</u>	<u>2004</u>
0-9	1.99	1.73
10-19	2.18	1.89
20-29	2.23	1.84
30-39	2.52	2.18
40-49	2.78	2.76
50+	2.36	1.96
<b>All Buildings</b>	<b>2.26</b>	<b>1.83</b>

Note(s): 1) Energy includes electric, gas, fuel oil, purchased steam, purchased chilled water, and water/sewage expenditures.

Source(s): BOMA International, The Experience Exchange Report 2007, August 2007; BOMA International, The Experience Exchange Report 2005; August 2005.

**3.6.3 Energy Consumption and Expenditures per Square Foot of Office Floorspace, by Function and Class (1)**

	<u>2006</u>		<u>2004</u>	
	<u>Energy Intensity (thousand Btu/SF)</u>	<u>Energy Expenditures (\$/SF)</u>	<u>Energy Intensity (thousand Btu/SF)</u>	<u>Energy Expenditures (\$/SF)</u>
Medical Offices	90.8	2.39	N.A.	2.19
Financial Offices	N.A.	2.91	N.A.	3.09
Corporate Facilities(2)	96.8	2.56	89.4	2.53
Class A	81.9	2.28	78.8	1.94
Class B	74.9	2.15	N.A.	1.89
Class C	N.A.	2.28	N.A.	1.71
<b>All Buildings</b>	<b>81.1</b>	<b>2.26</b>	<b>77.8</b>	<b>1.95</b>

Note(s): 1) Categories are not mutually exclusive. 2) Corporate Facilities are any building that the owner occupies at least 75% of the rentable space.

Source(s): BOMA International, The Experience Exchange Report 2007, August 2007; BOMA International, The Experience Exchange Report 2005; August 2005.

**3.6.4 2006 Energy Expenditures per Square Foot of Office Floorspace for Selected Cities by Location (\$2006/SF) (1)**

	<u>Urban</u>	<u>Suburban</u>
New York, NY	3.99	N.A.
Los Angeles, CA	2.14	2.36
Chicago, IL	1.51	N.A.
Houston, TX	2.64	2.35
Phoenix, AZ	1.88	1.80
Philadelphia, PA	2.40	2.73
San Antonio, CA	1.87	1.96
San Diego, CA	2.75	2.81
Dallas, TX	2.37	2.31
San Jose, CA	2.78	2.01
San Francisco, CA	2.68	1.43
Miami, FL	2.93	2.93
Washington, DC	2.79	N.A.
Seattle, WA	1.18	1.92
Boston, MA	3.31	3.57
<b>National Average (2)</b>	<b>2.32</b>	<b>2.18</b>

Note(s): 1) Energy includes electric, gas, fuel oil, purchased steam, purchased chilled water, and water/sewage expenditures. 2) Averages based on 831 urban respondents and 1788 suburban respondents across 94 US cities.

Source(s): BOMA International, The Experience Exchange Report 2007, August 2007.

**3.6.5 Top 10 Office Building Owners Globally as of Year End, 2006 (Million SF)**

<u>Owner</u>	<u>Square Footaged Owned</u>
Brookfield Properties Corp.	76.0
Tishman Speyer	53.9
LasSalle Investment Management	49.0
Hines	46.0
TIAA-CREF	44.2
Boston Properties	43.3
HRPT Properties Trust	42.0
Wells Real Estate Funds	39.2
CB Richards Ellis Investors LLC	38.4
<u>Mack-Cali Realty Corp.</u>	<u>33.9</u>
<b>Total for Top 10:</b>	<b>465.9</b>

Source(s): National Real Estate Investor, The Best of The Best: National Real Estate Investor Presents its Annual Rankings of the Leading Commercial Real Estate Companies, July 2007, p. 10.

**3.6.6 Top 10 Property Managers Globally as of Year End, 2006 (Million SF)**

<u>Managing Company</u>	<u>Square Footaged Owned</u>
CB Richard Ellis	1,700
Jones Lang LaSalle	1,000
Colliers International	829
Cushman & Wakefield	445
ProLogis	422
Lincoln Property Co.	221
Simon Property Group	211
Grubb & Ellis Co.	211
NAI Global	200
ING Clarion	193

Source(s): National Real Estate Investor, The Best of The Best: National Real Estate Investor Presents its Annual Rankings of the Leading Commercial Real Estate Companies, July 2007, p. 24.



**3.6.7 Advanced Energy Design Guide for Small Office Buildings (1)****Shell**

Percent Glass (WWR)	20-40%
Window U-Factor	0.33-0.56
SHGC	0.31-0.49
Wall R-Value	7.6-15.2
Roof R-Value	
Attic	30-60
Insulation Above Deck	15-30
Wall Material	Mass (HC > 7 Btu/ft <sup>2</sup> )

**Lighting**

Average Power Density (Watts/SF)	0.9
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**System and Plant**

System and Plant	
Packaged Single-Zone	
Packaged Single-Zone w/ Economizer	Cooling Capacity > 54 kBtu
Heating Plant:	
Gas Furnace	80% Combustion Efficiency
Cooling Plant:	
Air conditioner (135-240 thousand Btu*hr.)	10.8 EER/11.2 IPLV - 11.0 EER/11.5 IPLV
Service Hot Water:	
Gas Water Heater	90% Thermal Efficiency

Note(s): 1) Guide provides approximate parameters for constructing a building which is 30% more efficient than ASHRAE 90.1-1999. Ranges are because of climate zone dependencies.

Source(s): ASHRAE, Advanced Energy Design Guide for Small Office Buildings, 2004.

**3.6.8 Typical Office Building (1)**

	Large ( <u>&gt;= 25,000 SF</u> )	Small ( <u>&lt;25,000 SF</u> )
<b>Stock Floor Area (billion SF)</b>	8.22	4.29
<b>Floor-Area Weighted Averages</b>		
Building Area (thousand SF)	90 - 137	5.5 - 6.6
Floors	39,240	39,084
<b>Shell</b>		
Percent Glass	40 - 50	15 - 20
Window R-Value	1.39 - 1.71	1.34 - 1.99
Window Shading Coefficient	0.69 - 0.8	0.71 - 0.82
Wall R-Value	2.5 - 6.0	3.9 - 6.3
Roof R-Value	9.1 - 12.6	10.5 - 13.3
Wall Material	masonry	masonry
Roof Material	built-up	built-up
<b>Occupancy</b>		
Average Occupancy (SF/person)	390 - 460	420 - 470
Weekday Hours (hrs/day)	12	11
Weekend Hours (hrs/day)	5	4
<b>Equipment</b>		
Average Power Density (W/SF)	1	1
Full Lighting Hours (hrs/year)	3,580	3,360
<b>Lighting</b>		
Average Power Density (W/SF)	1.3 - 1.8	1.7 - 2.2
Full Lighting Hours (hrs/year)	4,190	3,340
<b>System and Plant</b>		
System and Distribution Type	Constant Volume w/ Reheat VAV w/ Economizer	Packaged Single-Zone Packaged Single-Zone w/ Economizer
Heating Plant	Gas Boiler	Gas Furnace
Cooling Plant	Hermetic Centrifugal Chiller	Direct Expansion
Service Hot Water	Gas Boiler	Gas Water Heater

Note(s): 1) The prototypes are synthetic buildings compiled from statistical data from building surveys or conclusions from previous studies. The physical characteristics, system characteristics, and usage patterns are based upon various surveys, studies, engineering estimates, or engineering judgment.

Source(s): LBNL, Commercial Heating and Cooling Loads Component Analysis, Nov. 1999, Table 10, p. 31.

**3.7.1 2006 Top Retail Companies, by Sales**

<u>Chain</u>	2006 Revenues (\$billion)	% Change over 2005 Revenues	# Stores 2006	% Change over 2005 Stores
Wal-Mart Stores, Inc.	345.0	11.7%	6,779	12.3%
The Home Depot	90.8	11.4%	2,147	5.1%
The Kroger Co.	66.1	9.2%	3,659	-1.8%
Target Corp.	59.5	13.1%	1,488	6.5%
Costco	59.0	13.7%	458	5.8%
Sears Holdings	53.0	7.9%	3,791	-1.4%
Walgreen Co.	47.4	12.3%	5,461	9.5%
Lowe's	46.9	8.5%	1,385	12.2%
CVS Caremark Corp.	43.8	18.4%	6,202	13.4%
Safeway	40.2	4.6%	1,761	-0.8%

Source(s): Chain Store Age, 2007 Top 100 U.S. Retailers, August 2007.

Full report available at [http://www.chainstoreage.com/industrydata/pdf/top100retailers/csa\\_2007\\_Top\\_100\\_Charts.pdf](http://www.chainstoreage.com/industrydata/pdf/top100retailers/csa_2007_Top_100_Charts.pdf)

**3.7.2 2006 Top Chain Restaurants, by Sales**

<u>Chain</u>	2006 Sales (\$billion)	% Change over 2005 Sales	Franchised Stores	Company-owned Stores	Total Stores
McDonald's	27.1	5.7%	11,670	2,104	13,774
Burger King (1)	8.5	0.4%	6,656	878	7,534
Wendy's (2)	7.8	1.1%	4,638	1,310	5,948
Subway (2)	7.7	7.5%	20,755	-	20,755
Taco Bell (2)	6.3	2.8%	4,341	1,267	5,608
Starbucks (3)	5.5	21.1%	-	5,728	5,728
KFC (2)	5.3	1.2%	4,371	1,023	5,394
Pizza Hut (2)	5.2	-2.3%	6,079	1,453	7,532
Dunkin' Donuts	4.3	11.9%	5,239	-	5,239
Sonic Drive-In	3.3	10.7%	2,565	623	3,188

Note(s): 1) Includes U.S. and Canadian Units. 2) Estimates. 3) U.S. only sales, estimate.

Source(s): QSR Magazine, The QSR 50 - 2007, Available at <http://www.qsrmagazine.com/reports/qsr50/2007/charts/qsr50-1.phtml>.

**3.7.3 2006 Top Supermarkets, by Sales**

<u>Supermarket</u>	2006 All Commodity Volume (millions)	No. of Stores (> \$2 million in sales)	Square Feet Selling Area (thousands)
Wal-Mart Stores, Inc.	126.7	2401	149,366
Kroger Co.	59.8	2459	103,493
Supervalu, Inc.	34.0	1718	70,068
Safeway, Inc.	33.7	1526	55,707
Ahold USA (Stop and Shop, Giant)	24.2	786	33,995
Publix Super Markets, Inc.	20.2	901	33,505
Delhaize America, Inc. (Food Lion)	17.3	1560	46,504
H.E. Butt Grocery Co. (HEB)	11.2	276	13,474
Winn-Dixie Stores, Inc.	8.5	522	24,180
Meijer, Inc.	7.3	176	10,397

Note(s): All commodity volume in this example represents the annualized range of the estimated retail sales volume of all items sold at a retail site that pass through the retailer's cash registers. TDLinX ACV is an estimate based on best available data—a directional measure to be used as an indicator of store and account size, not an actual retail sales report". (Progressive Grocer)

Source(s): TDLinX. Progressive Grocer Super 50. March 2007. [www.progressivegrocer.com](http://www.progressivegrocer.com).

**3.7.4 Advanced Energy Design Guide for Small Retail Buildings (1)****Shell**

Percent Glass	40%
Window (U-Factor)	0.38-0.69
SHGC	0.40-0.44
Wall R-Value	7.6-15.2 c.i.
Roof R-Value	
Attic	30-60
Insulation Above Deck	15-25 c.i.
Wall Material	Mass (HC > 7 Btu/ft <sup>2</sup> )

**Lighting**

Average Power Density (W/ft. <sup>2</sup> )	1.3
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**System and Plant**

System and Distribution Type	
Packaged Single-Zone	
Packaged Single-Zone w/ Economizer	Cooling Capacity > 54 kBtuh
Heating Plant	
Gas Furnace(>225 kBtuh)	80% Combustion Efficiency
Cooling Plant	
Air conditioner (>135-240 kBtuh)	10.0 EER/10.4 IPLV - 11.0 EER/11.5 IPLV
Service Hot Water	
Gas Water Heater	90% Thermal Efficiency

Note(s): 1) Guide provides approximate parameters for constructing a building which is 30% more efficient than ASHRAE 90.1-1999. Ranges are because of climate zone dependencies.

Source(s): ASHRAE, Advanced Energy Design Guide for Small Retail Buildings, 2004.

**3.7.5 Typical Mercantile & Service (Retail) Building (1)**

	Retail ( <u>&gt;= 25,000 SF</u> )	Retail ( <u>&lt;25,000 SF</u> )
<b>Stock Floor Area (billion SF)</b>	5.88	6.53
<b>Floor-Area Weighted Averages</b>		
Building Area (thousand SF)	80	5.3 - 6.4
Floors	2	1
<b>Shell</b>		
Percent Glass	15	15
Window R-Value	1.39 - 1.71	1.24 - 1.71
Window Shading Coefficient	0.74 - 0.79	0.85
Wall R-Value	3.1 - 6.4	2.5 - 6.6
Roof R-Value	10.6 - 14.0	9.5 - 13.2
Wall Material	masonry	masonry
Roof Material	built-up	built-up
<b>Occupancy</b>		
Average Occupancy (SF/person)	390 - 460	1,635 - 2,085
Weekday Hours (hrs/day)	12	12
Weekend Hours (hrs/day)	5	4
<b>Equipment</b>		
Average Power Density (W/SF)	0.40	0.50
Full Equipment Hours (hrs/year)	4,750 - 5,850	3,480
<b>Lighting</b>		
Average Power Density (W/SF)	1.6 - 2.1	1.7 - 2.2
Full Lighting Hours (hrs/year)	4,500 - 5,245	3,786 - 4,412
<b>System and Plant</b>		
System and Distribution Type	Constant Volume w/ Reheat VAV w/ Economizer	Packaged Single-Zone Packaged Single-Zone w/ Economizer
Heating Plant	Gas Boiler	Gas Furnace
Cooling Plant	Hermetic Centrifugal Chiller	Direct Expansion
Service Hot Water	Gas Boiler	Gas Water Heater

Note(s): 1) The prototypes are synthetic buildings compiled from statistical data from building surveys or conclusions from previous studies. The physical characteristics, system characteristics, and usage patterns are based upon various surveys, studies, engineering estimates, or engineering judgment.

Source(s): LBNL, Commercial Heating and Cooling Loads Component Analysis, June 1998, Table 11, p. 32.

**3.8.1 Medical Offices, Utilities Cost Per Square Foot (\$2006)**

Expense	<u>Downtown</u>	<u>Suburban</u>	<u>All</u>
Electricity	2.09	1.85	1.93
Natural Gas	0.34	0.37	0.36
Water/Sewer	0.21	0.21	0.21
<b>Overall Utilities (1)</b>	<b>2.57</b>	<b>2.31</b>	<b>2.39</b>

Note(s): 1) Does not equal sum of the other categories. Can also include purchased steam, purchased chilled water, and fuel oil.

Source(s): BOMA International, The Experience Exchange Report 2007, August 2007.

**3.8.2 Inpatient Medical Facilities Square Footage, Delivered Energy, Energy Intensity, Selected Years**

	<u>Total Square Footage</u> <u>(billion)</u>	<u>Energy Use</u> <u>(quadrillion Btus)</u>	<u>Energy Intensity</u> <u>(thousand Btus/SF)</u>
1999	1.865	0.43	229.0
2003	1.905	0.48	249.3
<b>2006</b>	<b>1.999</b>	<b>0.41</b>	<b>205.1</b>
2010	2.131	0.44	206.2
2015	2.314	0.50	215.0
2020	2.508	0.55	219.1
2025	2.718	0.60	220.9
2030	2.949	0.65	219.8

Source(s): EIA, The Commercial Energy Consumption Survey 2003, Table A2. Census Region, Number of Buildings and Floorspace for All Buildings (Including Malls); EIA, The Commercial Energy Consumption Survey 1999, Table B3. Page 11 Census Region, Number of Buildings and Floorspace; EIA, The Supplement to the Annual Energy Outlook 2008, Table 22, June 2008.

**3.8.3 Typical Hospital Building (1)**

	<u>Pre-1980</u>	<u>Post-1980</u>
<b>Stock Floor Area (billion SF)</b>	1.43	0.21
<b>Floor-Area Weighted Averages</b>		
Building Area (thousand SF)	66.2	156
Floors	6	12
<b>Shell</b>		
Percent Glass	25	25
Window R-Value	1.79	1.96
Window Shading Coefficient	0.71	0.66
Wall R-Value	0.3	6.9
Roof R-Value	12.3	11.5
Wall Material	masonry	masonry
Roof Material	built-up	built-up
<b>Occupancy</b>		
Average Occupancy (SF/person)	190	190
Weekday Hours (hrs/day)	24	24
Weekend Hours (hrs/day)	24	24
<b>Equipment</b>		
Average Power Density (W/SF)	2.20	2.20
Full Equipment Hours (hrs/year)	6,962	6,962
<b>Lighting</b>		
Average Power Density (W/SF)	2.1	2.1
Full Lighting Hours (hrs/year)	6,752	6,752
<b>System and Plant</b>		
System and Distribution Type	4-Pipe Fan-Coil in Rooms Reheat in Lobby & Core Single-Zone Reheat in Kitchen Dual-Duct in Kitchen	4-Pipe Fan-Coil in Rooms VAV in Lobby & Core Single-Zone Reheat in Kitchen Dual-Duct in Kitchen
Heating Plant	Gas Boiler	Gas Boiler
Cooling Plant	Hermetic Centrifugal Chiller	Direct Expansion
Service Hot Water	Gas Boiler	Gas Boiler

Note(s): 1) The prototypes are synthetic buildings compiled from statistical data from building surveys or conclusions from previous studies. The physical characteristics, system characteristics, and usage patterns are based upon various surveys, studies, engineering estimates, or engineering judgment.

Source(s): LBNL, Commercial Heating and Cooling Loads Component Analysis, June 1998, Table 14, p. 35.

**3.9.1 2003 Delivered Energy End-Use Intensities and Consumption of Educational Facilities, by Building Activity (1)**

	<u>(10<sup>12</sup> Btu)</u>		<u>(thousand Btu/SF)</u>
Space Heating	389	47%	39.4
Cooling	79	10%	8.0
Ventilation	83	10%	8.4
Water Heating	57	7%	5.8
Lighting	113	14%	11.5
Cooking	8	1%	0.8
Refrigeration	16	2%	1.6
Office Equipment	4	0%	0.4
Computers	32	4%	4.0
Other	39	5%	3.4
<b>Total</b>	<b>820</b>	<b>100%</b>	<b>83.1</b>

Note(s): 1) Educational facilities include K-12 as well as higher education facilities. 2) Due to rounding, sum does not add up to total.

Source(s): EIA, 2003 Commercial Building Energy Consumption and Expenditures End-Uses, Sept. 2008, Table E1A and E2A.

**3.9.2 2003-2004 Number of Public K-12 Schools in the United States and Students per School**

<u>Number of Schools (2004-2005)</u>		<u>Average Number of Students per School (2003-2004) (3)</u>	
Regular (1)	86,487	Elementary	438
Special	1,635	Middle	616
Vocational	326	High	758
Alternative	4,847	Other	266
<b>Total (2)</b>	<b>93,295</b>		

Note(s): 1) Regular schools are those responsible for providing free public education for school-age children residing within their jurisdiction. 2) Data is based on total number of schools reporting current student enrollment, which varies from the actual number of schools, 96,296. Special focuses primarily on special education with materials and instructional approaches to meet the needs of the students. A vocational school focuses on technical or career skills and training. An alternative school addresses the needs of students that typically cannot be met in a traditional school setting. 3) Averages are for regular schools.

Source(s): U.S. Department of Education/National Center for Educational Statistics (NCES), Public Elementary and Secondary Students, Staff, Schools, and School Districts: School Year 2003-04, Feb. 2006, Table 1, p. 3 and Table 8, p. 19.

**3.9.3 National Enrollment and Expenditures for Public K-12 Facilities (\$2006)**

	<u>Enrollment</u> <u>(millions)</u>	<u>Expenditures</u> <u>(\$billion)</u>	<u>Expenditures per Pupil</u>
1986	39.42	254.0	6,444
1990	40.54	301.9	7,446
1995	44.11	330.2	7,484
2000	46.86	389.5	8,313
2003	48.18	433.7	9,000
2005	48.56	454.0	9,405
2010	49.27	507.8	10,419
2015	50.74	597.6	11,779

Source(s): NCES, Projections of Educational Statistics to 2016, Sept. 2006, Table 33, p. 82 for 1990-2014; NCES, Projections of Educational Statistics to 2011, Oct. 2001, Table 33, p. 88 for 1986; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price inflators.



**3.9.4 Total Expenditures for K-12 School Plant Operations and Maintenance, by Function (\$2006 Billion)**

	1990		1995		2000		2004	
Salaries and Benefits	16.4	54%	17.2	53%	20.1	51%	22.1	51%
Purchased Services	8.2	27%	9.7	30%	11.2	28%	9.4	22%
Supplies	5.4	18%	5.3	16%	8.0	20%	0.4	1%
Other	0.5	2%	0.3	1%	0.3	1%	11.6	27%
<b>Total</b>	<b>30.4</b>	<b>100%</b>	<b>32.5</b>	<b>100%</b>	<b>39.6</b>	<b>100%</b>	<b>43.5</b>	<b>100%</b>

Note(s): 1) Operation and maintenance services include salaries, benefits, supplies, and contractual fees for supervision of operations and maintenance, operating buildings (heating, lighting, ventilating, repair and replacement), care and upkeep of grounds and equipment, vehicle operation and maintenance (other than student transportation), security and other operations and maintenance services.

Source(s): NCES, Digest of Educational Statistics 2007, Mar. 2008, Table 169, p. 250-251; EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price inflators.

**3.9.5 New Construction and Renovations Expenditures for Public K-12 Schools (\$2006 Billion)**

	New Schools	Additions	Modernizations	Total
1996	6.11	4.13	3.36	13.60
1997	7.46	4.36	3.31	15.13
1998	9.53	6.21	4.90	20.64
1999	7.11	6.04	5.95	19.09
2000	13.42	4.75	6.96	25.13
2001	12.74	4.81	12.92	30.47
2002	13.04	6.35	7.83	27.22
2003	19.10	5.79	6.47	31.36
2004	14.08	5.93	10.94	30.95
2005	12.67	6.34	4.66	23.67
2006	13.70	3.29	8.34	25.33

Source(s): American School and University, 23rd Annual Official Education Report, May 1997 for 1996; American School and University, 24th Annual Official Education Report, May 1998 for 1997; American School and University, 25th Annual Official Education Report, May 1999 for 1998; American School and University, 26th Annual Official Education Report, May 2000 for 1999; American School and University, 27th Annual Official Education Report, May 2001, Table 1, p. 26 for 2000; American School and University, 28th Annual Official Education Report, May 2002, Table 1, p. 24 for 2001; American School and University, 29th Annual Official Education Report, May 2003, Table 1, p. 29 for 2002; American School and University, 30th Annual Official Education Report, May 2004, Table 1, p. 24 for 2003; American School and University, 31st Annual Official Education Report, May 2005, Table 1, p. 29 for 2004; American School and University, 32nd Annual Official Education Report, May 2006, Table 1, p. 24 for 2005; American School and University, 33rd Annual Official Education Report, May 2007, Table 1, p. 30 for 2006; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377.

**3.9.6 Percentage of Public K-12 Schools with Inadequate Building Features (1)**

	Small		Medium		Large	
	1995	1999	1995	1999	1995	1999
Roofs	26%	24%	25%	22%	32%	22%
Framing, Floors, and Foundations	18%	19%	18%	12%	17%	14%
Exterior Walls, Finishes, Windows, and Doors	26%	31%	26%	21%	28%	23%
Interior Finishes	23%	20%	23%	16%	27%	18%
Plumbing	33%	28%	28%	27%	30%	20%
HVAC	36%	29%	35%	32%	39%	26%
Electrical Power	28%	23%	25%	21%	27%	22%
Electrical Lighting	25%	19%	24%	17%	26%	16%

Note(s): 1) Small school is defined as having 1-299 students, medium 300-599 students, and a large school has 600 or more students.

Source(s): National Center for Education Statistics, Digest of Educational Statistics 2005, July 2006, Table 100, p. 176-177 for 1999; and U.S. GAO, Health, Education, and Human Services Division, America's Schools Report Differing Conditions, GAO/HEHS-96-103, June 1996, Table II.9, p. 45 for 1995.

**3.9.7 Advanced Energy Design Guide for Typical Educational Facilities (1)****Shell**

Percent Glass	35% Maximum
Window U-Factor	0.33-0.56
Wall R-Value	5.7-15.2
Roof R-Value	
Attic	30.0-60.0 (2)
Insulation Above Deck	25.0
Wall Material	Mass: Heat Capacity > 7 Btu/SF*F

**Lighting**

Average Power Density(Watts/ft.^2)	
With Daylighting	0.9
Without Daylighting	1.1

**System and Plant**

System and Plant	
1 Central System	
Packaged Multi-Zone w/ Economizer	Comply with ASHRAE 90.1
Heating Plant:	Gas Boiler
	80-85 Combustion Efficiency
Cooling Plant:	Hermetic Centrifugal Chiller
	Comply with ASHRAE 90.1
Service Hot Water:	Gas Boiler
	80-85 Combustion Efficiency

Note(s): 1) Guide provides approximate parameters for constructing a building which is 30% more efficient than ASHRAE 90.1-1999. Ranges are because of climate zone dependencies.

Source(s): ASHRAE, Advanced Energy Design Guide for K-12 School Buildings, 2004.

**3.9.8 Typical School Building (1)**

	<u>Pre-1980</u>	<u>Post-1980</u>
<b>Stock Floor Area (billion SF)</b>	7.5	0.6
<b>Floor-Area Weighted Averages</b>		
Building Area (thousand SF)	22 - 47	16 - 26
Floors	2	2
<b>Shell</b>		
Percent Glass	27.0	18.0
Window R-Value	1.39 - 1.6	1.67 - 1.71
Window Shading Coefficient	0.80 - 0.83	0.71 - 0.73
Wall R-Value	2.7 - 3.4	5.3 - 5.7
Roof R-Value	10.1 - 10.9	12.6 - 13.3
Wall Material	masonry	masonry
Roof Material	built-up	built-up
<b>Occupancy</b>		
Average Occupancy (SF/person)	105	105
Weekday Hours (hrs/day)	8.0	8.0
Weekend Hours (hrs/day)	2.0	2.0
<b>Equipment</b>		
Average Power Density (W/SF)	0.8	0.8
Full Equipment Hours (hrs/year)	1,136	1,136
<b>Lighting</b>		
Average Power Density (W/SF)	1.8	1.7
Full Lighting Hours (hrs/year)	2,436	2,436
<b>System and Plant</b>		
System and Distribution Type	6 (Classrooms, Gym, Auditorium, Dining, Kitchen) Unit Ventilators	1 Central System Packaged Multi-Zone w/ Economizer
Heating Plant	Gas Boiler	Gas Boiler
Cooling Plant	Hermetic Centrifugal Chiller	Hermetic Centrifugal Chiller
Service Hot Water	Gas Boiler	Gas Boiler

Note(s): 1) The prototypes are synthetic buildings compiled from statistical data from building surveys or conclusions from previous studies. The physical characteristics, system characteristics, and usage patterns are based upon various surveys, studies, engineering estimates, or engineering judgment.

Source(s): LBNL, Commercial Heating and Cooling Loads Component Analysis, June 1998, Table 15, p. 36; and D&R for hours of occupancy.

**3.10.1 2003 Floorspace and Energy Consumption for Hotels and Motels/Inns (1)**

	<u>Hotels</u>	<u>Motels/Inns</u>
Average Electricity Consumption (thousand Btus/SF):	61.3	40.5
Average Natural Gas Consumption (thousand Btus/SF):	50.7	42.2
Average Fuel Oil Consumption (thousand Btus/SF) (2):	5.4	36.6
<b>Total Energy Consumption (quads)</b>	<b>0.21</b>	<b>0.08</b>
<b>Average Energy Consumption (thousand Btu/SF):</b>	<b>110.0</b>	<b>74.9</b>
<b>Total Floorspace (billion SF):</b>	<b>1.90</b>	<b>1.05</b>

Note(s): 1) Averages for fuel sources include only the floorspace that use a given fuel. 2) For Hotels, fuel oil was often used in buildings that used natural gas as well.

Source(s): EIA, Commercial Buildings Energy Consumption Survey 2003 Public Use Data Files, December 2006, Tables 2, 15, and 16.

**3.10.2 Lodging Industry, Rooms, Sales and Occupancy Rates**

	<u>Properties</u>	<u>Guestrooms (thousand)</u>	<u>Sales (\$2006 billion)</u>	<u>Avg. Occupancy Rate</u>	<u>Avg. Room Rate</u>
2001	41,393	4,200	133.40	60.3%	88.27
2002	47,040	4,398	114.71	59.1%	83.54
2003	47,584	4,416	115.29	61.1%	82.52
2004	47,598	4,412	120.98	61.3%	86.23
2005	47,590	4,402	126.50	63.1%	90.88
2006	47,135	4,389	133.40	63.3%	97.78

Source(s): The American Lodging Association, 2002 Lodging Industry Profile, p. 2-3; The American Lodging Association, 2003 Lodging Industry Profile, p. 2-3, 2002; The American Lodging Association, 2004 Lodging Industry Profile, p. 2-4, 2004; The American Lodging Association, 2005 Lodging Industry Profile, p. 2, 4, 2005; The American Lodging Association, 2006 Lodging Industry Profile, p. 2, 4, 2006; The American Lodging Association, 2007 Lodging Industry Profile, p. 2, 4, 2007.

**3.10.3 Hotel/Motel Rooms and Properties by Location, Room Size (Thousands)**

<u>Location</u>	<u>2001</u>		<u>2004 (1)</u>		<u>2005</u>		<u>2006</u>	
	<u>Properties</u>	<u>Rooms</u>	<u>Properties</u>	<u>Rooms</u>	<u>Properties</u>	<u>Rooms</u>	<u>Properties</u>	<u>Rooms</u>
Suburban	13.7	1,232	15.8	1,564	15.9	1,570	15.9	1,577
Highway	17.5	1,328	6.7	446	6.8	452	6.8	452
Urban	4.5	667	4.6	706	4.6	700	4.5	691
Airport	3.4	469	1.9	274	1.9	275	2.0	275
Resort	2.4	490	4.1	595	3.8	573	3.6	567
Small Metro(1)	-	-	14.5	826	14.6	832	14.4	827

Note(s): 1) Small Metro/Town category was created this year. With this recategorization, rooms were redistributed from other categories.

Source(s): The American Lodging Association, 2002 Lodging Industry Profile, p. 2-3, 2002; The American Lodging Association, 2005 Lodging Industry Profile, p. 2, 4, 2005; The American Lodging Association, 2006 Lodging Industry Profile, p. 2, 4, 2006; The American Lodging Association, 2007 Lodging Industry Profile, p. 2, 4, 2007.

**4.1.1 FY 2005 Federal Primary Energy Consumption (Quadrillion Btu)**

<b>Buildings and Facilities</b>	<b>0.65</b>
<u>Vehicles/Equipment/Energy-Intensive Operations</u>	<u>0.97</u> (mostly jet fuel and diesel)
Total Federal Government Consumption	1.62

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, Sept. 2006, Table A-1, p. 148 for total consumption and Table A-3, p. 150 for buildings consumption.

**4.1.2 FY 2005 Federal Building Energy Use Shares, by Fuel Type and Agency**

Fuel Type	Site Percent	Primary Percent	Agency	Primary Percent	FY 2005 (10 <sup>15</sup> Btu)
Electricity	46.1%	74.7%	DOD	62.9%	Total <i>Delivered</i> Energy Consumption = 0.30
Natural Gas	33.2%	15.6%	USPS	10.0%	Total Primary Energy Consumption = 0.65
Fuel Oil	9.4%	4.4%	DOE	5.3%	
Coal	4.3%	2.0%	VA	8.5%	
<u>Other</u>	<u>6.9%</u>	<u>3.3%</u>	GSA	4.8%	
Total	100%	100%	<u>Other</u>	<u>8.5%</u>	
			Total	100%	

Note(s): See Table 2.3.1 for floorspace.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, Sept. 2006, Table A-5, p. 152 for fuel types and Table A-3, p. 150 for agency consumption.

**4.1.3 Federal Building *Delivered* Energy Consumption Intensities, by Year (1)**

Year	Consumption per Gross Square Foot (10 <sup>3</sup> Btu/SF)	Year	Consumption per Gross Square Foot (10 <sup>3</sup> Btu/SF)
FY 1985	123.0	FY 1996	115.0
FY 1986	131.3	FY 1997	111.9
FY 1987	136.9	FY 1998	107.7
FY 1988	136.3	FY 1999	106.7
FY 1989	132.6	FY 2000	104.8
FY 1990	128.6	FY 2001	105.9
FY 1991	122.9	FY 2002	104.6
FY 1992	125.5	FY 2003	105.2
FY 1993	122.3	FY 2004	104.9
FY 1994	120.2	FY 2005 (3)	98.2
FY 1995 (2)	117.3	FY 2010 (4)	80.0

Note(s): 1) See Table 2.3.1 for floorspace. 2) Exceeds the National Energy Conservation Policy Act goal of 125,700 Btu/SF. 3) Misses the goal of Executive Order 13123 for FY 2005 of 97,600 Btu/SF. 4) Executive Order 13123 goal.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, Sept. 2004, Table 5-B, p. 57 for 1990-2002 energy consumption and Table 8-A, p. 65 for 2002 floorspace; DOE/FEMP, Annual Report to Congress on FEMP, Aug. 2005, Table 6-A, p. A-10 for 2003; DOE/FEMP, Annual Report to Congress on FEMP, Feb. 2006, Table 6-A, p. A-10 for 2004; DOE/FEMP, Annual Report to Congress on FEMP, Sept. 2006, Table 2, p. 13 for 1985 and 2005; and DOE/FEMP for remaining data.

**4.1.4 Federal Agency Progress Toward the Renewable Energy Goal (Trillion Btu) (1)**

	<u>Purchased Renewable Energy</u>	<u>Total Renewable Energy Usage</u>		<u>Total Facility Electricity Use</u>
DOD	5.33	8.35	8%	101.0
GSA	2.25	2.25	23%	9.9
DOE	0.53	0.55	3%	16.7
EPA	0.52	0.53	113% (2)	0.5
NASA	0.46	0.46	8%	5.5
DOC	0.30	0.30	27%	1.9
Others	0.46	0.56	1%	52.3
<b>All Agencies</b>	<b>9.85</b>	<b>13.00</b>	<b>7%</b>	<b>187.8</b>

Note(s): 1) In July 2000, in accordance with Section 503 of Executive Order 13123, the Secretary of Energy approved a goal that the equivalent of 2.5 percent of electricity consumption from Federal facilities should come from new renewable energy sources by 2005. 2) EPA's renewable energy use is 112.6% of its electricity use due to its purchases and generation of non-electric renewable energy.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, Sept. 2006, Table 5, p. 21, and p. 20 for note 1.

**4.2.1 Federal Building Gross Floorspace, by Year and Agency**

<u>Fiscal Year</u>	<u>Floorspace (10<sup>9</sup> SF)</u>	<u>Agency</u>	<u>2005 Percent of Total Floorspace</u>
FY 1985	3.37	DOD	66%
FY 1986	3.38	USPS	12%
FY 1987	3.40	GSA	6%
FY 1988	3.23	VA	5%
FY 1989	3.30	DOE	2%
FY 1990	3.40	Other	8%
FY 1991	3.21	Total	100%
FY 1992	3.20		
FY 1993	3.20		
FY 1994	3.11		
FY 1995	3.04		
FY 1996	3.03		
FY 1997	3.02		
FY 1998	3.07		
FY 1999	3.07		
FY 2000	3.06		
FY 2001	3.07		
FY 2002	3.03		
FY 2003	3.04		
FY 2004	2.97		
FY 2005	2.96		

Note(s): The Federal Government owns/operates over 500,000 buildings, including 422,000 housing structures (for the military) and 51,000 nonresidential buildings.

Source(s): DOE/FEMP for FY 1986-1998; DOE/FEMP, Annual Report to Congress on FEMP, May 10, 2001, Table 7-A, p. 56 for FY 1999; DOE/FEMP, Annual Report to Congress on FEMP, Dec. 11, 2002, Table 8-A, p. 83 for FY 1985 and FY 2000; DOE/FEMP, Annual Report to Congress on FEMP, Feb. 4, 2004, Table 8-A, p. 66 for 2001; DOE/FEMP, Annual Report to Congress on FEMP, Sept. 29, 2004, Table 8-A, p. 65 for 2002; DOE/FEMP, Annual Report to Congress on FEMP, Aug. 9, 2005, Table 6-A, p. 65 for 2003; DOE/FEMP, Annual Report to Congress on FEMP, Feb. 24, 2006, Table 6-A, p. A-10 for 2004; and DOE/FEMP, Annual Report to Congress on FEMP, Sept. 26, 2006, Table 2, p. 13 for 2005 .

**4.3.1 FY 2005 Federal Buildings Energy Prices' and Expenditures, by Fuel Type (\$2006)**

Fuel Type	Average Fuel Prices (\$/million Btu)	Total Expenditures (\$million) (2)
Electricity	21.51 (1)	2,977.3
Natural Gas	8.53	849.2
Fuel Oil	9.63	272.1
Coal	3.10	40.1
Purchased Steam	10.85	134.1
LPG/Propane	12.43	37.9
Other	14.63	79.5
<b>Average</b>	<b>14.19</b>	<b>Total 4,390.1</b>

Note(s): 1) \$0.071/kWh. 2) Energy used in buildings in FY 2005 accounted for 29.5% of the total Federal energy bill.

Source(s): DOE, Annual Report to Congress on FEMP, Sept. 2006, Table 5, p. 152 for prices and expenditures, and p. E-2 for Federal buildings energy expenditures. EIA, Annual Energy Review 2007, June 2008, p. 377 for price deflators.

**4.3.2 Annual Energy Expenditures per Gross Square Foot of Federal Floorspace Stock, by Year (\$2006)**

FY 1985	2.24
FY 2000	1.25
FY 2002	1.36
FY 2003	1.35
FY 2004	1.43
FY 2005	1.48

Note(s): Total Federal buildings and facilities energy expenditures in FY 2005 were \$4.26 billion (in \$2005).

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, Sept. 2006, Table 7-B, p. 62 for energy costs, and Table 2, p. 13 for floorspace; DOE/FEMP, Annual Report to Congress on FEMP, Feb. 2006, Table 5, p. A-9 for energy costs and Table 6-A, p. A-10 for floorspace; DOE/FEMP, Annual Report to Congress on FEMP, Aug. 2005, Table 5, p. A-9 for energy costs and Table 6-A, p. A-10 for floorspace; DOE/FEMP, Annual Report to Congress on FEMP, Sept. 2004, Table C, p. C-2 for energy costs and Table 8-A, p. 65 for floorspace; and DOE/FEMP, Annual Report to Congress on FEMP, Dec. 2002, Table 8-A, p. 61 for floorspace.

**4.3.3 Direct Appropriations on Federal Buildings Energy Conservation Retrofits and Capital Equipment (\$2006 Million)**

FY 1985	432.37	FY 1991	156.73	FY 1997	242.26	FY 2003	187.99
FY 1986	317.66	FY 1992	194.66	FY 1998	315.27	FY 2004	185.21
FY 1987	91.51	FY 1993	158.37	FY 1999	242.69	FY 2005	299.08
FY 1988	100.78	FY 1994	295.49	FY 2000	139.60		
FY 1989	77.26	FY 1995	362.20	FY 2001	147.87		
FY 1990	84.57	FY 1996	220.85	FY 2002	134.84		

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, Sept. 2006, Table 10-B, p. 32; DOE/FEMP, Annual Report to Congress on FEMP, Dec. 2002, Table 4-A, p. 32; and EIA, Annual Energy Review 2006, June 2007, Appendix D, p. 377 for price deflators.



The Envelope and Equipment chapter contains market and technology data on building materials and equipment. These include building assemblies, insulation, windows, and roofing. Data is also included on heating, cooling and ventilation equipment; water heaters; appliances; lighting; active solar systems; on-site wind power, and other on-site power technologies.

- Residential prime window sales declined 16 percent from 2005 to 2007.
- The best available residential furnaces and residential boilers are rated at 97 percent and 96 percent AFUE respectively. In 1985, the average furnace and boilers rated 74 percent AFUE.
- In 2006, LG Electronics was the top heat pump manufacturer and also the top room air conditioner manufacturer, while UTC/Carrier was the top gas furnace manufacturer, by market share.
- The average lifetime of central air conditioners and heat pumps is 11 years.
- The past two decades have seen a decline in electricity as the main fuel for residential heating. While natural gas has increased to regain the top spot.
- In 2006, Rheem Manufacturing was the top water heater manufacturer, by market share.
- Of households that use hot water, 53.4 percent of water heaters use natural gas and 39.2 percent use electricity as the fuel.
- Sales of screw based compact fluorescent lamps increased significantly between 2003 and 2004.
- The 2006 value of all residential refrigerator sales was \$5.4 billion.
- In 2006, GE was the top refrigerator manufacturer, followed by Electrolux (Frigidaire), and Whirlpool. Whirlpool was also the top clothes washer and dryer manufacturer. During 2006, Whirlpool completed a merger with Maytag.
- Over 75 million residential and small commercial appliances will be replaced during 2008.
- Over 90 percent of U.S. households own a refrigerator and a microwave. 83 percent of households own clothes washers while only 25 percent of households own room air conditioners.
- An increase in utility-scale solar thermal collector shipments from 2000 to 2005 is mostly due to a large plant project in the State of Nevada.

- Shipments of thermal solar collectors for hot water heating nearly doubled from 2005 to 2006. Florida is the top state for thermal solar collectors, followed closely by California and Nevada.
- Shipments of photovoltaic cells and modules increased 25 percent from 2004 to 2005 and saw a near 50 percent increase from 2005 to 2006.
- Over 60 percent of exported photovoltaic shipments go to Germany.
- New photovoltaic installations increased 25 percent from 2006 to 2007.
- California is the top state for grid-tied photovoltaic capacity. Followed by New Jersey, Arizona, Nevada, New York, and Colorado.
- Considering off-grid and on-grid photovoltaic systems, the total installed capacity is over 750MW.
- Over 9000 small wind units were installed in 2007. 41 percent are off-grid systems of less than one kilowatt. 34 percent are residential scale on-grid systems of 1 – 10kW. 25 percent are commercial scale on-grid systems of 11 – 100kW.

**5.1.1 U.S. Insulation Demand, by Type (Million Pounds) (1)**

Insulation Type	1992		2001		2006 (1)	
	Million Pounds	%	Million Pounds	%	Million Pounds	%
Fiberglass	2,938	55%	3,760	54%	4,085	53%
Foamed Plastic	1,223	23%	1,775	25%	1,955	26%
Cellulose	485	9%	665	9%	730	10%
Mineral Wool	402	8%	445	6%	480	6%
Other	309	6%	370	5%	395	5%
<b>Total</b>	<b>5,357</b>	<b>100%</b>	<b>7,015</b>	<b>100%</b>	<b>7,645</b>	<b>100%</b>

Note(s): 1) Projected.

Source(s): National Insulation Association, www.insulation.org, Aug. 2006.

**5.1.2 Industry Use Shares of Mineral Fiber (Glass/Wool) Insulation (1)**

	1997	1999	2001	2003	2004	2005
Insulating Buildings (2)	70%	71%	72%	65%	64%	63%
Industrial, Equipment, and Appliance Insulation	27%	26%	25%	28%	30%	31%
Unknown	3%	3%	3%	7%	6%	5%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Note(s): 1) Based on value of shipments. 2) Including industrial.

Source(s): DOC, Annual Survey of Manufacturers: Value of Product Shipments 2005, Nov. 2006, Table 1, p. 54 for 2003-2005; and DOC, 2001 Annual Survey of Manufacturers: Value of Product Shipments, Dec. 2002, p. 65 for 1997-2001.

**5.1.3 Thermal Performance of Insulation**

	R-Value per Inch (1)		R-Value per Inch (1)
Fiberglass (2)		Perlite/Vermiculite	
Batts	3.1 - 4.3 (3)	Loose-Fill	2.1 - 3.7
Loose-Fill	2.5 - 3.7	Foam Boards	
Spray-Applied	3.7 - 3.9	Expanded Polystyrene	3.9 - 4.4
Rock Wool (2)		Polyisocyanurate/	
Loose-Fill	2.5 - 3.7	Polyurethane	5.6 - 7.0
Cellulose		Phenolic	4.4 - 8.2
Loose-Fill	3.1 - 3.7	Reflective Insulation	2 - 17
Spray-Applied	2.9 - 3.5	Vacuum Powder Insulation	25 - 30
		Vacuum Insulation Panel	20 - 100

Note(s): 1) Hr-SF-F/Btu-in. Does not include the effects of aging and settling. 2) Mineral fiber. 3) System R-Value depends on heat-flow direction and number of air spaces.

Source(s): ASHRAE, 1997 ASHRAE Handbook: Fundamentals, p. 24-4, 22-5; DOE, Insulation Fact Sheet, Jan. 1988, p. 6; Journal of Thermal Insulation, 1987, p. 81-95; ORNL, ORNL/SUB/88-SA835/1, 1990; ORNL, Science and Technology for a Sustainable Energy Future, Mar. 1995, p. 17; and ORNL for vacuum insulation panel.

**5.1.4 "Green Roofs" Completed by Year (Thousands of SF)**

	North America			<b>Total</b>
	<u>Extensive</u>	<u>Intensive</u>	<u>Mixed</u>	
2004	916.8	405.8	4.924	1,327
2005	1,785	488.1	198.7	2,472
2006	1,957	1033	73.79	3,064
2007	-	-	-	2,408

	United States			<b>Total</b>
	<u>Extensive</u>	<u>Intensive</u>	<u>Mixed</u>	
2004	777.1	405.8	3.924	1,187
2005	1,570	476.4	102.9	2,150
2006	-	-	-	-

Note(s): 1) Extensive: soil depth of less than 6 inches. 2) Intensive: soil depth greater than 6 inches. 3) Mixed: at least 25% break up between extensive and intensive. 4) This data is best used as a gauge of activity in this market rather than actual amount of green roofs.

Source(s): Green Roof Industry Survey, Green Roof Infrastructure Monitor, (Reporting Years 2006, 2007, and 2008)

**5.1.5 Properties of Cool Roofing Materials (1)**

<b>Asphalt Shingles</b>	<u>Solar Reflectance (2)</u>	<u>Infrared Emittance (3)</u>
Shasta White	0.26	0.91
Generic White	0.25	0.91
Generic Grey	0.22	0.91
Light Brown	0.19	0.91
Medium Brown	0.12	0.91
Generic Black	0.05	0.91
<b>White Coatings</b>		
White Coating (1 coat, 8 mil)	0.80	0.91
White Coating (2 coats, 20 mil)	0.85	0.91
<b>Aluminum Coatings</b>		
Aluminum	0.61	0.25
Fibered on Black	0.40	0.56
<b>Membranes</b>		
Gray EPDM (4)	0.23	0.87
White EPDM (4)	0.69	0.87
T-EPDM (4)	0.81	0.92
Light Gravel on Built-Up Roof	0.34	0.90
<b>Metal Roof</b>		
New, Bare Galvanized Steel	0.61	0.04
<b>Tiles</b>		
Red Clay	0.33	0.90
White Concrete	0.73	0.90
Fiber Cement, Pewter Gray	0.25	0.90

Note(s): 1) A good cool-roofing material has high solar reflectance and high infrared emittance. 2) Solar Reflectance is the percentage of incident solar radiation that is reflected by the material. 3) A number between 0 and 1 that describes the ability of a material to shed heat. The lower the value, the more heat the material retains. 4) Ethylene propylene diene monomer rubber material.

Source(s): Lawrence Berkeley National Laboratory, Cool Roofing Materials Database, <http://eetd.lbl.gov/coolroofs/>.

**5.1.6 ENERGY STAR Cool Roofing Product Shipments (Billion SF) and Penetration Rate**

	<u>Commercial Roofing</u>	<u>Residential Roofing</u>	<u>Total</u>	<u>ENERGY STAR Penetration</u>
1999	0.0	0.1	0.1	0%
2000	0.0	0.1	0.1	0%
2001	0.0	0.1	0.1	0%
2002	4.4	0.0	4.5	24%
2003	1.0	0.1	1.0	5%
2004	1.2	0.3	1.4	7%
2005	3.5	0.2	3.7	19%
2006	4.1	0.5	4.5	23%

Note(s): N/A: Year is before date of ENERGY STAR specification. 1) Billion square feet.

Source(s): LBNL, Climate Change Action Plan spreadsheet (updated 2007).

**5.2.1 Residential Prime Window Sales, by Type (Million Units) (1)**

	<u>Aluminum (2)</u>	<u>Wood (3)</u>	<u>Vinyl</u>	<u>Other</u>	<u>Total (4)</u>
<b>New Construction</b>					
1990	5.9	9.4	1.2	0.1	16.6
1995	4.7	11.6	4.8	0.3	21.4
2000	3.7	12.8	9.0	0.4	25.8
2005	6.5	9.2	17.4	1.0	34.1
2007	4.4	6.2	13.2	1.0	24.8
<b>Remodeling/Replacement</b>					
1990	3.6	7.6	7.1	0.1	18.4
1995	3.9	9.4	9.6	0.2	23.1
2000	4.0	10.2	14.8	0.2	29.2
2005	2.4	10.0	23.2	0.9	36.4
2007	1.9	8.9	22.5	1.0	34.3
<b>Total Construction</b>					
1990	9.5	17.0	8.3	0.2	35.0
1995	8.6	21.0	14.4	0.5	44.5
2000	7.7	23.0	23.8	0.6	55.0
2005	8.9	19.2	40.6	1.9	70.5
2007	6.3	15.1	35.7	2.0	59.1

Note(s): 1) Average window life span is 35-45 years. 2) In 1993, 65% of aluminum-framed windows were thermally broken. 3) Includes vinyl-clad and metal-clad units. 4) Due to rounding, sums may not add up to totals.

Source(s): AAMA, Industry Statistical Review and Forecast 1992, 1993 for Note 2; AAMA/NWWDA, Industry Statistical Review and Forecast 1996, 1997, Table 6, p. 6 for 1990; AAMA/WDMA, 2000 AAMA/WDMA Industry Statistical Review and Forecast, Feb. 2001, p. 6 for 1995; 2003 AAMA/WDMA Industry Statistical Review and Forecast, June 2004, p. 6 for 2000 and 2003; and LBNL, Savings from Energy Efficient Windows, Apr. 1993, p. 6 for window life span; AAMA/WDMA, Study of U.S. Market For Windows, Doors, and Skylights, Apr. 2006, p. 41 for 2005.; AAMA/WDMA. U.S. Industry Statistical Review and Forecast Mar. 2008, p. 6 for 2007.

**5.2.2 Residential Storm Window and Door Shipments, by Type (Million Units)**

Type	Windows				Doors				Total			
	1990	2000	2005	2007	1990	2000	2005	2007	1990	2000	2005	2007
Aluminum	9.9	8.0	6.6	NA	1.9	4.3	4.4	3.8	11.8	12.3	11.0	NA
Wood	0.5	2.3	2.0	NA	0.4	1.4	1.7	1.3	0.9	3.7	3.7	NA
Other (1)	0.1	0.3	0.2	NA	0.1	0.1	0.1	0.1	0.2	0.4	0.3	NA
<b>Total (2)</b>	<b>10.5</b>	<b>10.6</b>	<b>8.8</b>	<b>NA</b>	<b>2.4</b>	<b>5.8</b>	<b>6.4</b>	<b>5.2</b>	<b>12.9</b>	<b>16.4</b>	<b>15.2</b>	<b>NA</b>

Note(s): 1) Other includes metal over wood/foam core or vinyl, etc. 2) Due to rounding, sums may not add up to totals.

Source(s): AAMA/NWWDA, Industry Statistical Review and Forecast 1996, 1997, Table 7, p. 7 for 1990; AAMA/NWWDA, 2000 AAMA/WDMA Industry Statistical Review and Forecast, Feb. 2001, p. 7 for 1995; and 2003 AAMA/WDMA Industry Statistical Review and Forecast, June 2004, p. 6 for 2000 and 2003; AAMA/WDMA, Study of U.S. Market for Windows, Doors, and Skylights, Apr. 2006, p. 101, Exhibit G.2 for 2005; AAMA/WDMA, Study of U.S. Market for Windows, Doors, and Skylights, Mar. 2008, p. 98

**5.2.3 Nonresidential Window Usage, by Type and Census Region (Million SF of Vision Area) (1)**

Type	Northeast		Midwest		South		West		Total	
	1995	2007	1995	2007	1995	2007	1995	2007	1995	2007
<b>New Construction</b>										
Commercial Windows (2)	4	33	16	32	21	56	13	37	54	159
Curtain Wall	3	17	6	15	16	31	8	23	33	86
Store Front	7	20	11	21	14	46	11	29	43	116
<b>Total (3)</b>	<b>14</b>	<b>71</b>	<b>33</b>	<b>68</b>	<b>51</b>	<b>133</b>	<b>32</b>	<b>90</b>	<b>130</b>	<b>361</b>
<b>Remodeling/Replacement</b>										
Commercial Windows (2)	18	29	25	27	46	34	27	19	116	109
Curtain Wall	4	3	6	3	8	5	10	4	28	15
Store Front	12	9	18	9	24	20	22	13	76	51
<b>Total (3) Green Roof Industry</b>	<b>34</b>	<b>40</b>	<b>49</b>	<b>38</b>	<b>78</b>	<b>60</b>	<b>59</b>	<b>36</b>	<b>220</b>	<b>174</b>
<b>Total</b>										
Commercial Windows (2)	22	62	41	59	67	90	40	56	170	268
Curtain Wall	7	20	12	18	24	36	18	27	61	101
Store Front	19	29	29	30	38	66	33	42	119	167
<b>Total (3)</b>	<b>48</b>	<b>111</b>	<b>82</b>	<b>106</b>	<b>129</b>	<b>193</b>	<b>91</b>	<b>126</b>	<b>350</b>	<b>536</b>

Note(s): 1) Usage is a good indication of sales. 2) Formerly referred to as Architectural. Includes both shop-fabricated (true architectural) and site-fabricated products. 3) Due to rounding, sums may not add up to totals.

Source(s): AAMA/Ducker Research, Industry Statistical Review and Forecast 1996, Mar. 1997, p. 17 for 1995; and AAMA/WDMA/Ducker, U.S. Industry Statistical Review and Forecast, Mar. 2008, p. 17 for 2007.

**5.2.4 Insulating Glass Historical Penetration, by Sector (Percent of Total U.S. Usage) (1)**

Sector	1985	1990	1995	2000	2005	2007
Residential	73%	86%	89%	92%	94%	95%
Nonresidential	63%	80%	84%	86%	88%	89%

Note(s): 1) Usage is a good indication of sales. Includes double- and triple-pane sealed units.

Source(s): Ducker Research, Industry Statistical Review and Forecast 1992, 1993 for 1985; AAMA/Ducker Research, Industry Statistical Review and Forecast 1993, for 1990; AAMA/WDMA, 2000 AAMA/WDMA Industry Statistical Review and Forecast, Feb. 2001, p. 12 for 1995-1997; and 2003 AAMA/WDMA Industry Statistical Review and Forecast, June 2004, p.12 for 1998-2000; AAMA/WDMA, Study of U.S. Market For Windows, Doors, and Skylights, Apr. 2006, for 2005; AAMA/WDMA, U.S. Industry Statistical Review and Forecast, Mar. 2008, p. 12

**5.2.5 Residential Prime Window Sales, by Type (Million Units)**

Type	1980	1990	1995	2001	2003	2005	2007
Single Lite	8.6	4.9	5.5	3.9	4.7	4.2	2.7
Two Lite, Sealed, IG (1)	0.0	12.0	37.8	50.9	55.9	63.8	55.0
Other	16.6	18.7	1.3	1.5	2.2	2.5	1.4
<b>Total</b>	<b>25.2</b>	<b>35.6</b>	<b>44.5</b>	<b>56.3</b>	<b>62.8</b>	<b>70.5</b>	<b>59.1</b>

Note(s): 1) IG = insulated glazing.

Source(s): AAMA/NWWDA, Study of the U.S. Market for Windows and Doors, 1996, Table 22, p.49; AAMA/WDMA, Study of U.S. and Canadian Market for Windows and Doors, Apr. 2000, Exhibit E.7, p. 55; AAMA/WDMA, Study of the Market for U.S. Doors, Windows and Skylights, Apr. 2004, Exhibit D.4, p. 46; and, AAMA/WDMA, Study of U.S. Market For Windows, Doors, and Skylights, Apr. 2006, Exhibit D.8 Conventional Window Glass Usage, p. 50.; AAMA/WDMA, Study of U.S. Market For Windows, Doors, and Skylights, Mar. 2008, Exhibit D.8 Conventional Window Glass Usage, p. 49

**5.2.6 2005 Residential Prime Window Stock (million households) (1)**

<u>Census Division</u>	<u>Double-Pane</u>			<u>Total</u>	<u>Total Households(2)</u>
	<u>Single-Pane</u>	<u>Without Low-e</u>	<u>With Low-e</u>		
New England	2.1	2.8	0.4	3.2	5.3
Middle Atlantic	4.7	9.4	0.9	10.3	15.0
East North Central	5.6	9.7	2.0	11.7	17.3
West North Central	2.9	3.9	0.9	4.8	7.7
South Atlantic	12.3	7.9	1.1	9.0	21.3
East South Central	3.4	3.1	0.3	3.4	6.8
West South Central	8.0	3.8	0.3	4.1	12.1
Mountain	2.8	3.6	0.9	4.5	7.3
<u>Pacific</u>	<u>8.9</u>	<u>6.4</u>	<u>1.1</u>	<u>7.5</u>	<u>16.4</u>
<b>National</b>	<b>50.7</b>	<b>50.6</b>	<b>7.9</b>	<b>58.5</b>	<b>109.2</b>
<u>Selected States</u>					
New York	2.2	4.2	0.6	4.8	7.0
Florida	5.4	1.3	N.A.	1.3	6.7
Texas	5.1	2.5	N.A.	2.5	7.6
California	7.6	3.7	0.7	4.4	12.0

Note(s): 1) Preliminary data. 2) This is the total households using single- and double-pane glass. An additional 1.3 million households use other forms of windows, such as triple-pane windows.

Source(s): EIA, The 2005 Residential Energy Consumption Survey, Tables HC 11.5, HC 12.5, HC 13.5, HC 14.5, and HC 15.5, June 2008.

**5.2.7 Nonresidential Window Stock and Usage, by Type (1)**

<u>Type</u>	<u>Existing U.S. Stock (% of buildings)</u>	<u>Glass Area Usage (million SF)</u>				
		<u>1995</u>	<u>2001</u>	<u>2003</u>	<u>2005</u>	<u>2007</u>
Single-Pane	53%	56	57	48	56	60
<u>Insulating Glass (2)</u>	<u>47%</u>	<u>294</u>	<u>415</u>	<u>373</u>	<u>407</u>	<u>476</u>
<b>Total</b>	<b>100%</b>	<b>350</b>	<b>472</b>	<b>421</b>	<b>463</b>	<b>536</b>
Clear	65%	36%	49%	43%	44%	38%
Tinted	28%	40%	24%	17%	15%	11%
Reflective	7%	7%	8%	6%	4%	3%
<u>Low-e</u>	<u>(3)</u>	<u>17%</u>	<u>19%</u>	<u>34%</u>	<u>37%</u>	<u>48%</u>
Total	100%	100%	100%	100%	100%	100%

Note(s): 1) Usage is a good indication of sales. 2) Includes double- and triple-pane sealed units (and stock glazing with storm windows). 3) Included as part of the Tinted category.

Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, June 2006, Table B1 for stock data; AAMA/NWWDA, 1996 Study of the U.S. Market for Windows and Doors, Table 27, p. 60 for 1995 usage values; 2003 AAMA/WDMA Study of the U.S. Market for Windows, Doors and Skylights, Exhibits D.31 and D.32 for 2001; AAMA/WDMA/Ducker, Study of U.S. Market For Windows, Doors, and Skylights, Apr. 2006, Exhibit D.31 and Exhibit D.32, p. 73 for 2003 and 2005.; AAMA/WDMA/Ducker, Study of U.S. Market For Windows, Doors, and Skylights, Mar. 2008, Exhibit D.31 and Exhibit D.32, p. 72 for 2007.



**5.2.8 Typical Thermal Performance of Residential Windows, by Type (1)**

	Solar Heat Gain		<u>Visual Transmittance</u>
	<u>U-Factor</u>	<u>Coefficient</u>	
Single-Glazed Clear	0.84-1.16	0.64-0.76	0.65-0.75
Single-Glazed with Bronze Tint	0.84-1.16	0.54-0.65	0.49-0.56
Double-Glazed Clear	0.44-0.76	0.56-0.68	0.59-0.68
Double-Glazed with grey/Bronze Tint	0.44-0.76	0.47-0.56	0.44-0.51
Double-Glazed with High Performance Tint	0.44-0.76	0.39-0.47	0.50-0.57
Double-Glazed with High-Solar Gain Low-e Glass, Argon/Krypton Gas	0.29-0.61	0.53-0.64	0.54-0.62
Double-Glazed with Moderate-Solar Gain Low-e Glass, Argon/Krypton Gas	0.27-0.60	0.44-0.53	0.556-0.65
Double-Glazed with Low-Solar Gain Low-e (1) Glass, Argon/Krypton Gas	0.26-0.59	0.30-0.37	0.51-0.59
Triple-Glazed (2) with High-Solar Gain Low-e Glass, Argon/Krypton Gas (3)	0.15	0.51	0.65
Triple-Glazed (2) with Low-Solar Gain Low-e (1) Glass, Argon/Krypton Gas (3)	0.14	0.33	0.56

Note(s): 1) Spectrally selective, 2) Includes double glazing with suspended film, 3) Center of glass properties, does not include frame or installation properties

Source(s): The Efficient Windows Collaborative <http://www.efficientwindows.org/index.cfm>.

**5.3.1 U.S. Heating and Air-Conditioning System Manufacturer Shipments, by Type (Including Exports)**

Equipment Type	1990 (1,000s)	2000 (1,000s)	2005 (1,000s)	2005 Value of Shipments (\$million) (6)
<b>Air-Conditioners (1)</b>	<b>2,920.0</b>	<b>5,346.0</b>	<b>6,472.3</b>	<b>5,836.6</b>
<b>Heat Pumps</b>	<b>808.7</b>	<b>1,539.2</b>	<b>2,336.0</b>	<b>2,226.4</b>
Air-to-Air Heat Pumps	808.7	1,339.4	2,113.9	1,869.5
Water-Source Heat Pumps (2)	N.A.	199.8	222.0	356.9
<b>Chillers</b>	<b>N.A.</b>	<b>38.1</b>	<b>37.3</b>	<b>1,092.6</b>
Reciprocating	N.A.	24.8	24.1	462.1
Centrifugal/Screw	5.0	8.5	5.8	566.3
Absorption	N.A.	4.8	7.4	64.2
<b>Furnaces</b>	<b>2,368.9</b>	<b>3,680.7</b>	<b>3,623.7</b>	<b>2,143.7</b>
Gas-Fired (3)	1,950.5	3,104.2	3,512.5	2,081.0
Electric	280.0	455.0	N.A.	N.A.
Oil-Fired (4)	138.5	121.5	111.2	62.8
<b>Boilers (5)</b>	<b>316.1</b>	<b>368.4</b>	<b>369.7</b>	<b>N.A.</b>

Note(s): 1) Includes exports and gas air conditioners (gas units <10,000 units/yr) and rooftop equipment. Excludes heat pumps, packaged terminal air conditioner units, and room air conditioners. Approximately 95% of unitary air conditioners shipped are 5.5 tons or less (65,000 Btu/hr). ~70% residential and ~30% commercial applications. 2) Includes ground-source heat pumps, which numbered around 80,600 units shipped in 2005. 3) Gas-fired furnace value of shipments are based on Census unit shipment data, which is about 873,500 units higher than the industry data shown. 4) Oil-fired furnace value of shipments are based on Census unit shipment data, which is approximately 33,600 units lower than the industry data shown. 5) 61% of shipments were gas-fired and 39% were oil-fired. 96% of shipments are cast iron and 4% are steel. 6) Total 2005 value of shipments for heating, ventilation, and air conditioning (HVAC) and refrigeration was \$24.7 billion, including industrial and excluding boilers and electric furnaces.

Source(s): ARI, Statistical Profile, Oct. 7, 2004, Table 17, p. 24, Table 18, p. 25, and Table 22, p. 30 for air conditioner, air-to-air heat pump, and 1990 centrifugal/screw chiller shipments; ARI, ARI Koldfax, Feb. 2005, p. 1 for 2004 air conditioner shipments; GAMA, GAMA Statistical Highlights: Ten Year Summary, 1987-1996; GAMA, GAMA Statistical Highlights: Ten Year Summary, 1994-2000 for furnace and boiler shipments; GAMA, GAMA News Release, Jan. 2005 for 2004 boiler shipments; GAMA, Statistical Highlights, Mar. 2005, p. 4 for 2004 furnace shipments; Appliance Manufacturer, Feb. 1998 for electric furnace; DOC, Current Industrial Reports: Refrigeration, Air Conditioning and Warm Air Heating Equipment, MA333M(06)-1, July 2007, Table 2, for water-source heat pumps, chillers, and value of shipments; Appliance Magazine Appliance Statistical Review, 54th Annual Report, May 2007, p. S1 - S4 for 2005 boiler data; ARI Statistical News Releases 2005, <http://ari.org/newsroom/stats/2005/>; and GAMA News Release, Jan. 2007 for note 5.

**5.3.2 Residential Furnace Efficiencies (Percent of Units Shipped) (1)**

Gas-Fired		Oil-Fired	
AFUE Range	1985	AFUE Range	2006
Below 65%	15%	75% to 88%	64%
65% to 71%	44%	<u>88% or More</u>	<u>36%</u>
71% to 80%	10%	Total	100%
80% to 86%	19%		
<u>More Than 86%</u>	<u>12%</u>		
Total	100%		
Average shipped in 1985 (2):	74% AFUE	Average shipped in 1985 (2):	79% AFUE
Average shipped in 1995:	84% AFUE	Average shipped in 1995:	81% AFUE
Best Available in 1981:	85% AFUE	Best Available in 1981:	85% AFUE
Best Available in 2007:	97% AFUE	Best Available in 2007:	95% AFUE

Note(s): 1) Federal appliance standards effective Jan. 1, 1992, require a minimum of 78% AFUE for furnaces. 3) Includes boilers.

Source(s): GAMA's Internet Home Page for 2006 AFUE ranges; GAMA News, Feb. 24, 1987, for 1985 AFUE ranges; LBNL for average shipped AFUE; GAMA, Consumer's Directory of Certified Efficiency Ratings, May 2004, p. 12 and 72-73 for 2004 best-available AFUEs; GAMA Consumer's Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment, May 2007; GAMA Tax Credit Eligible Equipment: Gas- and Oil-Fired Furnaces 95% AFUE or Greater, May 2007; and GAMA AFUE press release 2006: U.S. shipments of gas warm-air central furnaces

**5.3.3 Residential Boiler Efficiencies (1)****Green Roof Industry Survey, Green Roof Infrastructure Monitor, (Reporting Years 2006, 2007, and 2008)**

Gas-Fired Boilers		Oil-Fired Boilers	
Average shipped in 1985 (2):	74% AFUE	Average shipped in 1985 (2):	79% AFUE
Best Available in 1981:	81% AFUE	Best Available in 1981:	86% AFUE
Best Available in 2007:	96% AFUE	Best Available in 2007:	89% AFUE

Note(s): 1) Federal appliance standards effective Jan. 1, 1992, require a minimum of 80% AFUE (except gas-fired steam boiler, which must have a 75% AFUE or higher). 2) Includes furnaces.

Source(s): GAMA, Consumer's Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment, Aug. 2005, p. 88 and 106 for best-available AFUE; and GAMA for 1985 average AFUEs; GAMA Tax Credit Eligible Equipment: Gas- and Oil-Fired Boilers 95% AFUE or Greater, May 2007; and GAMA Consumer's Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment, May 2007.

**5.3.4 Residential Air Conditioner and Heat Pump Cooling Efficiencies**

Equipment Type	Efficiency Parameter	2005 Stock Efficiency	2007 U.S. Average New Efficiency	2007 Best-Available New Efficiency
Air Conditioners	SEER	10.2	13.0	21.0
Heat Pump - Cooling				
Air-Source	SEER	10.0	13.0	17.0
Ground-Source	EER	13.8	16.0	30.0
Heat Pump - Heating				
Air-Source	HSPF	6.8	7.7	10.6
Ground-Source	COP	3.4	3.4	5.0

Source(s): EIA/Navigant Consulting, EIA - Technology Forecast Updates - Residential and Commercial Buildings Technologies Reference Case, Second Edition (Revised), Sept. 2007, p. 26-31.

**5.3.5 Commercial Equipment Efficiencies**

Equipment Type	Efficiency Parameter	2003 Stock Efficiency	2007 U.S. Average New Efficiency	2007 Best-Available New Efficiency
Chiller				
Screw	COP	2.3	2.7	2.9
Scroll	COP	2.6	3.0	N.A.
Reciprocating	COP	2.3	2.7	3.5
Centrifugal	COP	4.7	5.9	7.3
Gas-Fired Absorption	COP	1.0	1.0	N.A.
Gas-Fired Engine Driven	COP	1.0	1.7	N.A.
Rooftop A/C	EER	9.2	10.1	12.0
Rooftop Heat Pump	EER (cooling)	9.3	10.3	11.7
	COP (heating)	3.1	3.2	3.4
Boilers				
Gas-Fired	Thermal Efficiency	76	80	96
Oil-Fired	Thermal Efficiency	79	83	89
Electric	Thermal Efficiency	98	98	98
Gas-Fired Furnace	AFUE	76	80	82
Water Heater				
Gas-Fired	Thermal Efficiency	77	80	94
Electric Resistance	Thermal Efficiency	97	98	98
Gas-Fired Instantaneous	Thermal Efficiency	76	84	89

Source(s): EIA/Navigant Consulting, EIA - Technology Forecast Updates - Residential and Commercial Buildings Technologies Reference Case, Second Edition (Revised), Sept. 2007, p. 43-80.

**5.3.6 2007 Air-Conditioner/Heat Pump Manufacturer Market Shares (Percent of Products Produced)**

<u>Company</u>	<u>Market Share (%)</u>	Total Units Shipped:	16,619,296 (1)
LG Electronics	17%		
UTC/Carrier	13%		
Whirlpool	9%		
Goodman (Amana)	7%		
American Standard (Trane)	6%		
Fedders	6%		
Electrolux (Frigidaire)	6%		
Lennox	6%		
Rheem	6%		
York	4%		
Nordyne	4%		
Haier	4%		
<u>Others</u>	12%		
Total (2)	100%		

Note(s): 1) Does not include water-source or ground-source heat pumps.

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 38.

**5.3.7 2007 Gas Furnace Manufacturer Market Shares (Percent of Products Produced)**

<u>Company</u>	<u>Market Share (%)</u>	Total Units Shipped:	2,782,006
UTC/Carrier	30%		
Goodman (Amana)	15%		
Lennox	14%		
American Standard (Trane)	13%		
Rheem	12%		
York	9%		
Nordyne	6%		
<u>Others</u>	1%		
Total	100%		

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 38.

**5.3.8 Major Residential HVAC Equipment Lifetimes, Ages, and Replacement Picture**

<u>Equipment Type</u>	<u>Typical Service Lifetime Range</u>	<u>Average Lifetime</u>	<u>1990 Average Stock Age</u>	<u>Units to be Replaced During 2009 (1,000s)</u>
<b>Central Air Conditioners</b>	<b>8 - 14</b>	<b>11</b>	<b>9</b>	<b>4,980</b>
<b>Heat Pumps</b>	<b>9 - 15</b>	<b>12</b>	<b>8</b>	<b>1,131</b>
<b>Furnaces</b>				<b>3,008</b>
Electric	10 - 20	15	11	N.A.
Gas-Fired	12 - 17	15	12	2,866
Oil-Fired	15 - 19	17	N.A.	141
<b>Steam or Hot-Water Boilers (gas and oil)</b>	<b>20 - 40</b>	<b>N.A.</b>	<b>14</b>	<b>N.A.</b>

Note(s): Replacement values include smaller commercial building units. Gas/oil furnaces include wall furnaces.

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 44 for service and average lifetimes, and units to be replaced; ASHRAE, 1999 ASHRAE Handbook: HVAC Applications, Table 3, p. 35.3 for boilers service lifetimes; and EIA, Housing Characteristics 1990, May 1992, Table 7, p. 24 for 1990 average stock ages.

**5.3.9 Major Commercial HVAC Equipment Lifetimes and Ages**

Equipment Type	Median <u>Lifetime</u>
Air Conditioners	
Through-the-Wall	15
Water-Cooled Package	24 (1)
Roof-Top	15
Chillers	
Reciprocating	20
Centrifugal	25 (1)
Absorption	23
Heat Pumps	
Air-to-Air	15
Water-to-Air	24 (1)
Furnaces (gas or oil)	18
Boilers (gas or oil)	
Hot-Water	24 - 35
Steam	25 - 30
Unit Heaters	
Gas-Fired or Electric	13
Hot-Water or Steam	20
Cooling Towers (metal or wood)	
Metal	22 (1)
Wood	20

Note(s): 1) Data from 2005. All other data is from 1978.

Source(s): ASHRAE, 2007 ASHRAE Handbook: HVAC Applications, Table 4, p. 36.3 for median service lifetimes.

**5.3.10 Main Residential Heating Fuel, by Vintage, as of 2001 (Percent of Total Households)**

Heating Fuel	1949 or <u>Before</u>	1950 to <u>1959</u>	1960 to <u>1969</u>	1970 to <u>1979</u>	1980 to <u>1989</u>	1990 to <u>2001</u>
Natural Gas	68%	67%	63%	42%	41%	56%
Electricity	11%	16%	22%	45%	50%	36%
Fuel Oil	14%	13%	8%	4%	2%	2%
LPG	6%	3%	4%	4%	5%	5%
Other (1)	2%	1%	2%	4%	2%	1%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Note(s): 1) Other includes wood and kerosene.

Source(s): EIA, Residential Energy Consumption Survey 2001, June 2004, Table HC 5.4.

**5.3.11 Main Residential Heating Equipment as of 1987, 1993, 1997, and 2001 (Percent of Total Households)**

<u>Equipment Type</u>	<u>1987</u>	<u>1993</u>	<u>1997</u>	<u>2001</u>
<b>Natural Gas</b>	<b>55%</b>	<b>53%</b>	<b>53%</b>	<b>55%</b>
Central Warm-Air Furnace	35%	36%	38%	42%
Steam or Hot-Water System	10%	9%	7%	7%
Floor/Wall/Pipeless Furnace	6%	4%	4%	3%
Room Heater/Other	4%	3%	4%	3%
<b>Electricity</b>	<b>20%</b>	<b>26%</b>	<b>29%</b>	<b>29%</b>
Central Warm-Air Furnace	8%	10%	11%	12%
Heat Pump	5%	8%	10%	10%
Built-In Electric Units	6%	7%	7%	6%
Other	1%	1%	2%	2%
<b>Fuel Oil</b>	<b>12%</b>	<b>11%</b>	<b>9%</b>	<b>7%</b>
Steam or Hot-Water System	7%	6%	5%	4%
Central Warm-Air Furnace	4%	5%	4%	3%
Other	1%	0%	0%	0%
<b>Other</b>	<b>13%</b>	<b>11%</b>	<b>9%</b>	<b>8%</b>
Total	100%	100%	100%	100%

Note(s): Other equipment includes wood, LPG, kerosene, other fuels, and none.

Source(s): EIA, A Look at Residential Energy Consumption in 2001, Apr. 2004, Table HC3-2a; EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table HC3-2a, p. 55; EIA, Housing Characteristics 1993, June 1995, Table 3.7b, p. 63; and EIA, Housing Characteristics 1987, May 1989, Table 14, p. 33.

**5.3.12 Main Commercial Heating and Cooling Equipment as of 1995, 1999, and 2003 (Percent of Total Floorspace) (1)**

<u>Heating Equipment</u>	<u>1995</u>	<u>1999</u>	<u>2003 (2)</u>	<u>Cooling Equipment</u>	<u>1995</u>	<u>1999</u>	<u>2003 (2)</u>
Packaged Heating Units	29%	38%	28%	Packaged Air Conditioning Units	45%	54%	46%
Boilers	29%	29%	32%	Individual Air Conditioners	21%	21%	19%
Individual Space Heaters	29%	26%	19%	Central Chillers	19%	19%	18%
Furnaces	25%	21%	30%	Residential Central Air Conditioners	16%	12%	17%
Heat Pumps	10%	13%	14%	Heat Pumps	12%	14%	14%
District Heat	10%	8%	8%	District Chilled Water	4%	4%	4%
Other	11%	6%	5%	Swamp Coolers	4%	3%	2%
				Other	2%	2%	2%

Note(s): 1) Heating and cooling equipment percentages of floorspace total more than 100% since equipment shares floorspace. 2) Malls are no longer included in most CBECs tables; therefore, some data is not directly comparable to past CBECs.

Source(s): EIA, Commercial Building Characteristics 1995, Oct. 1998, Tables B34 and B36 for 1995, and EIA, Commercial Building Characteristics 1999, Aug. 2002, Tables B33 and B34 for 1999; and, EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, June 2006, Tables B39 and B41 for 2003.

**5.3.13 Main Commercial Primary Energy Use of Heating and Cooling Equipment as of 1995**

<u>Heating Equipment</u>		<u>Cooling Equipment</u>	
Packaged Heating Units	25%	Packaged Air Conditioning Units	54%
Boilers	21%	Room Air Conditioning	5%
Individual Space Heaters	2%	PTAC (2)	3%
Furnaces	20%	Centrifugal Chillers	14%
Heat Pumps	5%	Reciprocating Chillers	12%
District Heat	7%	Rotary Screw Chillers	3%
Unit Heater	18%	Absorption Chillers	2%
PTHP & WLHP (1)	2%	Heat Pumps	7%
	100%		100%

Note(s): 1) PTHP = Packaged Terminal Heat Pump, WLHP = Water Loop Heat Pump. 2) PTAC = Packaged Terminal Air Conditioner

Source(s): BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume 1: Chillers, Refrigerant Compressors, and Heating Systems, Apr. 2001, Figure 5-5, p. 5-14 for cooling and Figure 5-10, p. 5-18 for heating.

**5.3.14 Halocarbon Environmental Coefficients and Principal Uses**

<u>Compound</u>	<u>100-Year Global Warming Potential (CO<sub>2</sub> = 1)</u>	<u>Ozone Depletion Potential (ODP) (Relative to CFC-11)</u>	<u>Principal Uses</u>
<b>Chlorofluorocarbons</b>			
CFC-11	4,600	1.00	Blowing Agent, Chillers
CFC-12 (1)	10,600	1.00	Auto A/C, Chillers, & Blowing Agent
CFC-113	6,000	0.80	Solvent
CFC-114	9,800	1.00	Solvent
CFC-115 (2)	7,200	0.60	Solvent, Refrigerant
<b>Hydrochlorofluorocarbons</b>			
HCFC-22 (2)	1,700	0.06	Residential A/C
HCFC-123	120	0.02	Refrigerant
HCFC-124	620	0.02	Sterilant
HCFC-141b	700	0.11	CFC Replacement
HCFC-142b	2,400	0.07	CFC Replacement
<b>Bromofluorocarbons</b>			
Halon-1211	1,300	3.00	Fire Extinguishers
Halon-1301	6,900	10.00	Fire Extinguishers
<b>Hydrofluorocarbons</b>			
HFC-23	12,000	0.00	HCFC Byproduct
HFC-125	3,400	0.00	CFC/HCFC Replacement
HFC-134a	1,300	0.00	Auto A/C, Refrigeration
HFC-152a (1)	140	0.00	Aerosol Propellant
HFC-227ea	2,900	0.00	CFC Replacement

Note(s): 1) R-500: 74% CFC-12 and 26% HFC-152a. 2) R-502: 49% HCFC-22 and 51% CFC-115.

Source(s): Intergovernmental Panel for Climate Change, Climate Change 2001: The Scientific Basis, Jan. 2001, Table 3, p. 47 for global warming potentials and uses; EPA for halon ODPs; AFEAS Internet Homepage, Atmospheric Chlorine: CFCs and Alternative Fluorocarbons, Feb. 1997 for remaining ODPs; and ASHRAE, 1993 ASHRAE Handbook: Fundamental, p. 16.3 for Notes 1 and 2; EPA, Emissions of Greenhouse Gases in the U.S. 2005, Table ES-1, p. ES-3 for GWP of HFCs.

**5.3.15 Conversion and Replacements of Centrifugal CFC Chillers**

	<u>Conversions</u>	<u>Replacements</u>	<u>Total</u>	<u>Cumulative Percent of 1992 Chillers (1)</u>
Pre-1995	2,304	7,208	9,512	12%
1995	1,198	3,915	5,113	18%
1996	1,311	3,045	4,356	24%
1997	815	3,913	4,728	30%
1998	905	3,326	4,231	35%
1999	491	3,085	3,576	39%
2000	913	3,235	4,148	45%
2001	452	3,324	3,776	49%
2002	360	3,433	3,793	54%
2003	334	2,549	2,883	55%
2004	165	2,883	3,048	59%
2005 (2)	155	2,674	2,829	62%
2006 (2)	130	2,860	2,990	66%
2007 (2)	108	3,002	3,110	70%
<b>Total</b>	<b>9,641</b>	<b>48,452</b>	<b>58,093</b>	

Note(s): 1) In 1992, approximately 80,000 centrifugal CFC chillers were in service, 82% of which used CFC-11, 12% CFC-12, and 6% CFC-113, CFC-114, or R-500. 2) Projected.

Source(s): ARI, Replacement and Conversion of CFC for a Decade Chillers Slower Than Expected Assuring Steady Demand for Non-CFC Units, Apr. 25, 2005; ARI, New Legislation Would Spur Replacement of CFC Chillers, Mar. 31, 2004; ARI, Economy Affects CFC Chiller Phase-out, Apr. 2, 2003; ARI, Half way Mark in Sight for Replacement and Conversion of CFC Chiller Used for Air Conditioning of Buildings, Apr. 11, 2001; ARI, Replacement and Conversion of CFC Chillers Dipped in 1999 Assuring Steady Demand for Non-CFC Units for a Decade, Mar. 29, 2000; ARI, Survey Estimates Long Use of CFC Chillers Nearly Two-Thirds of Units Still in Place, Apr. 15, 1999; ARI, CFCs Widely Used to Cool Buildings Despite 28-Month Ban on Production, Apr. 8, 1998; ARI, 1997 Chiller Survey, Apr. 9, 1997; Air Conditioning, Heating and Refrigeration News, Apr. 1996, p. 1; and ARI's web site, www.ari.org, Chiller Manufacturer Survey Confirms Slow Pace of Conversion and Replacements of CFC Chillers, Apr. 12, 1995.

**5.3.16 Estimated U.S. Emissions of Halocarbons, 1987-2001 (MMT CO2 Equivalent)**

<u>Gas</u>	<u>1987</u>	<u>1990</u>	<u>1992</u>	<u>1995</u>	<u>1998</u>	<u>2000</u>	<u>2001</u>
<b>Chlorofluorocarbons</b>							
CFC-11	391	246	207	167	115	105	105
CFC-12	1166	1194	853	549	223	182	226
CFC-113	498	158	103	52	0	0	0
CFC-114	N.A.	46	29	16	1	N.A.	N.A.
CFC-115	N.A.	30	27	22	19	N.A.	N.A.
<b>Bromofluorocarbons</b>							
Halon-1211	N.A.	1	1	1	1	N.A.	N.A.
Halon-1301	N.A.	12	12	12	13	N.A.	N.A.
<b>Hydrochlorofluorocarbons</b>							
HCFC-22	116	136	135	123	128	134	137
HCFC-123	N.A.	0	0	0	0	N.A.	N.A.
HCFC-124	0	0	0	3	4	N.A.	N.A.
HCFC-141b	N.A.	0	0	14	19	4	4
HCFC-142b	N.A.	0	2	18	22	26	26
<b>Hydrofluorocarbons</b>							
HFC-23	48	36	36	28	41	31	22
HFC-125	N.A.	0	1	2	4	5	6
HFC-134a	N.A.	1	1	19	35	44	41
<b>Total</b>	<b>2219</b>	<b>1861</b>	<b>1408</b>	<b>1024</b>	<b>624</b>	<b>532</b>	<b>566</b>

Source(s): Intergovernmental Panel for Climate Change, Climate Change 2001: The Scientific Basis, Jan. 2001, Table 3, p. 47 for GWPs; EIA, Emissions of Greenhouse Gases in the U.S. 2001, Dec. 2002, Table 29, p. 71 and Table D2, p. D-5 for 1990-2001 emissions; EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-1998, Table ES-6, p. ES-9 for HFCs and Annex L, Table L-1, p. L-2 for 1990-1998 ozone-depleting refrigerants; and EIA, Emissions of Greenhouse Gases in the U.S. 1985-1994, Oct. 1995, Table 34, p. 54 for 1987.



**5.4.1 2005 Water Heater Stock for Residential Buildings, By Fuel Type (Million Households)**

	<u>Households</u>	<u>Percent</u>
Electric	43.1	39.2%
Natural Gas	58.7	53.4%
Fuel Oil	4.0	3.6%
Propane/LPG	4.0	3.6%
Other	0.2	0.2%
<b>Total(1)</b>	<b>110.0</b>	<b>100.0%</b>

Note(s): According to RECS, 1.1 million households did not use hot water. The total only reflects those household that used hot water.

Source(s): EIA, Residential Energy Consumption Survey 2005, Table HC 2.8, June 2008.

**5.4.2 2005 Water Heater Stock for Residential Buildings, By Storage Type (Percent of Households)**

	<u>Used by One Unit</u>		<u>Used by Multiple Units</u>		<u>Total</u>	
Small (30 gallons or less)	17.1	17%	1.4	14%	18.5	17%
Medium (31 to 49 gallons)	52.4	53%	2.4	24%	54.8	50%
Large (50 gallons or more)	27.1	27%	2.8	27%	29.9	27%
Tankless water heater	1.1	1%	0.2	2%	1.3	1%
No Separate Water Heater	1.9	2%	3.4	33%	5.3	5%
<b>Total(1)</b>	<b>99.6</b>	<b>100%</b>	<b>10.2</b>	<b>100%</b>	<b>109.8</b>	<b>100%</b>

Note(s): According to RECS, 1.1 million households did not use hot water. The total only reflects those household that used hot water.

Source(s): EIA, Residential Energy Consumption Survey 2005, Table HC 2.8, June 2008.

**5.4.3 2006 Water Heater Manufacturer Market Shares (Percent of Products Produced)**

<u>Company</u>	<u>Market Share (%)</u>	Total Units Shipped: 9,446,076
Rheem Manufacturing	37%	
A.O. Smith/State Industries	23%	
American Water Heater	14%	
Bradford-White	14%	
Others	12%	
<b>Total</b>	<b>100%</b>	

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2007, p. 63.

**5.4.4 2003 Water Heater Stock for Commercial Buildings, By Fuel Type (Percent of Total Buildings)**

<u>Type</u>	
Electric	41%
Natural Gas	31%
Fuel Oil	2%
Propane/LPG	1%
District Heat	3%

Source(s): EIA, 2003 Commercial Buildings Energy Consumption Survey: Buildings Characteristics, June 2006, Table B31, p. 175.

**5.4.5 Water Heater Efficiencies**

<u>Residential Type</u>	<u>Efficiency Parameter (1)</u>	<u>2005 Stock Efficiency</u>	<u>Minimum New Efficiency (2)</u>	<u>2005 Best-Available New Efficiency</u>
Electric Storage	EF	0.88	0.92	0.95
Electric Instantaneous	EF	(3)	0.93	0.99
Electric Heat Pump	EF	(3)	0.92	2.28
Gas-Fired Storage	EF	0.56	0.59	0.65
Gas-Fired Instantaneous	EF	(3)	0.54	0.85
Oil-Fired Storage	EF	0.55	0.51	0.68
Solar	SEF	N.A.	0.80	4.80

Commerc Green Roof Industry Survey, Green Roof Infrastructure Monitor, (Reporting Years 2006, 2007, and 2008)

Electric Storage	Thermal Efficiency	98%	98%	98%
Gas-Fired Storage	Thermal Efficiency	82%	80%	94%
Oil-Fired Storage	Thermal Efficiency	77%	78%	82%

Note(s): 1) EF = energy factor and SEF = solar energy factor, which is the hot water energy delivered by the solar system divided by the electric or gas energy input to the system. 2) Based on a 40-gallon residential type tank. 3) Included in storage stock efficiency.

Source(s): EIA, Supplement to the AEO 2007, Feb. 2007, Table 21 and Table 22 for stock efficiencies; GAMA, Consumer's Directory of Certified Efficiency Ratings for the Residential and Water Heating Equipment, Aug. 2005 for best-available efficiencies and minimum efficiencies; and SRCC, Summary of SRCC Certified Solar Collector and Water Heating System Ratings, Apr. 2000, p. S16 - S20 for SEFs, Table 2.2, p. 4.

**5.5.1 Market Share of Major HVAC Equipment Manufacturers (\$2006 Million)**

	<u>Total Market Size</u>
Air-Handling Units	962
Cooling Towers	497
Pumps	310
Central System Terminal Boxes	179
Classroom Unit Ventilator	149
Fan Coil Units	114

Source(s): BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, Table 4-1, p. 4-4; and EIA, Annual Energy Review 2007, June 2008, Appendix D, p. 377 for price deflators.

**5.5.2 U.S. Commercial Buildings Conditioned Floorspace, Building Type and System Type (Million SF)**

	<u>Individual AC</u>	<u>Packaged</u>	<u>Central VAV</u>	<u>Central FCU</u>	<u>Central CAV</u>	<u>Not Cooled</u>	<u>Total</u>
Education	805	2,204	551	466	212	3,522	7,760
Food Sales	-	534	-	-	-	20	554
Food Service	83	1,100	-	-	-	64	1,247
Health Care	134	557	401	334	802	159	2,387
Lodging	1,669	283	85	707	85	779	3,608
Mercantile and Service	333	5,820	1,081	831	249	2,507	10,821
Office	1,257	4,450	2,322	484	1,161	561	10,235
Public Buildings	371	3,337	847	-	741	2,168	7,464
Warehouse/Storage	119	1,482	-	-	102	2,285	3,988
<b>Total</b>	<b>4,771</b>	<b>19,767</b>	<b>5,287</b>	<b>2,822</b>	<b>3,352</b>	<b>12,065</b>	<b>48,064</b>

Source(s): BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, Table A2-12, p. B2-1.

**5.5.3 Thermal Distribution Design Load and Electricity Intensities, by Building Activity**

	<u>Design Load Intensity</u> <u>(W/SF)</u>	<u>End Use Intensity</u> <u>(kWh/SF)</u>
Education	0.5	1.3
Food Sales	1.1	6.4
Food Service	1.5	6.4
Health Care	1.5	5.6
Lodging	0.5	1.9
Mercantile and Service	0.9	2.7
Office	1.3	3.3
Public Assembly	1.2	3.0
Warehouse	0.4	1.8
<b>All Buildings</b>	<b>1.0</b>	<b>2.8</b>

Source(s): BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, Table 5-11, p. 5-27.

**5.5.4 Thermal Distribution Equipment Design Load and Electricity Intensities, by System Type**

	Design Load Intensity (W/SF)			End Use Intensity (kWh/SF)		
	Central VAV	Central CAV	Packaged CAV	Central VAV	Central CAV	Packaged CAV
Condenser Fan			0.3			0.2
Cooling Tower Fan	0.2	0.2		0.1	0.2	
Condenser Water Pump	0.2	0.2		0.3	0.3	
Chilled Water Pump	0.2	0.2		0.1	0.2	
Supply & Return Fans	0.7	0.5	0.6	1.2	1.9	1.9
Chiller/Compressor	1.9	1.8	3.3	1.7	2.3	4.0

Source(s): BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, Table 5-11 p. 5-22.

**5.5.5 Typical Commercial Building Thermal Energy Distribution Design Load Intensities (Watts per SF)****Distribution System Fans**

Central System Supply Fans	0.3 - 1.0
Central System Return Fans	0.1 - 0.4
Terminal Box Fans	0.5
Fan-Coil Unit Fans (1)	0.1 - 0.3
Packaged or Split System Indoor Blower	0.6

**Other**

Cooling Tower Fan	0.1 - 0.3
Air-Cooled Chiller Condenser Fan	0.6
Exhaust Fans (2)	0.05 - 0.3
Condenser Fans	0.6

**Pumps**

Chilled Water Pump	0.1 - 0.3
Condenser Water Pump	0.1 - 0.2
Heating Water Pump	0.1 - 0.2

Note(s): 1) Unducted units are lower than those with some ductwork. 2) Strong dependence on building type.

Source(s): BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, Table 3-1, p. 3-6.

**5.5.6 1999 Energy Efficient Motors, Replacements and Sales, by Horsepower Class**

Horsepower Range	Existing		Replacements	
	Units in Use (thousands)	Horsepower (10 <sup>6</sup> )	% Retired	Energy Efficient Share of New Motors
1 - 5	20,784	59.6	2.5%	17%
5.1 - 20	6,927	81.8	2.0%	29%
21 - 50	2,376	78.2	1.5%	45%
51 - 100	738	59.6	1.0%	52%
101 - 200	412	56.5	0.8%	65%

Source(s): Electrical Apparatus Service Association, Past Trends and Probably Future Changes in the Electric Motor Industry 1990-1999, 2001, p. 18 for existing stock and retirements and p. 28 for energy efficient motor sales.

**5.5.7 1999 AC Adjustable-Speed Drive Population****Horsepower Range**

1 - 5	70%
5.1 - 20	23%
21 - 50	4%
51 - 100	1%
101 - 200	1%
200 +	1%
Total	100%

Source(s): Electrical Apparatus Service Association, Past Trends and Probably Future Changes in the Electric Motor Industry 1990-1999, 2001, p. 30.

**5.6.1 Selected Fluorescent and Incandescent Lamp Sales (Thousands)**

<u>Commercial Trends</u>	<u>2001</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>	<u>2005</u>
T12 Rapid-Start Fluorescent (Mainly 4')	213	206	182	176	163
T8 Medium Bi-Pin Fluorescent (Mainly 4')	164	164	172	196	216
<b>Total (mainly) 4'</b>	<b>377</b>	<b>370</b>	<b>354</b>	<b>372</b>	<b>378</b>
2' U-Shaped T12	10	9	9	7	9
2' U-Shaped T8	8	7	7	9	9
<b>Total 2' U lamp</b>	<b>18</b>	<b>16</b>	<b>16</b>	<b>16</b>	<b>17</b>
8' Slimline T12 (Mainly 8')	43	41	37	36	34
8' Slimline T8 (Mainly 8')	4	5	5	6	5
<b>Total Slimline (Mainly 8')</b>	<b>48</b>	<b>47</b>	<b>42</b>	<b>42</b>	<b>39</b>
8' HO T12 (Mainly 8')	24	24	24	25	25
8' HO T8 (Mainly 8')	1	1	0	1	0
<b>Total HO (Mainly 8')</b>	<b>25</b>	<b>25</b>	<b>25</b>	<b>25</b>	<b>26</b>
<u>Residential Trends</u>					
Incandescent A-line	1,568	1,526	1,542	1,470	1,410
Screw-Based Compact Fluorescent- Census	69	52	66	93	102
<b>Total Medium Screw-Based Market</b>	<b>1,637</b>	<b>1,577</b>	<b>1,608</b>	<b>1,563</b>	<b>1,512</b>
<u>Commercial and Residential Trends</u>					
PAR Incandescent	9	7	5	5	15
R Incandescent	89	96	103	112	125
PAR 38 Halogen	41	46	46	50	46
PAR30 and PAR20 Halogen	33	27	31	36	40
<b>Total Reflector Lamps</b>	<b>172</b>	<b>176</b>	<b>185</b>	<b>203</b>	<b>226</b>

Note(s): 2001-2005 growth rate for A-line Incandescent was -2.62% while Screw-based Compact Fluorescent had a growth rate of 10.17% over the same period.  
Source(s): National Electrical Manufacturers Association, Special Bulletin for the Lamp Section (2-LL), June 2006, page 1.

**5.6.2 Value of Electric Lighting Fixture Shipments (\$Million)**

<u>Lighting Fixture Type</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>	<u>2001</u>
Residential	786.8	827.6	983.8	1,296.5	983.9
Commercial/Institutional (except spotlight)	1,832.3	2,379.7	2,797.3	3,506.7	3,239.1
Industrial	389.2	529.4	676.3	718.3	628.1
Vehicular (1)	1,001.2	1,620.7	N.A.	N.A.	N.A.
Outdoor	905.5	1,061.5	1,473.0	1,957.4	1,923.2

Note(s): 1) Data for vehicular lighting fixtures was discontinued in 1992.

Source(s): DOC, Electric Lighting Fixtures MA 335L(01)-1, Jan. 2003 for 2000 and 2001; DOC, Current Industrial Reports: Electric Lighting Fixtures, MA335L(99)-1, Dec. 2000, Table 1 for 1990-1999; and DOC, Current Industrial Reports: Electric Lighting Fixtures, MA36L, Oct. 1995, Table 1 for 1985.

**5.6.3 Shipments of Fluorescent Lamp Ballasts**

Year	Standard Magnetic Type (1)		Electronic Type		Total		Electronic Type as a % of Total Units Shipped
	Quantity (million)	Value (\$million)	Quantity (million)	Value (\$million)	Quantity (million)	Value (\$million)	
1985	70.1	398.9	N.A.	N.A.	70.1	398.9	N.A.
1986	69.4	396.1	0.4	11.8	69.8	407.9	1%
1988	74.6	450.9	1.1	25.5	75.7	476.4	1%
1990	78.4	546.3	3.0	69.3	81.4	615.6	4%
1992	83.7	537.7	13.3	274.6	97.0	812.3	14%
1994	83.5	550.0	24.6	390.8	108.1	940.7	23%
1996	67.0	457.8	30.3	451.4	97.3	909.2	31%
1998	63.9	401.4	39.8	512.8	103.7	914.3	38%
2000	55.4	343.0	49.3	555.5	104.8	898.5	47%
2002	40.7	263.3	53.8	573.1	94.5	836.4	57%
2004	Green 30.5	218.4	59.2	579.4	89.7	797.8	66%
2005	22.2	175.1	61.3	594.6	83.5	769.8	73%

Note(s): 1) Standard magnetic type includes uncorrected and corrected power-factor type ballasts.

Source(s): DOC Current Industrial Reports: Fluorescent Lamp Ballasts, MQ335C(05)-5, July 2006 for 2000-2005; DOC, Current Industrial Reports: Fluorescent Lamp Ballasts MQ36C(99)-5, July 2000, Table 1 for 1990-1999; and DOC, Current Industrial Reports: Fluorescent Lamp Ballasts, MQ36C(95), 1996, Table 1 for 1985-1989.

**5.6.4 2001 Total Lighting Technology Electricity Consumption, by Sector (Billion kWh per Year) (1)**

	Residential		Commercial		Industrial		Other (2)		Total	
	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%
Incandescent										
Standard	176	87%	103	26%	2	2%	5	10%	287	38%
Halogen	6	3%	21	5%	0	0%	1	2%	28	4%
Fluorescent										
T5	N.A.		0	0%	0	0%	N.A.		0	0%
T8	N.A.		50	13%	23	21%	0	0%	72	10%
T12	N.A.		157	40%	49	45%	0	0%	206	27%
Compact	1	1%	13	3%	1	1%	N.A.		14	2%
Miscellaneous	18	9%	0	0%	0	0%	1	1%	19	3%
HID										
Mercury Vapor	1	0%	7	2%	3	3%	12	21%	22	3%
Metal Halide	N.A.		34	9%	25	23%	4	7%	62	8%
HP Sodium	0	0%	6	1%	5	5%	30	54%	41	5%
LP Sodium	N.A.		0	0%	0	0%	3	5%	3	0%
<b>Total (3)</b>	<b>202</b>	<b>100%</b>	<b>391</b>	<b>100%</b>	<b>108</b>	<b>100%</b>	<b>56</b>	<b>100%</b>	<b>756</b>	<b>100%</b>

Note(s): 1) Lumens-hour is a measure of lighting output; Watt-hour is a measure of electrical input for lighting. A value of zero indicates less than 0.5 billion kWh/year. 2) Includes stationary aviation, billboard, and traffic and street lighting. 3) Lighting consumed 756 10<sup>9</sup> kWh of energy in 2001. This amount is equivalent to 99% of the energy generated by all 104 nuclear power plants in the same year.

Source(s): BTS/Navigant Consulting, U.S. Lighting Market Characterization, Phase I National Lighting Inventory and Energy Consumption Estimate, July 2002; EIA, Annual Energy Review 2003, Table 9.2 Nuclear Power Plant Operations, p. 271, for note 3.

**5.6.5 2001 Total Lighting Technology Light Output, by Sector (Trillion Lumen-Hour per Year)(1)**

	Residential		Commercial		Industrial		Other (2)		Total	
Incandescent										
Standard	2,504	66%	1,384	6%	22	0%	87	2%	3,997	10%
Halogen	102	3%	392	2%	13	0%	23	0%	530	1%
Fluorescent										
T5	N.A.		13	0%	0	0%	N.A.		13	0%
T8	N.A.		4,208	20%	1,925	24%	1	0%	6,134	16%
T12	N.A.		11,752	54%	3,781	47%	2	0%	15,535	41%
Compact	57	1%	735	3%	35	0%	N.A.		827	2%
Miscellaneous	1,103	29%	24	0%	3	0%	39	1%	1,169	3%
HID										
Mercury Vapo	23	1%	261	1%	149	2%	532	11%	965	3%
Metal Halide	N.A.		2,202	10%	1,605	20%	249	5%	4,055	11%
HP Sodium	8	0%	587	3%	562	7%	3,381	72%	4,539	12%
LP Sodium	N.A.		18	0%	4	0%	408	9%	430	1%
<b>Total</b>	<b>3,797</b>	<b>100%</b>	<b>21,574</b>	<b>100%</b>	<b>8,100</b>	<b>100%</b>	<b>4,722</b>	<b>100%</b>	<b>38,194</b>	<b>100%</b>

Note(s): 1) Lumens-hour is a measure of lighting output; Watt-hour is a measure of electrical input for lighting. A value of zero indicates less than 0.5 billion kWh/year. 2) Includes stationary aviation, billboard, and traffic and street lighting.

Source(s): BTS/Navigant Consulting, U.S. Lighting Market Characterization, Phase I National Lighting Inventory and Energy Consumption Estimate, July 2002.

**5.6.6 2001 Lamp Wattage, Number of Lamps, and Hours of Usage (Weighted Average)**

	Lamp Wattage (Watts per lamp)				Number of Lamps per Building			Hours of Usage per Day			
	Res	Com	Ind	Other (1)	Res	Com	Ind	Res	Com	Ind	Other
	Incandescent										
Standard	66	88	115	115	37	70	12	2	9	14	8
Halogen	202	102	447	167	0	12	1	2	10	14	8
Fluorescent											
T5	N.A.	8	10	N.A.	N.A.	1	0 (2)	N.A.	13	18	N.A.
T8	N.A.	32	30	105	N.A.	93	671	N.A.	10	13	7
T12	N.A.	51	66	190	N.A.	191	646	N.A.	10	13	7
CFL	17	19	27	N.A.	1	32	13	2	11	14	N.A.
Miscellaneous	41	18	34	83	6	1	2	2	10	11	11
HID											
Mercury Vapor	179	331	409	239	0	1	8	3	10	12	11
Metal Halide	N.A.	472	438	23	N.A.	4	47	N.A.	10	14	10
HP Sodium	79	260	394	216	0	1	12	3	10	13	11
LP Sodium	N.A.	104	90	180	N.A.	0	0	N.A.	10	12	12

Note(s): 1) Other includes stationary aviation, billboard, and traffic and street lighting. 2) A value of zero indicates less than 0.5.

Source(s): BTS/Navigant Consulting, U.S. Lighting Market Characterization, Phase I National Lighting Inventory and Energy Consumption Estimate, July 2002.

**5.6.7 2003 Lighted Floorspace for the Stock of Commercial Buildings, by Type of Lamp (1)**

Type of Lamp	Lighted Floorspace (Billion SF) (2)	Percent of Lighted Floorspace	Total Lighted Floorspace:	62.06 Billion SF
Standard Fluorescent	59.7	96%		
Incandescent	38.5	62%		
Compact Fluorescent	27.6	44%		
High-Intensity Discharge	20.6	33%		
Halogen	17.7	29%		

Note(s): 1) Mall buildings are no longer included in most CBECs tables; therefore, some data are not directly comparable to past CBECs.

2) The percentages of lighted floorspace total more than 100% since most floorspace is lighted by more than one type of lamp.

Source(s): EIA, 2003 Commercial Buildings Energy Consumption Survey: Building Characteristics Tables, June 2006, Table B44, p. 220.

**5.6.8 2003 Lighting Consumption and Energy Intensities, by Commercial Building Type**

<u>Building Type</u>	<u>Percent of Total Lighted Floorspace</u>	<u>Total Annual Lighting Energy (billion KWh)</u>		<u>Annual Lighting End-Use Intensity (kWh/SF)</u>
Education	14%	33.1	6.5%	3.4
Food Sales	2%	13.5	2.6%	10.8
Food Service	2%	12.3	2.4%	7.4
Health Care	5%	30.8	6.0%	9.7
Inpatient	3%	22.3	4.3%	11.8
Outpatient	2%	8.2	1.6%	6.6
Lodging	7%	36.3	7.1%	7.1
Mercantile	16%	90.3	17.6%	8.1
Retail (Other Than Mall)	6%	32.5	6.3%	7.5
Enclosed and Strip Malls	10%	57.7	11.3%	8.4
Office	18%	82.4	16.0%	6.8
Public Assembly	6%	7.9	1.5%	2.1
Public Order and Safety	2%	5.3	1.0%	4.8
Religious Worship	5%	5.0	1.0%	1.3
Service	6%	18.5	3.6%	4.6
Warehouse and Storage	13%	38.7	7.5%	3.8
Other	2%	17.3	3.4%	10.0
<u>Vacant</u>	1%	1.2	0.2%	0.5
<b>Total (1)</b>		<b>513.2</b>	<b>100%</b>	

Source(s): EIA, 2003 Commercial Buildings Energy Consumption Survey Characteristics and End-Uses, Oct. 2006 and Sept. 2008, Table A1 and Table E1A.

**5.6.9 Typical Efficacies and Lifetimes of Lamps (1)**

<u>Current Technology</u>	<u>Efficacy (lumens/Watt)</u>	<u>Typical Rated Lifetime (hours)</u>	<u>CRI (2)</u>
Incandescent	10 - 19	750 - 2,500	97
Halogen	14 - 20	2,000 - 3,500	99
Fluorescent - T5	25 - 55	6,000 - 7,500	52 - 75
Fluorescent - T8	35 - 87	7,500 - 20,000	52 - 90
Fluorescent - T12	35 - 92	7,500 - 20,000	50 - 92
Compact Fluorescent	40 - 70	10,000	82
Mercury Vapor	25 - 50	29,000	15 - 50
Metal Halide	50 - 115	30,000 - 20,000	65 - 70
High-Pressure Sodium	50 - 124	29,000	22
Low-Pressure Sodium	18 - 180	18,000	0
Solid State Lighting	(3)	(4)	70-80

Note(s): 1) Theoretical maximum luminous efficacy of white light is 220 lumens/Watt. 2) CRI = Color Rendition Index, which indicates a lamp's ability to show natural colors. 3) The DOE Solid State Lighting program has set an efficacy goal twice that of fluorescent lights (160 lumen per Watt). 4) Has not been determined.

Source(s): DOE, EERE, Building Technology Program/Navigant Consulting, U.S. Lighting Market Characterization, Volume I: National Lighting Inventory and Energy Consumption Estimate, Sept. 2002, Appendix A, p. 74; DOE/Navigant Consulting, Solid State Lighting Research and Development Portfolio, Mar. 2006, p 55.



**5.7.1 Refrigeration System Shipments, by Type (Including Exports)**

<u>Appliance Type</u>	<u>1990 (thousands)</u>	<u>2000 (thousands)</u>	<u>2006 (thousands)</u>	<u>2006 Value of Shipments (\$million)</u>
Refrigerator-Freezers (1)	7,317	9,462	11,966	5,419
Freezers (chest and upright)	1,328	2,007	2,199	N.A.
Refrigerated Display Cases	359	347	181	N.A.
Unit Coolers	178	207	221	158
Ice-Making Machines	171	385	386	678
Water Cooler	253	348	300 (2)	N.A.
Beverage Vending Machine	229	353	N.A.	N.A.

Note(s): 1) Does not include commercial products value. 2) 2004.

Source(s): Appliance Magazine, 54th Annual Statistical Review, May 2007, p. S1-S4 for refrigerator, freezer, refrigerated display cases, water cooler, and beverage vending machines shipments; The Air Conditioning, Heating and Refrigeration News, Nov. 11, 1995, p. 19 for 1990 unit cooler and ice-making machine shipments; DOC, Current Industrial Reports: Refrigeration, Air Conditioning, and Warm Air Heating Equipment, MA333M(06)-1, July 2007, for 2005 refrigerator-freezer, unit cooler, and ice-making machine data and value of shipments; and AHAM Factbook 2005: A Statistical Overview of the Home Appliance Industry, Table 7, p. 223; and DOC, Current Industrial Reports: Major Household Appliances, MA335f(06)-1, June 2007, Table 2 for 2005 refrigerator-freezer and water cooler data and value of shipments.

**5.7.2 Other Major Appliance Shipments, by Type (Including Exports)**

<u>Appliance Type</u>	<u>1990 (1000)</u>	<u>2000 (1000)</u>	<u>2005 (1000)</u>	2005 Value of Shipments (5) <u>(\$million)</u>
<b>Room Air Conditioners</b>	<b>3,799</b>	<b>6,496</b>	<b>8,024</b>	<b>1,050</b>
<b>Ranges (total)</b>	<b>5,873</b>	<b>8,202</b>	<b>9,963</b>	<b>4,491</b>
Electric Ranges	3,350	5,026	6,201	2,753
Gas Ranges	2,354	3,176	3,762	1,738
<b>Microwave Ovens/Ranges</b>	<b>7,693</b>	<b>12,644</b>	<b>13,862</b>	<b>1,377</b>
<b>Clothes Washers</b>	<b>5,591</b>	<b>7,495</b>	<b>9,394</b>	<b>3,373</b>
<b>Clothes Dryers (total)</b>	<b>4,160</b>	<b>6,575</b>	<b>8,114</b>	<b>2,486</b>
Electric Dryers	3,190	5,095	6,408	N.A.
Gas Dryers	970	1,480	1,706	N.A.
<b>Water Heaters (total)</b>	<b>7,252</b>	<b>9,329</b>	<b>9,455</b>	<b>1,609</b>
Electric (1,2)	3,246	4,299	4,572	638
Gas and Oil (2)	4,005	5,006	4,884	970
Solar (3)	N.A.	24	N.A.	N.A.
<b>Office Equipment</b>				
Personal Computers (4)	N.A.	47,168	59,259	33,028
Copiers	N.A.	1,989	2,013	N.A.
Printers	N.A.	27,945	19,232	1,614
Scanners	N.A.	9,400	N.A.	238

Note(s): 1) Sales of heat pump water heaters were less than 2,000 units in 1994, down from its peak of 8,000 in 1985. 2) Includes residential and small commercial units. 3) Shipments and value of shipments of entire systems. 4) Includes workstations, laptops, and notebooks. 5) Value of shipments are based on Census unit shipment data, which is about 31 million units lower than industry data shown.

Source(s): AHAM, AHAM Fact Book 2000, 2000, Tables 7 and 8, for 1990 data except water heaters; AHAM, AHAM 2005 Fact Book, 2006, Table 7 for 2000-2005 shipments and Table 6, p. 19 for value of shipments of ranges, microwave ovens, laundry equipment, and room air conditioners; GAMA, Statistical Highlights: Ten Year Summary, 1987-1996; GAMA, Statistical Highlights: Ten Year Summary, 1994-2003 for water heater shipments; GAMA, Statistical Highlights, Dec. 2006 for 2005 water heater shipments; DOC, Current Industrial Reports: Major Household Appliances, MA335F(02)-1, July 2003, Table 2 for value of water heater shipments; EIA, 2000 Solar Thermal and Photovoltaic Collector Manufacturing Activities, July 2001, Table 17, p. 20 for solar water heater data; BTS/OBE, Market Disposition of High-Efficiency Water Heating Equipment, Nov. 1996, p. I-8 for HPWH note; DOC, Current Industrial Reports: Computers and Office and Accounting Machines, MA334R(05)-1, Aug. 2006, Table 2 for value of computer shipments; Appliance, 52nd Annual Statistical Review, May 2005, p. S1-S4 for office equipment shipments; and DOC, Current Industrial Reports: Major Household Appliances, MA335f(06)-1, June 2007, Table 2 for 2005 water heater value of shipments.

**5.7.3 Major Appliance Ownership (Millions of Households and Percent of U.S. Households)**

Appliance Type	1982		1990		1996		2001		2005	
	Households		Households		Households		Households		Households	
Room Air Conditioners	22.6	27%	30.2	32%	30.4	31%	26.9	26%	27.4	25%
Refrigerators	83.4	100%	91.2	98%	96.8	98%	100.0	96%	104.7	96%
Freezers	35.7	43%	42.4	45%	41.9	42%	42.8	41%	36.1	33%
Electric Ranges/Cooktops	48.4	58%	58.4	63%	65.3	66%	69.2	66%	71.0	65%
Gas Ranges/Cooktops	35.7	43%	36.1	39%	38.3	39%	39.4	38%	42.2	39%
Microwave Ovens	21.4	26%	77.2	83%	89.5	91%	94.6	91%	97.2	89%
Clothes Washers	61.5	74%	86.4	93%	94.3	95%	96.9	93%	90.1	83%
Electric Clothes Dryers	42.3	51%	56.1	60%	60.4	61%	61.8	59%	67.6	62%
Gas Clothes Dryers	12.3	15%	19.1	21%	21.1	21%	19.8	19%	20.7	19%
Personal Computers	N.A.	N.A.	N.A.	N.A.	43.5	44%	N.A.	N.A.	N.A.	N.A.
<b>Number of U.S. Households</b>	<b>83.6</b>		<b>94.0</b>		<b>98.9</b>		<b>107.0</b>		<b>108.8</b>	

Source(s): AHAM, AHAM 2005 Fact Book, 2006, Table 93, p. 28 for 1982, 1990, 2001 and 2005; AHAM, 2000 Major Home Appliance Industry Fact Book, Nov. 2000, Table 13, p. 21 for 1996; Consumer Electronic Manufacturers Association's Home Page, 1999 for 1997 personal computers; EIA, AEO 1995, Jan. 1995, Table B4, p. 104 for 1990 households; EIA, AEO 2004, Jan. 2004, Table A4 for 2001 households.

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**5.7.4 2007 Refrigerator Manufacturer Market Shares (Percent of Products Produced)**

Company	Market Share (%)	Total Units Shipped:	11,267,000
GE	29%		
Electrolux (Frigidaire)	25%		
Whirlpool	25%		
Maytag (Admiral)	10%		
Haier	4%		
W.C. Wood	1%		
Others	6%		
Total	100%		

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 40.

**5.7.5 Refrigerator-Freezer Sizes and Energy Factors (Shipment-Weighted Averages)**

	<u>Average Volume (cu. ft.)</u>	<u>Consumption/Unit (kWh/yr)</u>	<u>Best-Available (kWh/yr)</u>
1972	18.2	1,726	N.A.
1980	19.6	1,278	N.A.
1985	19.5	1,058	N.A.
1990	20.5	916	N.A.
1995	20.0	649	555
2000	21.9	704	523
2001	21.9	565	438
2002	22.2	520	428
2003	22.3	514	428
2004	21.5	500	402
2005	20.7	490	417
2006	22.3	506	464
2007	21.9	498	459

Note(s): The average stock energy uses for refrigerator-freezers was 1,220 kWh/yr in 1990, 1,319 kWh/yr in 1997, and 1,462 kWh/yr in 2001.

Source(s): AHAM, Efficiency and Consumption Trends 2008; AHAM, 2000 Major Home Appliance Industry Fact Book, 2000, Table 25, p. 30 for 1972-1985; AHAM, 2005 AHAM Fact Book, 2006, Table 17, p. 40 for 1990-2004; AHAM, 1991, 1993-1999 Directory of Certified Refrigerators and Freezers for 1993-1999 best-available data (at 19.6 or more cu. ft.); LBNL, Center for Building Science News, Summer 1995, p. 6 for 1990 portion of note; EIA, A Look at Residential Energy Consumption in 2001; Apr. 2004, Table CE5-1c for 2001 portion of note; EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table CE5-2c, p. 205 for 1997 portion of note; and ENERGY STAR certified products lists for 2001-2007 best available, [http://www.energystar.gov/ia/products/prod\\_lists/appliances\\_prod\\_list.xls](http://www.energystar.gov/ia/products/prod_lists/appliances_prod_list.xls).

**5.7.6 2007 Room Air Conditioner Manufacturer Market Shares (Percent of Products Produced)**

<u>Company</u>	<u>Market Share (%)</u>	Total Units Shipped: 9,550,000
LG Electronics (Goldstar)	32%	
Fedders	12%	
Electrolux (Frigidaire)	13%	
Whirlpool	13%	
Haier	8%	
Samsung	5%	
Sharp	4%	
Friedrich	4%	
UTC/Carrier	3%	
Matsushita	2%	
<u>Others</u>	<u>4%</u>	
Total	100%	

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 39.

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**5.7.7 Room Air Conditioner Capacities and Energy Efficiencies (Shipment-Weighted Averages)**

	<u>Average Capacity (Btu/hr)</u>	<u>EER</u>	<u>Best-Available (EER)</u>
1972	10,227	5.98	N.A.
1980	10,607	7.02	N.A.
1985	10,287	7.70	N.A.
1990	10,034	8.73	N.A.
1995	10,099	9.03	12.0
2000	9,739	9.30	11.7
2001	9,874	9.63	11.7
2002	9,800	9.75	11.7
2003	9,203	9.75	11.7
2004	9,735	9.71	11.7
2005	7,916	9.95	12.0
2006	9,197	10.02	12.0
2007	8,518	9.81	12.0

Source(s): AHAM, Efficiency and Consumption Trends 2008; AHAM, 1997 Major Appliance Industry Fact Book, Oct. 1997, Table 27, p. 32 for 1972; AHAM, AHAM 2003 Fact Book, 2003, Table 25, p. 45 for 1980-1985 average capacity and EER; AHAM, AHAM 2005 Fact Book, 2006, Table 19, p. 42 for 1990-2004 average capacity and EER; AHAM, 1994-1999 Directory of Certified Room Air Conditioners, Mar. 2000 for 1994-2000 best available; and ENERGY STAR certified products lists for 2001-2007 best available, [http://www.energystar.gov/ia/products/prod\\_lists/appliances\\_prod\\_list.xls](http://www.energystar.gov/ia/products/prod_lists/appliances_prod_list.xls).

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**5.7.8 2007 Clothes Washer Manufacturer Market Shares (Percent of Products Produced)**

<u>Company</u>	<u>Market Share (%)</u>	Total Units Shipped:	9,002,000
Whirlpool	51%		
GE	17%		
Maytag	16%		
Electrolux (Frigidaire)	6%		
LG Electronics	2%		
<u>Others</u>	<u>8%</u>		
Total	100%		

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 40.

**5.7.9 2007 Clothes Dryer Manufacturer Market Shares (Percent of Products Produced)**

<u>Company</u>	Electric	Gas	Total Electric Units Shipped:	6,035,000
	<u>Market Share (%)</u>	<u>Market Share (%)</u>		
Whirlpool	56%	55%	Total Gas Units Shipped:	1,530,000
Maytag	16%	22%		
GE	15%	11%		
Electrolux (Frigidaire)	8%	5%		
<u>Others</u>	<u>5%</u>	<u>7%</u>		
Total	100%	100%		

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 40.

**5.7.10 2007 Range Manufacturer Market Shares (Percent of Products Produced)**

<u>Company</u>	Electric	Gas	Total Electric Units Shipped:	5,990,240
	<u>Market Share (%)</u>	<u>Market Share (%)</u>		
GE	48%	38%	Total Gas Units Shipped:	3,268,000
Whirlpool	22%	11%		
Electrolux (Frigidaire)	9%	25%		
Maytag	7%	14%		
Peerless Premier	5%	7%		
<u>Others</u>	<u>9%</u>	<u>5%</u>		
Total	100%	100%		

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 40.

**5.7.11 2006 Microwave Oven Manufacturer Market Shares (Percent of Products Produced)**

<u>Company</u>	<u>Market Share (%)</u>	Total Units Shipped:	13,889,429
LG Electronics (Goldstar)	35%		
Sharp	21%		
Samsung	12%		
Daewoo	8%		
Matsushita	8%		
Whirlpool	4%		
<u>Others</u>	<u>12%</u>		
Total	100%		

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2007, p. 63.

**5.7.12 2007 Copier Machine Manufacturer Market Shares (Percent of Products Produced)**

	<u>Copier Market Share (%)</u>		
Canon	31%		
Konica Minolta	21%	Total Copier Units Shipped:	247,763
Ricoh	16%		
Xerox	10%		
Sharp	4%		
Kyocera Mita	4%		
<u>Others</u>	<u>14%</u>		
<u>Total</u>	<u>100%</u>		

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 41.

**5.7.13 2007 Personal Computer Manufacturer Market Shares (Percent of Products Produced)**

<u>Company</u>	<u>Desktop Computer Market Share (%)</u>	<u>Portable Computer Market Share (%)</u>		
Dell	32%	25%	Total Desktop Computer Units Shipped:	34,211,601
Hewlett-Packard	24%	26%	Total Portable Computer Units Shipped:	30,023,844
Gateway	5%	4%		
Apple	4%	9%		
Acer America	3%	N/A		
IBM	1%	N/A		
Micron	0%	N/A		
Toshiba	N/A	12%		
Levono (IBM)	N/A	6%		
Sony	N/A	5%		
Fujitsu Siemens	N/A	1%		
<u>Others</u>	<u>30%</u>	<u>13%</u>		
<u>Total</u>	<u>100%</u>	<u>100%</u>		

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 41.

**5.7.14 2007 Printer Manufacturer Market Shares (Percent of Products Produced)**

Company	Ink Jet Printer Market Share (%)	Laser Printer Market Share (%)	Dot Matrix Market Share (%)	Total Ink Jet Units Shipped:	6,392,177
Hewlett-Packard	58%	56%	N/A		
Canon	16%	N/A	N/A	Total Laser Units Shipped:	3,356,556
Epson	11%	N/A	27%		
Lexmark	15%	10%	11%	Total Dot Matrix Units Shipped:	231,547
Dell	0%	11%	N/A		
Samsung	N/A	6%	N/A		
Brother	N/A	4%	N/A		
Oki Data	N/A	3%	46%		
Konica Minolta	N/A	1%	N/A		
Panasonic	N/A	N/A	6%		
TallyGenicom	N/A	N/A	5%		
Others	0%	9%	6%		
Total	100%	100%	100%		

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 41.

**5.7.15 Major Residential and Small Commercial Appliance Lifetimes, Ages, and Replacement Picture**

Appliance Type	Typical Service Lifetime Range (years)	Average Lifetime (years)	2001 Average Stock Age (years)	Units to be Replaced During 2009 (1,000s)
Refrigerators (1)	10 - 16	12	8	7,924
Freezers	8 - 16	11	12	2,020
Room Air Conditioners	7 - 13	9	8	6,496
Microwave Ovens	7 - 10	9	N.A.	12,725
Ranges (2)				
Electric	12 - 19	16	N.A.	4,348
Gas	14 - 22	17	N.A.	2,594
Clothes Washers	7 - 14	11	N.A.	6,835
Clothes Dryers				
Electric	8 - 15	12	N.A.	4,115
Gas	8 - 15	12	N.A.	1,195
Water Heaters				
Electric	4 - 20	13	9	4,147
Gas	7 - 15	11	9	4,671
Facsimile Machines	3 - 5	4	N.A.	3,838
Portable Computers	2 - 4	3	N.A.	20,350

Note(s): 1) Excluding compact refrigerators. 2) Ranges include free-standing, built-in, high-oven and cooktop/oven combination units.

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sep. 2007, p. 65 - 66 for service and average lifetimes and units to be replaced; EIA, A Look at Residential Energy Consumption in 2001, Apr. 2004, Table HC4-1a and Table HC5-1a for average stock ages.



**5.7.16 Other Major Appliance Efficiencies**

<u>Residential Appliance Type</u>	<u>Efficiency Parameter (1)</u>	<u>2003 Stock Efficiency</u>	<u>2007 U.S. Average New Efficiency</u>	<u>2008 Best Available New Efficiency</u>
Dishwashers	EF	0.40	0.60	1.39
Clothes Washers (2)	MEF	0.92	1.66	2.79
<u>Commercial Appliance Type</u>	<u>Efficiency Parameter (1)</u>	<u>2005 Stock Efficiency</u>	<u>U.S. Average New Efficiency</u>	<u>2001 Best Available New Efficiency</u>
<b>Cooking Equipment:</b>				
Electric Appliances	EF	0.71		
Gas Appliances	EF	0.51		
<b>Laundry Equipment:</b>				
Electric Drying	EF/COP			0.98 (3)
Gas Drying	EF			0.36 (3)
Motors	EF			0.65 (3)
<b>Office Equipment:</b>				
Linear Power Supplies	EF			0.30 - 0.60 (3)
Switching Power Supplies	EF			0.80 - 0.95 (3)
Motors	EF			0.60 - 0.70 (3)

Note(s): 1) EF = Energy Factor. MEF = Modified Energy Factor. COP = Coefficient of Performance. 2) EF does not include remaining moisture content (RMC) of clothes. MEF includes RMC which shows how much the clothes dryer will be needed. 3) 1992.

Source(s): AHAM, Efficiency and Consumption Trends 2008; AHAM, AHAM 2005 Fact Book, 2006, Tables 21, p. 44 and Table 22, p. 45 for residential efficiencies; DOE/EPA, ENERGY STAR Appliances, www.energystar.gov, Jan. 2009 for best-available dishwashers and clothes washers; EIA/Navigant Consulting, EIA - Technology Forecast Updates - Residential and Commercial Building Technologies - Reference Case, Sept. 2004, p. 34-37 for residential stock; EIA, Supplement to the AEO 2006, Feb. 2006, Table 22 for average cooking efficiency; and BTS/OBE, Characterization of Commercial Building Appliances, Aug. 1993 for commercial efficiencies.

**5.8.1 Solar Collector Shipments, by Type and Market (Thousand SF, unless noted) (1)**

Type	1980	1990	2000	2006 (2)	2006 Value of Shipments (\$million)
Solar Thermal Collectors (3)	19,398	11,409	8,354	20,744	121
Residential	N.A.	5,851	7,473	15,123	N.A.
Commercial	N.A.	295	810	1,626	N.A.
Industrial	N.A.	(4)	57	42	N.A.
Utility	N.A.	5,236	5	3,845	N.A.
Other	N.A.	26	10	107	N.A.
Photovoltaics (kW) (5)	(6) 6,897	13,837	88,221	337,268	1,155

Note(s): 1) Includes imports and exports; 2001 solar thermal collector imports were 3.5 million square feet, and exports were 0.8 million square feet. 2) Preliminary. 3) Solar thermal collectors: receive solar radiation, convert it to thermal energy, and are typically used for space heating, water heating, and heating swimming pools. 4) Industrial is included in Other. 5) Generate electricity by the conversion of solar radiation to electrical energy. 6) 1982.

Source(s): EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2006, Aug. 2006, Table 2.9, 2.10, 2.22, and 2.23, p. 20-21, 33-34 for 2005-2006; EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2005, Aug. 2006, Table 37 and Table 38, p. 21 and 22 for 2004 collector data, Table 47, p. 31 for 2000-2005 PV shipments, and Table 50, p. 34 for PV value of shipments; EIA, Renewable Energy Annual 2001, Nov. 2002, Table 18, p. 19 for 2000 collector data; EIA, Annual Energy Review 1991, June 1992, Table 111, p. 251 for 1990 collector sector; and EIA, Annual Energy Review 2004, Aug. 2005, Table 10.5, p. 291 for 1980-1990 PV shipments.

**5.8.2 Thermal Solar Collector Shipments, by End Use (including imports and exports) (Thousand SF) (1)**

Type	2000	2003	2004	2005 (2)	2006 (3)
Pool Heating	7,863	10,800	13,634	15,041	15,362
Hot Water	367	511	452	640	1,136
Space Heating	99	76	13	228	330
Space Cooling		0	0	2	3
Combined Space/Water Heating	2	23	16	16	66
Process Heating	20	34	0	0	0
Electricity Generation	3	0	0	114	3,847 (4)
<b>Total</b>	<b>8,354</b>	<b>11,444</b>	<b>14,114</b>	<b>16,041</b>	<b>20,744</b>

Note(s): 1) 5.8% of shipments are exported in 2005. 2) Approximately 51,000 systems in 2005. 3) Approximately 80,000 systems in 2006. 4) 2005 to 2006 increase in electricity generation due to shipment to the Nevada Solar One Project.

Source(s): EIA, Renewable Energy Annual 2001, Nov. 2002, Table 18, p. 19 for 2000; EIA, Renewable Energy Annual 2003, June 2005, Table 18, p. 10 for 2003; and EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2005, Aug. 2006, Table 38, p. 22 for 2004-2005, Table 30, p. 14 for Note 1, and Table 39, p. 23 for Note 2; EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2006, Table 2.10, p. 21 for 2006

**5.8.3 2007 Top Five Destinations of Thermal Solar Collector Shipments**

State	Percent of U.S. Unit Shipments
California	28%
Florida	26%
Arizona	5%
Oregon	4%
Illinois	3%

Source(s): EIA, Solar Thermal Manufacturing Activities 2007, October 2008, Table 2.4, p. 11.

**5.8.4 Thermal Solar Collector Manufacturer Statistics (1)**

-	Number of Manufacturers in 2007:	60
-	Companies with 90% of their revenue coming from solar collector sales:	36
-	Percentage of shipped solar collectors produced by top 5 manufacturers:	86%

Note(s): 1) Preliminary.

Source(s): EIA, Solar Thermal Collector Manufacturing Activities 2007, Oct. 2008, p. 2.

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**5.8.5 Shipments of Photovoltaic Cells and Modules, by Market (Peak Kilowatts) (1)**

<u>Market</u>	<u>1995</u>	<u>2000</u>	<u>2003(2)</u>	<u>2004</u>	<u>2005</u>	<u>2006</u>
Industrial	7,198	28,808	27,951	30,493	22,199	28,618
<b>Residential</b>	<b>6,272</b>	<b>24,814</b>	<b>23,389</b>	<b>53,928</b>	<b>75,040</b>	<b>95,815</b>
<b>Commercial</b>	<b>8,100</b>	<b>13,692</b>	<b>32,604</b>	<b>74,509</b>	<b>89,459</b>	<b>180,852</b>
Transportation	2,383	5,502	11,089	1,380	1,621	2,458
Utility	3,759	6,298	8,474	3,233	143	3,981
Government	2,000	4,417	5,538	3,257	28,683	7,688
<u>Other</u>	<u>1,347</u>	<u>4,690</u>	<u>313</u>	<u>14,316</u>	<u>9,772</u>	<u>17,857</u>
<b>Total</b>	<b>31,059</b>	<b>88,221</b>	<b>109,357</b>	<b>181,116</b>	<b>226,916</b>	<b>337,268</b>

Note(s): 1) Includes imports and exports. 2) Due to rounding, sum does not equal total.

Source(s): EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2005, Aug. 2006, Table 51, p. 35; EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2003, Sept. 2004, Table 30, p. 14; EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2001, Nov. 2002, Table 30, p. 23; and EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 1997, Feb. 1998, Table 29, p. 31.

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**5.8.6 Annual Shipments of Photovoltaic Cells and Modules (Peak Kilowatts)**

<u>Year</u>	<u>Number of Companies</u>	<u>Domestic</u>	<u>Exports</u>	<u>Total</u>
1996	25	13,016	22,448	35,464
1997	21	12,561	33,793	46,354
1998	21	15,069	35,493	50,562
1999	19	21,225	55,562	76,787
2000	21	19,838	68,382	88,220
2001	19	36,310	61,356	97,666
2002	19	45,313	66,778	112,091
2003	20	48,664	60,693	109,357
2004	19	78,346	102,770	181,116
2005	29	134,465	92,451	226,916
2006	41	206,511	130,757	337,268
2007(1)	46	280,475	237,209	517,684

Note(s): 1) Preliminary.

Source(s): EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2006, October 2007, Table 2.17 and Table 2.19, p. 28 and p. 30; EIA, Solar Photovoltaic Cell/Module Manufacturing Activities 2007, December 2008, Table 3.1 and Table 3.2, p. 8-9.

**5.8.7 2007 Top 5 Destinations of U.S. Photovoltaic Cell and Module Export Shipments, by Country**

<u>Country</u>	<u>Peak Kilowatts</u>	<u>Percent of U.S. Exports</u>
Germany	152,654	64%
Spain	31,384	13%
Italy	10,364	4%
France	10,228	4%
China	7,238	3%
<b>All Countries</b>	<b>237,209</b>	<b>100%</b>

Source(s): EIA, Solar Photovoltaic Cell/Module Manufacturing Activities 2007, Dec. 2008, Table 3.14, p. 22.

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**5.8.8 Annual New Installations of Grid-Tied Photovoltaic Cells and Modules, by Market (MW)**

<u>Peak Capacity by Use</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>	<u>2005</u>	<u>2006</u>	<u>2007</u>
<b>Residential</b>	<b>9.6</b>	<b>13.3</b>	<b>21.6</b>	<b>21.5</b>	<b>37.9</b>	<b>53.3</b>
<b>Non-Residential</b>	<b>8.0</b>	<b>25.4</b>	<b>29.6</b>	<b>42.1</b>	<b>60.6</b>	<b>85.7</b>
Utility	2.0	3.0	1.8	0.6	0.2	8.7
Unknown	3.0	1.7	1.7	3.2	4.4	2.4
Total New Capacity	22.6	43.4	54.7	67.4	103.1	150.1
Cumulative Capacity	51.1	94.5	149.2	216.6	319.8	469.9
<b>Number of Installations</b>	<b>3,438</b>	<b>4,217</b>	<b>6,275</b>	<b>6,339</b>	<b>10,634</b>	<b>13,287</b>

Source(s): Sherwood, Larry. Interstate Renewable Energy Council. Personal Communication. July, 2008.

**5.8.9 2007 Total Grid-Tied PV Capacity, by State**

<u>State</u>	<u>PV Capacity (MW)</u>				<u>Net Metering Utility (2006)</u>		
	<u>Total (1)</u>	<u>Residential</u>	<u>Non-Res.</u>	<u>Unknown</u>	<u>Utility Participants (2)</u>	<u>Residential Customers</u>	<u>Non-Res. Customers</u>
California	328.8	118.3	193.7	16.8	19	24,160	1,972
New Jersey	43.6	14.5	27.6	1.5	5	1,789	203
Arizona	18.9	3.2	13.1	2.6	4	185	3
Nevada	18.8	1.2	17.6	-	2	213	23
New York	15.4	9.7	5.2	0.5	5	1,088	119
Colorado	14.6	4.8	9.6	0.2	17	380	25
Massachusetts	4.6	1.5	3.2	-	5	454	104
Hawaii	4.5	1.3	2.4	0.8	4	184	23
Texas	3.2	1.6	1.7	-	9	375	56
<u>All Other States</u>	<u>8.3</u>	<u>9.4</u>	<u>22.6</u>	<u>17.7</u>	<u>180</u>	<u>2,495</u>	<u>617</u>
<b>Total</b>	<b>475.0</b>	<b>164.4</b>	<b>283.5</b>	<b>22.4</b>	<b>232</b>	<b>31,323</b>	<b>3,146</b>

Note(s): 1) Projections totals may not add due to rounding. 2) Includes entities with participants in more than one state. 3) Arizona does not have state-wide net metering provisions.

Source(s): Sherwood, Larry. Interstate Renewable Energy Council (IREC). Personal Communication. July, 2008; EIA. Green Pricing and Net Metering Programs, 2006. July 2008. Table 4.2, p. 10.

**5.8.10 Annual Installed Capacity of Photovoltaic Cells and Modules, Off-Grid and On-Grid(DC MW)**

	<u>On-Grid</u>	<u>Off-Grid</u>	<u>Total</u>
1997	1.4	9.0	10.4
1998	1.8	9.7	11.5
1999	2.6	12.0	14.6
2000	3.7	13.5	17.2
2001	11.1	16.0	27.1
2002	22.5	21.4	43.9
2003	43.4	25.0	68.4
2004	54.7	28.0	82.7
2005	67.4	33.0	100.4
2006	103.2	37.0	140.2
<u>2007</u>	<u>150.1</u>	<u>55.0</u>	<u>205.1</u>
<b>Cumulative</b>	<b>469.9</b>	<b>282.0</b>	<b>751.9</b>

Source(s): Sherwood, Larry. Interstate Renewable Energy Council. Personal Communication. July, 2008.

**5.9.1 United States Small Wind Units and Capacity Added per Year**

	<u>Units</u>	On-Grid <u>Units</u>	Off-Grid <u>Units</u>	Capacity <u>kW</u>	On-Grid <u>kW</u>	Off-Grid <u>kW</u>	<u>Sales (\$million)</u>
2001 (1)	2100	-	-	2100	-	-	-
2002 (1)	3100	-	-	3100	-	-	-
2003 (1)	3200	-	-	3200	-	-	-
2004	4671	-	-	4878	-	-	14.9
2005	4324	-	-	3285	-	-	9.9
2006	8329	453	7876	8565	4522	4043	33.2
2007	9092	1292	7800	9737	5720	4017	42.0

	Remote Off-Grid(2) <u>&lt; 1 kW</u>	Residential-Scale <u>On-Grid (1 - 10 kW)</u>	Commercial Scale <u>On-Grid (11 - 100 kW)</u>
% 2007 Units	86%	13%	1%
% 2007 Capacity	41%	34%	25%

Note(s): 1) Estimates. 2) Turbines under 1 kW are often used on marine vehicles to charge batteries and to pump water for irrigation or ranching.

Source(s): American Wind Energy Association, Stimmel, Ron, 2008 AWEA Small Wind Turbine Global Market Study, June 2008.

**5.10.1 Average Combined Heat and Power Capacity, Principal Building Type and Prime Mover (kW)**

<u>Residential</u>	Combustion		Reciprocating	
	<u>Turbine</u>	<u>Engine</u>	<u>Fuel Cell</u>	<u>Microturbine</u>
Apartments		245	330	262
Households	6	16		
<u>Commercial</u>				
Colleges/Univ	16215	2114	223	182
Food Sales/Services		161		120
General Gov't	8617	1041	198	198
Health Clinics		180		240
Hospitals/Healthcare	3984	1283	240	187
Hotels	3188	647	407	108
Justice/Public Order	10304	1236	521	58
Mercantile	4100	1496		360
Nursing Homes		176		565
Office	4699	1116	326	160
Public Assembly	11170	252	171	189
Schools K-12		326	200	120
Service	3700	252	250	45
Warehouses	42500	1147		

Source(s): Energy and Environmental Analysis Inc, The Combined Heat and Power Database, <http://www.eea-inc.com/chpdata/index.html>**5.10.2 Installed Combined Heat and Power Capacity, Principal Building Type and Prime Mover (MW)**

<u>Residential</u>	Combustion		Reciprocating		<u>Total</u>
	<u>Turbine</u>	<u>Engine</u>	<u>Fuel Cell</u>	<u>Microturbine</u>	
Apartments		32	0	3	36
Households	0	1			1
<u>Commercial</u>					
Colleges/Univ	811	144	3	2	960
Food Sales/Services		3		0	4
Hospitals/Healthcare	120	141	1	1	262
Hotels	13	54	3	2	72
Justice/Public Order	52	17	3	0	72
Mercantile	4	25		0	30
Nursing Homes		19		2	21
Office	47	95	3	2	146
Public Assembly	34	23	1	2	60
Schools K-12		65	1	4	70
<u>Service</u>	11	24	0	0	36
<b>Total</b>	1090	645	15	18	<b>1768</b>

Source(s): Energy and Environmental Analysis Inc, The Combined Heat and Power Database, <http://www.eea-inc.com/chpdata/index.html>

**5.10.3 Installed Combined Heat and Power Capacity, Principal Building Type and Census Region (MW)**

<u>Residential</u>	<u>Northeast</u>	<u>South</u>	<u>Midwest</u>	<u>West</u>	<u>Total</u>
Apartments	21	1	6	8	36
Private Households	0	0	0	0	1
<u>Commercial</u>					
Colleges/Univ	268	223	95	375	960
Food Sales/Services	2	0	0	1	4
Hospitals/Healthcare	66	65	46	85	262
Hotels	8	6	15	43	72
Justice/Public Order	14	0	6	52	72
Mercantile	19	5	5	2	30
Nursing + Green Roof Industry S	10	3	2	6	21
Office	34	41	28	43	146
Public Assembly	10	5	37	8	60
Schools K-12	27	8	6	28	70
<u>Service</u>	<u>6</u>	<u>5</u>	<u>1</u>	<u>24</u>	<u>36</u>
<b>Total</b>	<b>485</b>	<b>362</b>	<b>246</b>	<b>676</b>	<b>1768</b>

Source(s): Energy and Environmental Analysis Inc, The Combined Heat and Power Database, <http://www.eea-inc.com/chpdata/index.html>

**5.10.4 Installed Combined Heat and Power Capacity, Prime Mover and Census Region (MW)**

<u>Prime Mover</u>	<u>Northeast</u>	<u>South</u>	<u>Midwest</u>	<u>West</u>	<u>Total</u>
Combustion Turbine	318	199	135	439	1090
Reciprocating Engine	156	161	109	219	645
Fuel Cell	4	2	1	8	15
Microturbine	6	1	1	10	18
<b>Total</b>	<b>485</b>	<b>362</b>	<b>246</b>	<b>676</b>	<b>1768</b>

Source(s): Energy and Environmental Analysis Inc, The Combined Heat and Power Database, <http://www.eea-inc.com/chpdata/index.html>



Chapter 6 contains information on the United States energy supply. Production and distribution of both electricity and natural gas have a large impact on primary energy use in the United States. For example, it takes approximately twice as much energy to produce and transmit electricity than is delivered to the end-user. Information about public benefit funds and carbon emissions are also provided in this chapter.

The following pieces of information give some insight into the current condition of the U.S. energy supply:

- Approximately 52 percent of all electricity was produced by coal in 2006.
- As of 2006, there were 16,924 electric generators with a combined capacity of 1,076 GW.
- The U.S. currently has 104 nuclear power plants which account for 106 GW of generating capacity.
- U.S. wind capacity is expected to expand from 11.5 GW of capacity in 2006 to 40.1 GW of capacity by 2030. This is the largest growth of any renewable energy technology.
- The buildings sector consumed almost 73 percent of all the electricity produced in 2006. This number is expected to rise to approximately 78 percent by 2030.
- Over 80 percent of the additional electricity need to meet demand by 2030 will come from coal fired power plants.
- The average capacity of a nuclear power plant is about 1000 MW.
- The average cost of a generic quad in the buildings sector for 2006 was 9.46 billion dollars.
- 21.66 trillion cubic feet of natural gas was consumed in 2006.
- During transmission and distribution, 9.5 percent of the generated electricity is lost.

**6.1.1 Buildings Share of U.S. Electricity Consumption/Sales (Percent)**

	Buildings			Industry	Transportation	Total	Delivered Total (10 <sup>15</sup> Btu)
	Residential	Commercial	Total				
1980	34.3%	26.7%	60.9%	38.9%	0.2%	100%	7.15
1990	34.1%	30.9%	65.0%	34.9%	0.2%	100%	9.26
2000	34.9%	33.9%	68.7%	31.1%	0.2%	100%	11.67
<b>2006</b>	<b>36.9%</b>	<b>35.5%</b>	<b>72.4%</b>	<b>27.4%</b>	<b>0.2%</b>	<b>100%</b>	<b>12.49</b>
2010	37.5%	35.8%	73.3%	26.5%	0.2%	100%	13.20
2015	36.3%	37.5%	73.8%	26.1%	0.2%	100%	13.85
2020	36.1%	39.0%	75.1%	24.7%	0.2%	100%	14.54
2025	36.2%	40.3%	76.5%	23.3%	0.2%	100%	15.26
2030	36.6%	41.3%	77.9%	22.0%	0.2%	100%	16.05

Note(s): 1) Buildings accounted for 80% (or \$238 billion) of total U.S. electricity expenditures.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2005; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 consumption, and Table A3, p. 120-121 expenditures.

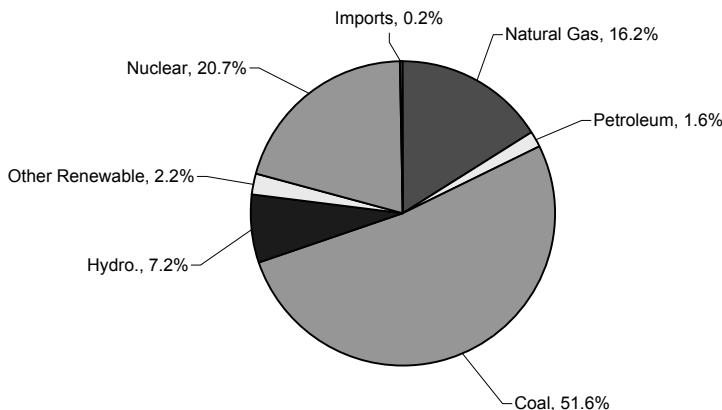
**6.1.2 U.S. Electricity Generation Input Fuel Shares (Percent)**

	Natural Gas	Petroleum	Coal	Renewables			Nuclear	Net Electric Imports	Total
				Hydro.	Oth(2)	Total			
1980	15.6%	10.8%	50.0%	11.8%	0.5%	12.3%	11.3%	(1)	100%
1990	10.9%	4.2%	53.0%	9.8%	2.2%	12.0%	19.9%	(1)	100%
2000	13.9%	3.0%	53.0%	7.3%	2.1%	9.4%	20.6%	(1)	100%
<b>2006</b>	<b>16.2%</b>	<b>1.6%</b>	<b>51.6%</b>	<b>7.2%</b>	<b>2.2%</b>	<b>9.4%</b>	<b>20.7%</b>	<b>0.2%</b>	<b>100%</b>
2010	16.6%	1.3%	50.7%	7.0%	4.0%	10.9%	20.0%	0.1%	100%
2015	15.6%	1.3%	51.4%	6.9%	4.8%	11.7%	19.5%	0.1%	100%
2020	13.5%	1.3%	52.4%	6.6%	5.9%	12.5%	20.0%	0.1%	100%
2025	11.5%	1.3%	54.1%	6.3%	6.3%	12.6%	20.1%	0.1%	100%
2030	10.4%	1.3%	56.0%	6.0%	6.4%	12.5%	19.4%	0.2%	100%

Note(s): 1) Electric imports included in renewables. 2) Includes geothermal, municipal solid waste, biomass, solar thermal, solar PV, and wind.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2005; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 consumption and Table A17, p. 143-144 for renewables.

**2006 U.S. Electricity Generation Input Fuel Shares (Percent)**



**6.1.3 U.S. Electricity Generation Input Fuel Consumption (Quadrillion Btu)**

	Natural Gas	Petroleum	Coal	Renewables			Nuclear	Net Electric Imports	Total	Growth Rate 2006-Year
				Hydro	Oth(2)	Total				
1980	3.80	2.63	12.16	2.87	0.11	2.98	2.74	(1)	24.32	-
1990	3.33	1.29	16.26	3.01	0.67	3.69	6.10	(1)	30.67	-
2000	5.32	1.14	20.22	2.77	0.81	3.58	7.86	(1)	38.12	-
<b>2006</b>	<b>6.42</b>	<b>0.64</b>	<b>20.48</b>	<b>2.86</b>	<b>0.88</b>	<b>3.74</b>	<b>8.21</b>	<b>0.06</b>	<b>39.68</b>	-
2010	6.89	0.56	21.01	2.89	1.64	4.53	8.31	0.05	41.46	1.1%
2015	6.75	0.57	22.18	2.96	2.09	5.05	8.41	0.04	43.12	0.9%
2020	6.09	0.59	23.67	2.97	2.67	5.64	9.05	0.04	45.21	0.9%
2025	5.45	0.61	25.51	2.97	2.97	5.94	9.50	0.05	47.19	0.9%
2030	5.13	0.63	27.55	2.97	3.16	6.13	9.57	0.08	49.21	0.9%

Note(s): 1) Electric imports included in renewables. 2) Includes geothermal, municipal solid waste, biomass, solar thermal, solar PV, and wind.

Source(s): EIA, State Energy Data 2005: Consumption, Feb. 2008, Tables 8-12, p. 18-22 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for 2006-2030 consumption, and Table A17, p. 143-144 for renewables.

**6.1.4 U.S. Electricity Net Generation, by Plant Type (Billion kWh)**

	Natural Gas	Petroleum	Coal	Renewables			Nuclear	CHP (3)	Tot.(4)	Growth Rate 2006-year
				Hydr(1)	Oth(2)	Total				
1980	346	246	1162	276	6	282	251	N.A.	2286	-
1990	265	118	1560	290	35	324	577	61	2901	-
2000	399	98	1911	271	45	316	754	165	3638	-
<b>2006</b>	<b>608</b>	<b>55</b>	<b>1930</b>	<b>285</b>	<b>61</b>	<b>347</b>	<b>787</b>	<b>173</b>	<b>3899</b>	-
2010	695	49	2002	289	131	421	797	160	4124	1.4%
2015	682	50	2122	297	168	465	807	160	4287	1.1%
2020	614	52	2287	298	220	518	868	145	4483	1.0%
2025	543	54	2502	298	242	540	911	136	4685	1.0%
2030	503	56	2756	299	255	553	917	133	4918	1.0%

Note(s): 1) Electricity used for hydroelectric pumped storage is subtracted from this conventional hydroelectric generation. 2) Includes geothermal, municipal solid waste, wood, biomass, solar thermal, solar photovoltaic, and wind. 3) CHP = Combined heat and Power. Includes CHP plants whose primary business is to sell electricity and heat to the public. 4) Includes batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, distributed generation, and other miscellaneous technologies that are not listed individually.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A8, p. 131-132; EIA, Annual Energy Review 2007, July 2008, Table 8.2c, p. 230 for 1990-2000; and EIA, Annual Energy Review 2002, Oct. 2003, Table 8.2b, p. 149 for 1980.

**6.1.5 U.S. Electric Utility and Nonutility Net Summer Electricity Generation Capacity (GW)**

	Coal Steam	Other Fossil	Combine Cycle	Combustion Turbine	Nuclear	Pumped	Total
1980	N.A.	N.A.	N.A.	N.A.	51.8	0.0	495.9
1990	302.3	N.A.	N.A.	N.A.	99.6	19.5	628.4
2000	310.2	N.A.	N.A.	N.A.	97.9	19.5	693.3
<b>2006</b>	<b>305.2</b>	<b>119.3</b>	<b>144.7</b>	<b>128.06</b>	<b>100.2</b>	<b>21.5</b>	<b>819.0</b>
2010	311.4	118.0	158.2	134.55	100.9	21.5	844.5
2015	319.3	93.2	159.9	127.08	102.1	21.5	823.1
2020	338.5	93.0	164.2	129.20	110.9	21.5	857.2
2025	367.6	92.6	173.3	140.92	115.7	21.5	911.6
2030	401.5	92.6	177.5	161.81	114.9	21.5	969.8

Note(s): 1) Nuclear capacity includes 3 GW of uprates from 2006 to 2030. New nuclear plants are expected to come online 2013-2019.

Source(s): EIA, Annual Energy Outlook 1994, Jan. 1994, Table A9, p. 66 and Table A16, p. 73 for 1990; EIA, AEO 2003, Jan. 2003, Table A9, Table 133-134, and Table A17, p.142 for 2000; and EIA, AEO 2008, Mar. 2008, Table A9, p. 133-134 and Table A16, p. 142 for 2006-2030.

**6.1.6 U.S. Renewable Electric Utility and Nonutility Net Summer Electricity Generation Capacity (GW)**

	<u>Conv. Hydropower</u>	<u>Geothermal</u>	<u>MSW (1)</u>	<u>Biomass</u>	<u>Solar Thermal</u>	<u>Solar PV</u>	<u>Wind</u>	<u>Total</u>
1980	81.7	0.9	0.0	0.1	N.A.	N.A.	N.A.	82.7
1990	73.3	2.7	2.1	1.2	0.3	N.A.	1.8	81.4
2000	78.2	2.8	3.3	1.7	0.4	N.A.	2.4	88.8
<b>2006</b>	<b>76.7</b>	<b>2.3</b>	<b>3.4</b>	<b>2.0</b>	<b>0.4</b>	<b>0.0</b>	<b>11.5</b>	<b>96.3</b>
2010	76.7	2.5	4.0	2.2	0.5	0.1	25.6	111.6
2015	77.1	2.9	4.0	2.7	0.8	0.1	29.6	117.3
2020	77.3	3.3	4.0	4.4	0.8	0.2	33.6	123.6
2025	77.3	3.8	4.1	4.8	0.8	0.3	37.2	128.3
2030	77.3	4.2	4.1	5.6	0.9	0.4	40.1	132.5

Note(s): 1) MSW = Municipal Solid Waste.

Source(s): EIA, Annual Energy Outlook (AEO) 1994, Jan. 1994, Table A9, p. 66 and Table A16, p. 73 for 1990; EIA, AEO 2003, Jan. 2003, Table A9, Table 133-134, and Table A17, p.142 for 2000; and EIA, AEO 2008, Mar. 2008, Table A9, p. 133-134 and Table A16, p. 142 for 2006-2030.

**6.1.7 U.S. Electric Power Sector Cumulative Power Plant Additions Needed to Meet Future Electricity Demand (1)**

<u>Electric Generator</u>	<u>Typical New Plant Capacity (MW)</u>	<u>Number of New Power Plants to Meet Demand</u>				
		<u>2010</u>	<u>2015</u>	<u>2020</u>	<u>2025</u>	<u>2030</u>
Coal Steam	600	13	29	62	110	167
Combined Cycle	400	34	40	50	73	84
Combustion Turbine/Diesel	160	45	53	66	139	271
Nuclear Power (2)	1,000	-	-	8	13	17
Pumped Storage	143 (3)	-	-	-	-	-
Fuel Cells	10	-	-	-	-	-
Conventional Hydropower	20 (3)	1	22	28	28	31
Geothermal	50	4	12	20	30	38
Municipal Solid Waste	30	20	20	21	23	23
Wood and Other Biomass	80	2	9	30	35	45
Solar Thermal	100	1	4	4	4	5
Solar Photovoltaic	5	8	24	37	55	72
Wind	50	282	363	443	514	573
<b>Total</b>		<b>412</b>	<b>581</b>	<b>785</b>	<b>1,060</b>	<b>1,385</b>

Distributed Generation 160 (4)

Note(s): 1) Cumulative additions after Dec. 31, 2005. 2) Nuclear capacity includes 3 GW of uprates from 2004 to 2030. New nuclear plants are expected to come online 2013-2019. 3) Based on current stock average capacity. 4) Combustion turbine/diesel data used.

Source(s): EIA, Annual Energy Outlook (AEO) 2008, Mar. 2008, Table A9, p. 153-154 and Table A16, p. 162; EIA, Assumption to the AEO 2008, June 2008, Table 39, p. 77; and EIA, Electric Power Annual 2006, Sept. 2007, Table 2.2, p. 19 for pumped storage plant capacity and Table 2.6, p. 21 for hydroelectric plant capacity.

**6.2.1 2006 Existing Capacity, by Energy Source (GW)**

<u>Plant Fuel Type</u>	<u>Number of Generators</u>	<u>Generator Nameplate Capacity</u>	<u>Net Summer Capacity</u>	<u>Net Winter Capacity</u>
Coal	1,493	336	313	315
Petroleum	3,744	64	58	63
Natural Gas	5,470	443	388	417
Other Gases	105	3	2	2
Nuclear	104	106	100	102
Hydroelectric Conventional	3,988	77	78	77
Other Renewables	1,823	26	24	24
Pumped Storage	150	20	21	21
<u>Other</u>	<u>47</u>	<u>1</u>	<u>1</u>	<u>1</u>
<b>Total</b>	<b>16,924</b>	<b>1,076</b>	<b>986</b>	<b>1,022</b>

Source(s): EIA, Electric Power Annual 2006, Oct. 2007, Table 2.2, p. 24.

**6.2.2 Net Internal Demand, Capacity Resources, and Capacity Margins in the Contiguous United States (GW)**

	<u>Net Internal Demand (1)</u>	<u>Capacity Resources (2)</u>	<u>Capacity Margin (3)</u>
1995	589.9	727.5	18.9%
1996	602.4	730.4	17.5%
1997	618.4	737.9	16.2%
1998	638.1	744.7	14.3%
1999	653.9	765.7	14.6%
2000	680.9	808.1	15.7%
2001	674.8	789.0	14.5%
2002	696.4	833.4	16.4%
2003	696.8	856.1	18.6%
2004	692.9	875.9	20.9%
2005	746.5	882.1	15.4%
2006	760.1	906.2	16.1%

Note(s): 1) Net internal demand represent the system demand that is planned for by the electric power industry's reliability authority and is equal to internal demand less direct control load management and interruptible demand. Direct control load management: Customer demand that can be interrupted at the time of the seasonal peak by direct control of the system operator by interrupting power supply to individual appliances or equipment on customer premises. This type of control usually reduces the demand of residential customers. Interruptible demand: Customer demand that can be interrupted (through contractual agreement) during peak loads by direct control of the system operator or by the customer at direct request of the system operator. This type of control usually reduces the demand of large-volume commercial and industrial consumers. 2) Capacity Resources: Utility- and IPP-owned generating capacity that is existing or in various stages of planning or construction, less inoperable capacity, plus planned capacity purchases from other resources, less planned capacity sales. 3) Capacity Margin is the amount of unused available capability of an electric power system at peak load as a percentage of capacity resources.

Source(s): EIA, Electric Power Annual 2006, Oct. 2007, Table 3.2, p. 34.

**6.2.3 Electric Capacity Factors, by Year and Fuel Type**

	<u>Coal</u>	<u>Petroleum</u>	<u>Natural Gas</u>	<u>Nuclear</u>	<u>Conventional Hydroelectric</u>	<u>Solar/PV</u>	<u>Wind</u>	<u>Total</u>
1990	58%	17%	25%	66%	45%	13%	18%	46%
1995	62%	12%	27%	77%	44%	17%	21%	47%
2000	70%	19%	27%	88%	39%	15%	27%	51%
2001	68%	21%	25%	89%	31%	16%	20%	50%
2002	69%	17%	22%	90%	37%	16%	27%	46%
2003	71%	21%	18%	88%	39%	15%	21%	46%
2004	71%	22%	19%	90%	39%	17%	25%	45%
2005	73%	23%	20%	89%	39%	15%	23%	46%
2006	72%	12%	22%	90%	42%	14%	27%	46%
2007(1)	73%	12%	24%	91%	36%	14%	23%	46%

Note(s): 1) Preliminary.

Source(s) EIA, Annual Energy Review 2007, June 2008, 8.2a, p. 226, Table 8.11a, p. 260.

**6.2.4 Electric Conversion Factors and Transmission and Distribution (T&D) Losses**

	<u>Average Utility Delivery Efficiency (1, 2)</u>	<u>Average Utility Delivery Ratio (Btu/kWh) (2, 3)</u>	<u>Growth Rate (2006-year)</u>
1980	29.3%	11,644	-
1990	30.2%	10,815	-
2000	30.5%	10,644	-
<b>2006</b>	<b>31.5%</b>	<b>10,405</b>	<b>-</b>
2010	31.8%	10,270	0.3%
2015	32.1%	10,151	0.3%
2020	32.2%	10,098	0.2%
2025	32.3%	10,005	0.2%
2030	32.6%	9,896	0.2%

Transmission and Distribution (T&D) losses as a:

Percent of Electric Generator Fuel Input	3.2%
Percent of Net Electricity Generated (4)	9.5%

Note(s): 1) Use these values to convert primary energy of electric generator fuel input to delivered energy. 2) Accounts for fuel conversion losses, plant use of electricity, and T&D losses. 3) Use these values to convert delivered electric energy to primary energy. 4) After fuel conversion losses and plant use of electricity.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for generator consumption and Table A8, p. 131-132 for electricity sales; EIA, Annual Energy Review 2006, July 2007, Diagram 5, p. 223 for T&D losses; EIA, 2005 State Energy Data Report, Tables 8-12 for Electricity Consumption and Generator Fuel Consumption.

**6.2.5 2006 Impacts of Saving an Electric Quad (1)**

<u>Plant Fuel Type</u>	<u>Utility Fuel Input Shares (%)</u>	<u>Average-Sized Utility Unit (MW) in 2006</u>	<u>Aggregate Number of Units to Provide the Fuel's Share of the Electric Quad (2)</u>
Natural Gas	16%	81	138
Petroleum	2%	17	94
Coal	52%	225	38
Nuclear	21%	1,015	3
<u>Renewable (3)</u>	<u>9%</u>	<u>21</u>	<u>154</u>
<b>Total</b>	<b>100%</b>		<b>427</b>

Note(s): 1) This table displays the breakdown of electric power plants that could be eliminated by saving an electric quad, in exact proportion to the actual primary fuel shares for electricity produced nationwide in 2006. Use this table to estimate the avoided capacity implied by saving one electric quad. 2) Based on typical U.S. power plants operating less than full load throughout the year. 3) Includes pumped storage.

Source(s): EIA, Electric Power Annual 2006, Oct. 2007, Table 2.2, p. 24; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 for consumption and Table A8, p. 131-132 for electricity supply.

**6.2.6 Cost of an Electric Quad Used in the Buildings Sector (\$2006 Billion)**

	<u>Residential</u>	<u>Commercial</u>	<u>Buildings Sector</u>
1980	9.92	10.14	<b>10.02</b>
1990	9.89	9.13	<b>9.53</b>
2000	8.59	7.65	<b>8.13</b>
<b>2006</b>	<b>9.90</b>	<b>9.00</b>	<b>9.46</b>
2010	10.30	9.15	<b>9.74</b>
2015	9.95	8.45	<b>9.19</b>
2020	10.01	8.50	<b>9.23</b>
2025	10.11	8.57	<b>9.30</b>
2030	10.30	8.80	<b>9.51</b>

Note(s): This table provides the consumer cost of an electric quad. Use this table to estimate the savings to consumers when a primary quad is saved in the form of *delivered* electricity.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119 and Table A3, p. 120-121; EIA, State Energy Data 2005: Consumption, February 2008, Tables 8-12, p. 18-22 for 1980-2005; EIA, State Energy Data 2005: Prices and Expenditures, Feb. 2008, Tables 2-3, p. 24-25 for 1980-2005 and prices; and EIA, Annual Energy Review 2007, July 2008, Appendix D, Gross Domestic Product and Implicit Price Deflators, p. 377.

**6.2.7 Characteristics of New and Stock Generating Capacities, by Plant Type**

<u>New Plant Type</u>	2006	2015	2006 Installed Capital Costs of a Typical Power Plant		
	Heat Rate (Btu/kWh)	Heat Rate (Btu/kWh)	Price (\$2006 thousand per MW)	Size (MW)	Cost (\$2006 million)
Pulverized Coal	9,200	9,069	1,534	600	920
Coal-Gasification Comb. Cycle	8,765	8,389	1,773	550	975
Combined Cycle	7,196	7,064	703	250	176
Advanced Combined-Cycle	6,752	6,612	706	400	282
Combustion Turbine	10,833	10,675	500	160	80
Advanced Combustion Turbine	9,289	9,012	473	230	109
Fuel Cell	7,930	6,960	5,374	10	54
Wind	10,022	10,280	1,434	50	72
Advanced Nuclear	10,400	10,400	2,475	1,350	3,341

<u>Stock Plant Type</u>	2006	2010	2015	2020	2025	2030
Fossil Fuel Steam Heat Rate (Btu/kWh)	10,542	10,455	10,311	10,181	10,024	9,825
Nuclear Energy Heat Rate (Btu/kWh)	10,517	10,421	10,421	10,421	10,421	10,421

Note(s): This table provides comparisons of electric generating plants. Plant use of electricity is included; however, transmission and distribution losses of the electric grid are excluded.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 117-119, and Table A8, p. 131-132. EIA, Assumptions to the AEO 2008, June 2008, Table 48, p. 89 for fossil fuel heat rates, Table 39, p. 77 for other generator data.

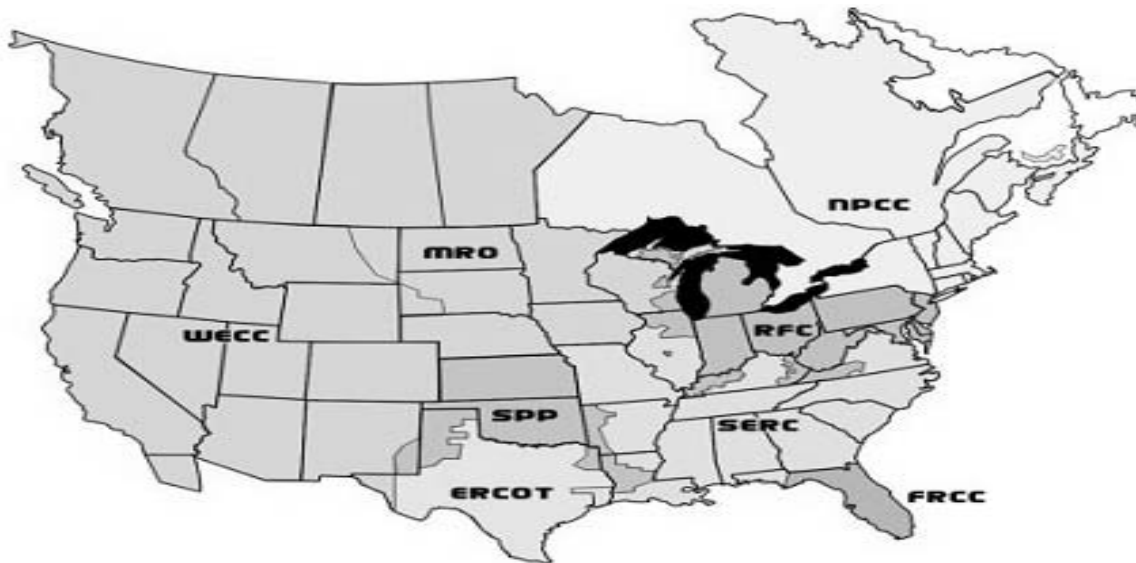
**6.2.8 Characteristics of New Commercial Distributed Generating Technologies, by Plant Type**

<u>New Plant Type</u>	Efficiency (HHV)		2006 Installed Capital Costs of Typical DG Technologies			Service Life (years)
	Electrical	Electrical + Thermal	Price (\$2006 per kW)	Size (kW)	Cost (\$2006 thousand)	
Solar Photovoltaic	0.16	N.A.	6,547	25	164	30
Fuel Cell	0.36	0.72	5,674	200	1,135	20
Natural Gas Engine	0.32	0.77	1,233	200	247	20
Oil-Fired Engine	0.31	0.82	1,353	200	271	20
Natural Gas Turbine	0.23	0.66	1,974	1000	1,974	20
Natural Gas Microturbine	0.30	0.63	1,768	200	354	20

Source(s): Discovery Insights, Final Report: Commercial and Industrial CHP Technology Cost and Performance Data Analysis for EIA's NEMS, Jan. 2006, Table 7, p. 12; and EIA, Annual Energy Review 2007, July 2008, Appendix D, p. 373.



**6.2.9 NERC Regions Map**



Source(s): EIA, Form EIA-411, Cordinated Bulk Power Supply Program Report, Feb. 2007

**6.2.10 Peak Hour Demand and Capacity Margin, Summer and Winter by NERC Region (MW)**

Region	Sub-region	Summer 2006 (1)			Winter 2005/2006 (2)		
		Peak Hour Demand	Month	Capacity Margin (3)	Peak Hour Demand	Month	Capacity Margin (3)
ERCOT	-	62,339	August	12%	47,948	December	21%
FRCC	-	45,751	August	10%	43,413	February	19%
MRO	-	47,892	July	4%	39,045	February	16%
NPCC	-	63,241	August	13%	46,828	December	38%
NPCC	New England	28,130	August	10%	21,768	December	34%
NPCC	New York	35,111	August	16%	25,060	December	42%
RFC	-	191,920	August	11%	153,600	December	33%
SERC	-	198,831	August	11%	158,984	February	30%
SERC	Central	41,976	August	8%	34,640	February	27%
SERC	Delta	27,620	August	17%	21,442	December	42%
SERC	Gateway	19,313	July	12%	14,511	December	43%
SERC	Southeastern	47,535	August	15%	38,466	February	31%
SERC	VACAR	62,608	August	7%	50,804	February	29%
SPP	-	42,556	July	12%	31,764	December	33%
WECC	-	142,096	July	11%	107,493	December	29%
WECC	AZ-NM-SNV	30,111	July	14%	17,130	December	47%
WECC	CA-MX US	62,324	July	9%	40,537	December	25%
WECC	NWPP	38,753	July	27%	40,298	December	29%
WECC	RMPA	10,908	July	12%	9,528	December	24%
U.S. TOTAL		776,193	July	13%	609,564	December	31%

Note(s): 1) Summer Demand includes the months of June, July, August, and September. 2) Winter Demand includes December of the previous year and January-March of the current year. 3) Capacity Margin is the amount of unused available capability of an electric power system at peak load as a percentage of net capacity resources. Net Capacity Resources: Utility- and IPP-owned generating capacity that is existing or in various stages of planning or construction, less inoperable capacity, plus planned capacity purchases from other resources, less planned capacity sales.

Source(s): NERC, Electricity Supply and Demand Database 2007, November 2007, Tables used: Capacity and Demand 1990-2007 and Monthly Demand and Energy 1997-2007.

**6.3.1 Natural Gas Overview (Trillion Cubic Feet)**

	<u>Production</u>	Supplemental <u>Gas</u>	Net <u>Import</u>	Storage <u>Withdrawal</u>	Balancing <u>Item (1)</u>	<u>Consumption (2)</u>
1980	19.40	0.16	0.94	0.02	-0.64	19.88
1990	17.81	0.12	1.45	-0.51	0.31	19.17
2000	19.18	0.09	3.54	0.83	-0.31	23.33
<b>2006</b>	<b>18.51</b>	<b>0.06</b>	<b>3.46</b>	<b>-0.74</b>	<b>0.37</b>	<b>21.66</b>
2010	19.29	0.06	3.85	0.09	-0.05	23.25
2015	19.52	0.06	4.03	0.09	-0.05	23.66
2020	19.67	0.06	3.55	0.09	-0.05	23.33
2025	19.60	0.06	3.28	0.09	-0.04	22.99
2030	19.43	0.06	3.18	0.09	-0.05	22.72

Note(s): 1) Net internal demand represent the system demand that is planned for by the electric power industry's reliability authority and is equal to

Source(s): EIA, Annual Energy Review 2007, June 2008, Table 6.1, p. 181 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A13, p. 139 for 2006-2030.

**6.3.2 Natural Gas in Underground Storage (Billion Cubic Feet)**

	<u>Base Gas</u>	<u>Working Gas</u>	<u>Total</u>	<u>Underground Storage Capacity</u>	
1980	3642	2655	6297	7434	85%
1990	3868	3068	6936	7794	89%
2000	4352	1719	6071	8241	74%
2001	4301	2904	7204	8415	86%
2002	4340	2375	6715	8207	82%
2003	4303	2563	6866	8206	84%
2004	4201	2696	6897	8255	84%
2005	4200	2635	6835	8268	83%
2006	4211	3070	7281	8330	87%
2007	4234	2879	7113	8368	85%

Source(s): EIA, Annual Energy Review 2007, June 2008, Table 6.6, p. 193.

**6.3.3 Natural Gas Well Productivity**

	Gross Withdrawals from Wells (billion cubic feet)	Producing Wells	Average Productivity (thousand cubic feet per day)
1980	17,573	182	263.8
1990	16,054	269	163.4
2000	17,726	276	158.8
2001	18,129	373	133.1
2002	17,795	388	125.7
2003	17,882	393	124.6
2004	17,885	406	120.3
2005	17,472	426	112.4
2006	17,942	449	109.6
2007	18,437	427	118.3

Source(s): EIA, Natural Gas Annual 2006, October 2007, p. 26

**6.3.4 Natural Gas End-Use Deliveries by Type of Distributor for 1996, 2000, and 2006**

Type of Distributor	1996			2000			2006		
	Volume Delivered (Tcf)	(Percent)	Customers (millions)	Volume Delivered (Tcf)	(Percent)	Customers (millions)	Volume Delivered (Tcf)	(Percent)	Customers (millions)
Local Distribution Comp.	14.3	72%	58.7	14.2	67%	57.8	11.1	56%	61.4
Investor-Owned	13.3		54.0	13.2		4.3	0.8		4.9
Municipal	0.8		4.0	0.8		0.5	0.2		0.8
Privately-Owned	0.2		0.7	0.2		0.1	0.0		0.1
Cooperative	0.0		0.1	0.0		62.8	12.0		67.2
Interstate Pipeline	1.6	8%	0.0	2.5	12%	0.0	3.5	17%	0.0
Intrastate Pipeline	3.8	19%	1.4	4.3	20%	1.4	4.3	21%	2.7
Other	0.3	1%	0.0	0.2	1%	0.0	0.2	1%	0.0
Total	20.0	100%	60.2	21.2	100%	64.2	19.9	100%	69.9

Source(s): EIA, Distribution of Natural Gas: The Final Step in the Transmission Process, June 2008, Table 1, p. 6.

**6.3.5 Natural Gas Consumption, by Sector (Trillion Cubic Feet)**

	Residential	Commercial	Industrial	Transportation	Electric Power	Total
1980	4.75	2.61	8.20	0.64	3.68	19.88
1990	4.39	2.62	8.26	0.66	3.25	19.17
2000	5.00	3.18	9.29	0.66	5.21	23.33
<b>2006</b>	<b>4.37</b>	<b>2.83</b>	<b>7.62</b>	<b>0.60</b>	<b>6.24</b>	<b>21.66</b>
2010	4.81	2.96	8.13	0.66	6.70	23.25
2015	5.01	3.20	8.19	0.69	6.56	23.66
2020	5.15	3.37	8.15	0.74	5.92	23.33
2025	5.19	3.53	8.20	0.78	5.30	22.99
2030	5.17	3.67	8.11	0.78	4.99	22.72

Source(s): EIA, Annual Energy Review 2007, June 2008, Table 6.5, p. 191 for 1980-2000; and EIA, Annual Energy Outlook 2008, Mar. 2008, Table A13, p. 139 for 2006-2030.

**6.4.1 Emissions of Carbon Dioxide from Electric Utilities (Million Metric Tons)**

1990	1980
1995	1955
2000	2301
<b>2006</b>	<b>2344</b>
2010	2413
2015	2519
2020	2627
2025	2771
2030	2948

Source(s): EIA, Emissions of Green House Gases in the United States 2006, p. 16, November 2007; EIA, Annual Energy Outlook 2008, Mar. 2008, Table A18, p. 145.

**6.4.2 Electric Quad Average Carbon Dioxide Emissions with Average Utility Fuel Mix (Million Metric Tons) (1)**

	<u>Petroleum</u>	<u>Natural Gas</u>	<u>Coal</u>	<u>Nuclear</u>	<u>Renewable</u>	<u>Total</u>
<b>2006</b>	<b>1.38</b>	<b>8.57</b>	<b>48.91</b>	<b>0.00</b>	<b>0.30</b>	<b>59.16</b>
2007	0.00	0.75	0.59	0.00	0.00	1.34
2008	0.00	0.81	0.35	0.00	0.00	1.17
2009	0.00	0.72	0.86	0.00	0.00	1.58
2010	0.00	0.63	1.32	0.00	0.00	1.95
2011	0.00	0.54	2.25	0.00	0.00	2.79
2012	0.00	0.58	2.80	0.00	0.00	3.38
2013	0.00	0.25	3.13	0.00	0.00	3.38
2014	0.00	0.24	3.62	0.00	0.00	3.86
2015	0.00	0.43	3.88	0.00	0.00	4.31
2016	0.00	0.55	4.24	0.00	0.00	4.80
2017	0.00	0.44	4.86	0.00	0.00	5.31
2018	0.00	0.18	5.69	0.00	0.00	5.87
2019	0.00	0.00	6.32	0.00	0.00	6.32
2020	0.00	0.00	6.85	0.00	0.01	6.85
2021	0.00	0.00	7.61	0.00	0.01	7.61
2022	0.00	0.00	8.21	0.00	0.01	8.22
2023	0.00	0.00	8.94	0.00	0.01	8.94
2024	0.00	0.00	9.68	0.00	0.01	9.69
2025	0.00	0.00	10.29	0.00	0.01	10.30
2026	0.00	0.00	10.88	0.00	0.01	10.88
2027	0.00	0.00	11.55	0.00	0.01	11.55
2028	0.00	0.00	12.19	0.00	0.01	12.20
2029	0.00	0.00	12.87	0.00	0.01	12.88
2030	0.00	0.00	13.78	0.00	0.01	13.79

Note(s): 1) This table provides estimates of the carbon emissions resulting from consumption of a primary quad at electric utilities. Projected (2007-2030) new marginal capacity emissions will result from natural gas- and coal-fired power plants. Electric generation capacity is projected to increase for biomass, wind, and nuclear power. Biomass and wind power electric generation will increase 2007-2010. Nuclear electric generation capacity will increase 2016-2019. Electricity imports from utility consumption were ignored since this energy was produced outside of the U.S. "Average" means the weighted average of different fuels (e.g., petroleum is the average of residual and distillate fuel oils). The combustion of fossil fuels produces carbon in the form of carbon dioxide and carbon monoxide; however, carbon monoxide emissions oxidize in a relatively short time to form carbon dioxide. 2) Emissions from renewable energy include emissions released from geothermal power and non-biogenic emissions from municipal solid waste.

Source(s): EIA, Annual Energy Outlook 2008, Mar. 2008, Table A2, p. 137-139 and Table A18, p. 164.

**6.4.3 The Clean Air Act****1970 Amenements**

- Established the National Ambient Air Quality Standards(NAAQS) for stationary sources and placed limits on mobile sources.
- Established the New Source Performance Standards(NSPS) which mandated a strict limit on emissions from new pollution sources.
- Expanded on the State Implementation Plans(SIPs) to carry out mandates.

**1977 Amendments**

- Categorized regions into attainment and non-attainment regions.
- Non-attainment designation occurred if region emitted in excess of any federal standard.
- If a region complied with federal standards, it was designated as a PSD, which stands for prevention of significant deterioration.
- Lengthened federal deadlines for meeting pollution reduction, particularly in regards to mobile emissions sources.

**1990 Amendments**

- Established a sulfur dioxide(SO<sub>x</sub>) and a nitrous oxide(NO<sub>x</sub>) cap and trade program. Under this program, an emissions cap is set and permits are issued. An emitter of SO<sub>x</sub> or NO<sub>x</sub> must have a permit for each unit of pollutant they release. These emissions permits may be traded(bought and sold) amongst polluting parties to minimize costs.
- Mandated the control of 189 Hazardous Pollutants.
- Updated and expanded provisions of the National Ambient Air Quality Standards.

Source(s): The United States Congress, Public Law 108-201, The Clean Air Act as amended through February 24, 2004; EPA, The History of the Clean  
[http://www.epa.gov/air/caa/caa\\_history.html](http://www.epa.gov/air/caa/caa_history.html)

**6.5.1 Funding for States with Active Public Benefit Efficiencies Programs as of 2003 (Nominal Dollars)**

	<u>Reporting Year</u>	<u>Program Budget</u>	<u>Percent of Utility Revenues</u>
Arizona	2002	2.0	0.1%
California	2003	240.0	1.5%
Connecticut	2002	87.1	3.1%
Illinois	2003	2.0	0.0%
Massachusetts	2002	138.0	3.0%
Maine	2003	2.9	0.3%
Michigan	2002	7.8	0.1%
Montana	2002	14.3	2.0%
New Hampshire(1)	2002-2003	5.2	0.5%
New Jersey	2002	99.6	1.5%
New York	2002	129.0	1.3%
Nevada	2003	11.2	0.5%
Ohio	2002	14.3	0.1%
Oregon(2)	2002	19.1	0.9%
Rhode Island	2002	16.4	2.7%
Texas	2002	69.0	0.4%
Vermont	2002	16.8	3.3%
Wisconsin	FY2003	49.7	1.4%
<b>Total</b>		<b>924.4</b>	

Note(s): 1) Due to a start-up date of June 1, 2002 and counted til March 2003; remainder of year estimated 2) Partial year; program began March 1, 2002

Source(s): American Council for an Energy Efficient Economy, Kushle, York, Wittie, Five Years In: An Examination of the First Half Decade of Public Benefit Energy Efficiency Policies, April 2004, Table 3, p. 27

**6.5.2 Demand-Side Management Funds Collected for Energy Efficiency Programs in 2000 (\$2006) (1)**

	<u>Total Expenditures</u> <u>(\$ million)</u>	<u>Per Capita Spendings</u> <u>(\$/person)</u>
Connecticut	77.4	22.69
Massachusetts	115.6	18.18
Rhode Island	16.3	15.53
New Jersey	129.6	15.38
Vermont	7.3	12.00
Maine	14.7	11.50
Wisconsin	57.3	10.67
Hawaii	12.8	10.57
New York	189.7	9.99
California	334.0	9.82
<b>National(2)</b>	<b>1,276</b>	<b>4.52</b>

Note(s): 1) This table shows demand side management funds(including Public Benefit Funds) collected in 2000 that were spent of energy efficiency programs. 2) The top ten states in spending per capita represent 74.8% of total U.S. funds collected for energy efficiency programs.

Source(s): American Council for an Energy Efficient Economy, Kushle, York, Wittie, Five Years In: An Examination of the First Half Decade of Public Benefit Energy Efficiency Policies, April 2004, Table 3, p. 27

**7.1.1 Minimum Efficiency Standards and Maximum Energy Use for Typical Single-Family Residential Heating and Cooling Equipment**

	Minimum Efficiency (1)		Maximum Energy Use for Space Heating (2)							
			1992				2006			
			New		Existing		New		Existing	
Heating Equipment	1992	2006	North	South	North	South	North	South	North	South
Natural Gas, Furnace	78 AFUE	78 AFUE	1170	445	1489	771	1170	445	1489	771
Oil, Boiler	80 AFUE	80 AFUE	731	N.A.	930	422	731	N.A.	930	422
Electric, Heat Pump	6.8 HSPF	7.7 HSPF	12923	4685	11232	5546	11412	4137	9919	4898

	Minimum Efficiency (3)		Maximum Electricity Use for Space Cooling							
			1992				2006			
			New		Existing		New		Existing	
Cooling Equipment	1992	2006	North	South	North	South	North	South	North	South
Central Air Conditioner	10 SEER	13 SEER	1113	2543	1000	3743	927	2119	833	3119
Electric, Heat Pump	10 SEER	13 SEER	1100	2414	813	2657	846	1857	625	2044

Note(s): 1) AFUE = Annual Fuel Utilization Efficiency. HSPF = Heating Season Performance Factor. 2) Gas use is in therms. Oil use is in gallons. Electricity use is in kWh. 3) SEER = Seasonal Energy Efficiency Ratio.

Source(s): DOC/GPO, Title 10, Chapter 2, Part 430, Section 430.32, Jan 1, 2001, p. 259 for efficiencies; LBNL, Energy Data Sourcebook for the U.S. Residential Sector, Sept. 1997, Table 3.20, p. 52-53 and Table 3.21, p. 58; and Federal Register, Energy Conservation Program for Consumer Products: Central Air Conditioners and Heat Pumps Energy Conservation Standards, Vol. 66, No. 14, Jan. 22, 2001, p. 7170 for central air conditioner and heat pump.

**7.1.2 Federal Minimum Efficiency Standard for Commercial Cooling Equipment from the Energy Policy Act of 2005 (1)**

Type	65 - 134 kBtu/h	135 - 239 kBtu/h	240 - 759 kBtu/h
Central Air Conditioner (EER)			
without heating or electrical resistance heating	11.2	11.0	10.0
without heating equipment	11.0	10.8	9.8
Central Air Heat Pump (EER) -- Cooling			
without heating or electrical resistance heating	11.0	10.6	9.5
without heating equipment	10.8	10.4	9.3
Central Air Heat Pump (COP) -- Heating	3.3	3.2	3.2

Note(s): 1) The effective date of these manufacturing standards is January 1, 2010.

Source(s): U. S. Government, Energy Policy Act of 2005, August 2005, Section 136, Paragraphs 7-9.

**7.1.3 HVAC Tax Incentives of the Energy Policy Act of 2005**

Equipment Type	Qualifying Efficiency	Credit
Central air conditioner	15 SEER and 12.5 EER	300
Central air-source heat pump	15 SEER, 9 HSPF, and 13 EER	300
Ground-source heat pump		
Closed loop	14.1 EER and 3.3 COP	300
Open loop	16.2 EER and 3.6 COP	300
Direct expansion (DX)	15.0 EER and 3.5 COP	300
Gas, oil, or propane furnace or boiler	95% AFUE	150
Furnace Blower	Electricity use <2% of total furnace <i>site energy consumption</i>	50 300
Electric heat pump water heater	2.0 EF	300
Gas, oil, or propane water heater	0.80 EF	

Source(s): ACEEE, The Federal Energy Policy Act of 2005 and its Implications for Energy Efficiency Program Efforts, Sept. 2005, Table 1, p. 6.

**7.1.4 Phase Out Schedule of Halocarbons in the U.S. (1)**

<u>Gas</u>	<u>Manufacturing Base Level (2)</u>	<u>Manufacturing Freeze (3)</u>	<u>Montreal Protocol Reduction</u>		<u>U.S. Clean Air Act Reduction</u>	
			<u>%</u>	<u>By</u>	<u>%</u>	<u>By</u>
Chlorofluorocarbons (CFCs)	1986	1989	75%	1994	75%	1994
			100%	1996 (4)	100%	1996
Bromofluorocarbons (Halons)	1986	1992	100%	1994 (4)	100%	1994
Hydrochlorofluorocarbons (HCFCs)	1989 HCFC consumption + 2.8 % of 1989 CFC consumption	1996	35%	2004	35%	2003
			75%	2010	75%	2010
			90%	2015	90%	2015
			99.5%	2020	99.5%	2020
			100%	2030 (4)	100%	2030
Hydrofluorocarbons (HFCs)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Note(s): 1) The phase out of halocarbons is consistent with Title VI of the Clean Air Act and is in accordance with the Montreal Protocol and Amendments. 2) The amount of gas produced and consumed in this year is established and defined as the base level. To meet basic domestic needs, levels of production are allowed to exceed the base level by up to 10%. 3) After this year, levels of production are no longer permitted to exceed the base year level. 4) With possible essential use exemptions.

Source(s): Federal Register, Vol. 72, No. 123, June 2007, p. 35230, <http://www.epa.gov/ozone/title6/phaseout>; United Nations Ozone Environmental Programme, Ozone Secretariat, 2005, <http://www.unep.ch/ozone/index.shtml>; and Title VI, The Clean Air Act of 1990, S.1630, 101st Congress., 2nd Session.



**7.2.1 Minimum Efficiency Standards for Appliances and Equipment**

	Adjusted Volume (2) (Cu. Ft.)	Rated Maximum Electricity Use (kWh)				
		1990	1993	2001		
<b>Refrigerator-Freezers (Auto Defrost) (1)</b>						
Top freezer w/o through-the-door ice service and all-refrigerators—auto defrost	21	955	685	478		
Side freezer w/o through-the-door ice service	25	1,183	797	631		
Bottom freezer w/o through-the-door ice service	25	1,183	781	574		
Top freezer w/ through-the-door ice service	18	1,015	711	542		
Side freezer w/ through-the-door ice service	29	1,428	992	694		
<b>Freezers (1)</b>						
	Adjusted Volume (2) (Cu. Ft.)	Rated Maximum Electricity Use (kWh)				
		1990	1993	2001		
Upright Freezers w/ Manual Defrost	25.7	702	529	452		
Upright Freezers w/ Automatic Defrost	30.0	1,103	838	699		
Chest Freezers and all other Freezers except Compact Freezers	24.8	590	433	389		
<b>Room Air-Conditioners (3)</b>						
	Minimum EER	Typical Maximum Electricity Use (kWh) (4)				
Less than 6,000 Btu/h	9.7		464			
6,000 to 7,999 Btu/h	9.7		541			
8,000 to 13,999 Btu/h	9.8		842			
14,000 to 19,999 Btu/h	9.7		1,314			
20,000 Btu/h or more	8.5		1,765			
<b>Clothes Dryers (3)</b>						
	Minimum EF (lbs./kWh)	Typical Maximum Energy Use				
Electric, Standard	3.01		835 kWh			
Gas	2.67		32 therms			
<b>Clothes Washers (3)</b>						
	Minimum EF (cu. Ft./kWh per cycle)	Minimum Modified EF (cu. Ft./kWh per cycle)		Typical Maximum Electricity Use (kWh) (5)		
	1994	2004	2007			
Top Loading, Standard	1.18	1.04	1.26	1,265		
Horizontal-Axis	N.A.	1.04	1.26	731		
<b>Dishwashers (3)</b>						
	Minimum EF (cycles/kWh)	Typical Maximum Electricity Use (kWh)				
Standard Dishwasher	0.46		498			
<b>Water Heaters (6)</b>						
	Minimum EF (7)			Typical Maximum Energy Use		
	1990	1991	2004	1990	1991	2004
Gas-Fired	0.54	0.54	0.59	208 therms	208 therms	191 therms
Oil-Fired	0.51	0.51	0.51	155 gallons	155 gallons	155 gallons
Electric Resistance	0.90	0.88	0.92	3456 kWh	3534 kWh	3380 kWh

Note(s): 1) DOE regulations mandate maximum electrical consumption for appliance based on its size. 2) AV = Adjusted Volume = Refrigerator Compartment + 1.63 \* Freezer Compartment. 3) DOE regulations mandate minimum efficiency for appliance. 4) Electric use based on 750 hours of operation. 5) Includes electricity for water heater and clothes dryer. 6) DOE regulations mandate minimum efficiency for appliance based on its size. 7) Based on a 40-gallon tank.

Source(s): DOC/GPO, 2001 CFR, Title 10, Chapter 2, Part 430, Section 430.32, Jan. 1, 2001, p. 258-264 for minimum efficiencies; AHAM, 2000 Major Home Appliance Industry Factbook, Nov. 2000, Table 21, p. 28, for refrigerator and freezer sizes; DOE/EE, Final Rule Technical Support Document: Energy Efficiency Standards for Consumer Products: Clothes Washers, Dec. 2000, p. 10-8; LBNL, Energy Data Sourcebook for U.S. Residential Sector, May 1997, p. 102-103 for clothes dryers, p. 94 for dishwashers; DOE/EE, Technical Support Document: Energy Efficiency Standards for Consumer Products: Water Heaters, Apr. 2000, p. 9-14.

**7.2.2 Energy Independence and Security Act 2007, Lighting Standards for General Service Incandescent Lamps****General Service Incandescent**

<u>Effective Date</u>	<u>Maximum Wattage</u>	<u>Rated Lumen Range</u>	<u>Minimum Life</u>
2012	72	1,490-2,600	1000 hrs.
2013	53	1,050-1,498	1000 hrs.
2014	43	750-1,049	1000 hrs.
2015	29	310-749	1000 hrs.

**Modified Spectrum General Service Incandescent**

<u>Effective Date</u>	<u>Maximum Wattage</u>	<u>Rated Lumen Range</u>	<u>Minimum Life</u>
2012	72	1,118-1,950	1000 hrs.
2013	53	788-1,117	1000 hrs.
2014	43	563-787	1000 hrs.
2015	29	232-563	1000 hrs.

By 2020, the minimum efficacy for general service incandescent will be 45 lm/W unless the Secretary of Energy has implemented another standard which saves as much or more energy than a 45 lm/W standard.

Source(s): U. S. Government, Energy Independence and Security Act of 2007, January 2007, Section 321.

**7.2.3 Federal Minimum Efficiency Standard for Commercial Refrigeration Equipment from the Energy Policy Act of 2005 (1)**

<u>Type of Equipment</u>	<u>Consumption Maximum (kWh/day) (2)</u>
Refrigerator with Solid Doors	0.10 V + 2.04
Refrigerator with Transparent Doors	0.12 V + 3.34
Freezers with Solid Doors	0.40 V + 1.38
Freezers with Transparent Doors	0.75 V + 4.10
Refrigerators/Freezers with Solid Doors (3)	0.27 AV - 0.71, or 0.70

Note(s): 1) The effective date of these manufacturing standards is January 1, 2010. 2) V = volume in cubic feet. 3) AV = Adjusted Volume in cubic feet. Standard is the greater of the two numbers.

Source(s): U. S. Government, Energy Policy Act of 2005, August 2005, Section 136, Paragraphs 7-9

**7.2.4 Federal Minimum Efficiency Standards from the Energy Policy Act of 2005**

	<u>Effective Date</u>	<u>Standard</u>
<b>Residential</b>		
Ceiling Fan Light Kits	Jan. 2007	Packaged with ENERGY STAR v2 screw-in CFLs
Dehumidifiers	Oct. 2007	ENERGY STAR v1 criteria
CFLs	Jan. 2006	ENERGY STAR v2 criteria
Torchiere Lighting Fixtures	Jan. 2006	190 Watt maximum
<b>Commercial</b>		
Clothes Washers	Jan. 2007	MEF at least 1.26 and WF no more than 9.5 (1)
Distribution Transformer	Jan. 2007	Meet NEMA TP-1-2002
Exit Signs	Jan. 2006	ENERGY STAR v2 criteria
Fluorescent Lamp Ballasts (F34 and F96ES)	Jan. 2009	Closes loophole in DOE regulations so that these ballasts will be electronic, like other covered ballasts.
Ice-Makers (Cube type, 50-2,500 lbs/day)	Jan. 2010	CEC Standard (2)
Mercury Vapor Lamp Ballasts	Jan. 2008	Bans sale of mercury vapor lamp ballasts
Pre-Rinse Spray Valves	Jan. 2006	Maximum 1.6 gallon/minute
Unit Heaters	Aug. 2008	Equipped with an intermittent ignition device and have power venting or an automatic flue damper

Note(s): 1) MEF = Modified Energy Factor. WF = Water Factor. 2) California Energy Commission.

Source(s): ACEEE, The Federal Energy Policy Act of 2005 and its Implications for Energy Efficiency Program Efforts, Sept. 2005, Table 2, p. 10.

**7.2.5 Tax Incentive of the Energy Policy Act of 2005****Appliance Manufacturers**

- Refrigerator manufacturers receive a \$75 credit for each unit sold that uses 15-19.9% less energy than required by the 2001 Federal minimum efficiency; \$125 for 20-24.9% less; and \$175 for at least 25% less.
- Clothes washer manufacturers receive a \$100 credit for each unit sold that meeting the 2007 ENERGY STAR criteria.
- Dishwasher manufacturers receive a \$3 credit per percentage of energy savings greater than the current ENERGY STAR criteria for each unit sold. For example, a dishwasher is 15% more efficient than the current ENERGY STAR criteria, the credit is  $\$3 \times 15 = \$45$ .
- Credits are only available for products manufactured in the U.S.
- Each manufacturer is capped at \$75 million for available credits.

**Stationary Fuel Cells and Microturbines**

- Tax credit of 30%, up to \$1000 per kW for fuel cells that at 500 kW or greater and have an efficiency of at least 30%. Residential applications do not have a capacity or efficiency requirement. Units must be put in place between January 1, 2006 and December 31, 2007.
- Tax credit of 10%, up to \$200 per kW for microturbines that are less than 2,000 kW and have an efficiency of at least 26%. Units must be put in place between January 1, 2006 and December 31, 2007.

Source(s): ACEEE, The Federal Energy Policy Act of 2005 and its Implications for Energy Efficiency Program Efforts, Sept. 2005, p. 1-7.

**7.2.6 Daylight Savings Time from the Energy Policy Act of 2005 (1)**

- Daylight saving time starts second Sunday of March and now begins 3 weeks earlier in the spring.
- Daylight saving time ends the first Sunday of November, one week later in the fall.
- New schedule starts in 2007. The last time daylight saving time schedule was last adjusted in 1986.
- Congress retains the right to revert the daylight saving time back to the 2005 time schedule.
- Secretary of Energy to report to Congress the impact of extending daylight saving time.

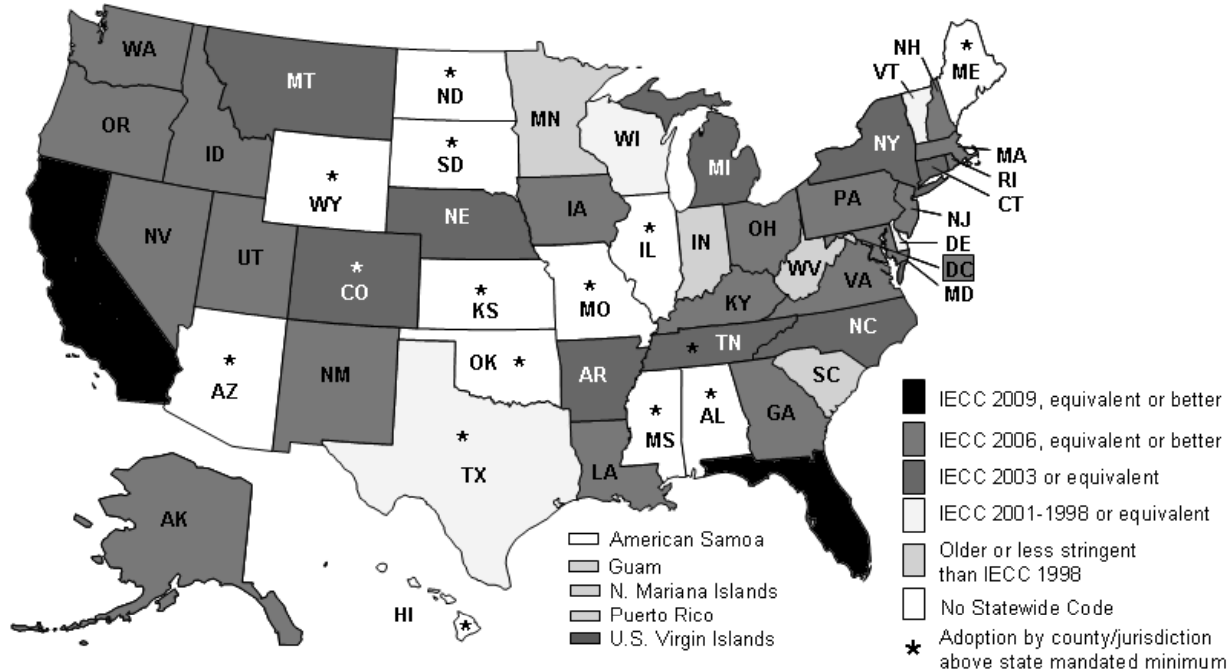
Source(s): U.S. Government, Energy Policy Act of 2005, August 2005, Section 110.

**7.2.7 Energy Policy Act of 1992, Appliance and Equipment Efficiency Standards**

- DOE is to: (1) detail energy conservation and labeling requirements for specified commercial and industrial equipment (including lamps and plumbing products); and (2) delineate standards for heating and air-conditioning equipment, electric motors, high intensity discharge lamps, and distribution transformers.
- DOE is to provide financial and technical assistance to support a voluntary national testing and information program for widely used commercial office equipment and luminaries with potential for significant energy savings.
- Requires DOE to report to the Congress on: (1) the potential for the development and commercialization of appliances which are substantially more efficient than required by Federal or State law; and (2) the energy savings and environmental benefits of early appliance replacement programs.

Source(s): U.S. Government, Energy Policy Act of 1992 Conference Report, Oct. 1992.

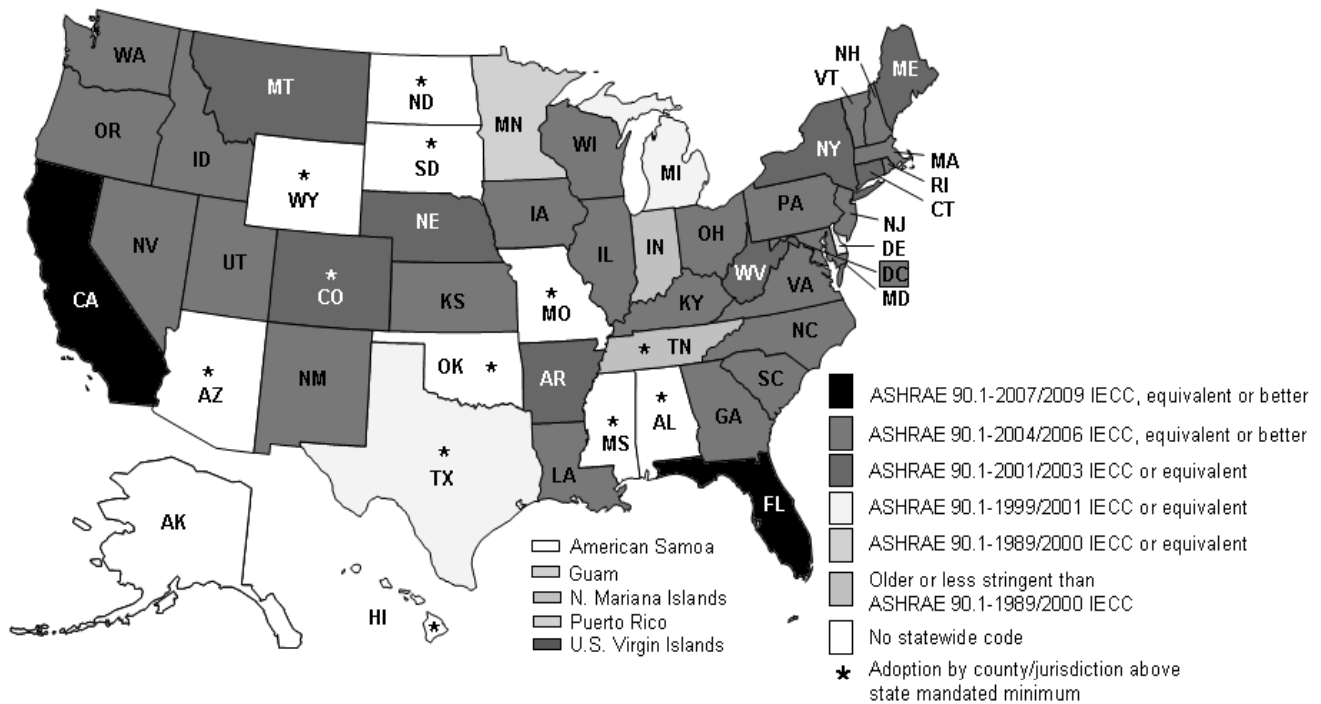
7.3.1 Status of State Energy Codes: Residential Sector (1)



Note(s): 1) These are the current residential codes as of February 2009.

Source(s): The Department of Energy, Energy Efficiency and Renewable Energy, The Status of State Energy Codes, [www.energycodes.gov/implement/state\\_codes/](http://www.energycodes.gov/implement/state_codes/);

7.3.2 Status of State Energy Codes: Commercial Sector (1)



Note(s): 1) These are the current Commercial codes as of January 2009.

Source(s): The Department of Energy, Energy Efficiency and Renewable Energy, The Status of State Energy Codes, [www.energycodes.gov/implement/state\\_codes/](http://www.energycodes.gov/implement/state_codes/);

**7.3.3 Energy Independence and Security Act 2007, High Performance Commercial Buildings**

- Create the Office of Commercial High Performance Green Buildings
- The Office of Commercial High Performance Green Buildings with The Office of Federal High Performance Green Buildings will establish a High Performance Green Buildings Clearinghouse to disseminate research through outreach, education, and technical assistance
- Zero Net Energy Initiative for Commercial Buildings was also included establishing specific goals
  - Net zero energy use in all new commercial buildings constructed by 2030
  - Net zero energy use in 50% of the United State commercial building stock by 2040
  - Net zero energy use in the entire United States commercial building stock by 2050

Source(s): The 110th Congress of the United States, The Energy Independence and Security Act of 2007, January 2007, Section 422.

**7.3.4 Tax Incentive of the Energy Policy Act of 2005****New Homes**

- Builders who build homes that use 50% less energy for space heating and cooling than the IECC 2003 are eligible for a \$2,000 tax credit per home.
- Manufactured housing builder that either uses 30% less energy than this reference code or that meet the then-current ENERGY STAR criteria are eligible for \$1,000 tax credit per home. At least 10% of energy savings must be obtained through building envelope improvements.

**Envelope Improvements to Existing Homes**

- 10% tax credit up to \$500 for upgrading building envelope to be compliant with codes for new construction. Window replacement is capped at \$200. \$500 is the cap for all for envelope and HVAC improvements. Improvements must be installed between January 1, 2006 and December 31, 2007.

**Commercial Buildings**

- Tax deduction up to \$1.80/SF for new commercial buildings which are 50% more efficient than the requirements of ASHRAE 90.1-19XX.
- Tax deduction up to \$0.60/SF for existing commercial buildings which upgrade the envelope, lighting, or HVAC building systems to 50% more efficient than ASHRAE 90.1-19XX.. The deduction can be combined when improvements are made to two building components.
- Deductions apply to new buildings placed in service and improvements to existing buildings completed between August X, 2005 and December 31, 2007.

Source(s): ACEEE, The Federal Energy Policy Act of 2005 and its Implications for Energy Efficiency Program Efforts, Sept. 2005, p. 1-7.

**7.3.5 Energy Policy Act of 1992, Building Energy Codes**

- Each State must certify to the Secretary of Energy whether its energy efficiency standards with respect to residential and commercial building codes meet or exceed those of the Council of American Building Officials (CABO) Model Energy Code, 1992, and of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, respectively.
- Requires DOE to provide technical assistance and incentive funding to the States to promote increased use of energy efficiency codes for buildings.
- Directs the Secretary to: (1) establish standards that require energy efficiency measures that are technologically feasible and economically justified in new Federal buildings; and (2) review them every five years. Mandates Federal agency compliance with such standards.
- Prescribes guidelines under which DOE shall support the upgrading of voluntary building energy codes for new residential and commercial buildings.
- The Department of Housing and Urban Development (HUD) and Agriculture are to jointly establish energy efficiency standards for residential housing. Amends Federal law regarding veterans' readjustment benefits to condition a loan for new residential housing upon compliance with such standards.
- DOE is to: (1) issue voluntary building energy code guidelines for use by the private and public sectors to encourage the assignment of energy efficiency ratings for new residential buildings; (2) establish a technical assistance program for State and local organizations to encourage the use of residential energy efficiency rating systems consistent with such guidelines; (3) provide matching grants for the establishment of regional building energy efficiency centers in each of the regions served by a DOE regional support office; and (4) establish an advisory task force to evaluate grant activities.
- HUD is to: (1) assess the energy performance of manufactured housing and make recommendations to the National Commission on Manufactured Housing regarding thermal insulation and energy efficiency improvements; and (2) test the performance and determine the cost effectiveness of manufactured housing constructed in compliance with certain statutory standards. Authorizes the States to establish thermal insulation and energy efficiency standards for manufactured housing if the Secretary of HUD has not issued final regulations by October 1993.
- HUD is to promulgate a uniform affordable housing plan using energy efficient mortgages (mortgages that provide financing incentives either for the purchase of energy efficient homes, or for incorporating the cost of such improvements into the mortgage).
- DOE is to provide financial assistance to support a voluntary national window rating program that will develop energy ratings and labels for windows and window systems. Requires the National Fenestration Rating Council to develop such rating program according to specified procedures. Requires the Secretary to develop specified alternative rating systems if a national voluntary window rating program consistent with this Act has not been developed.

Source(s): U.S. Government, Energy Policy Act of 1992 Conference Report, Oct. 1992.

While small in comparison, there is significant room to reduce the water consumption of buildings. This chapter examines water used by buildings and their appliances.

- Buildings account for over nine percent of total water use in the United States, behind water used for electric generation (48 percent) and farm irrigation (34 percent).
- In single-family homes, nearly 40 percent of water used is hot water. Leaks account for 10 percent of water use.
- If the cost of water is included in rent, water consumption is 15 percent higher than under a submetering scheme, where rental units are charged for actual usage.
- Water usage in commercial buildings varies significantly depending on the type of establishment occupying the building.
- Water used by cooling towers is significant: Among buildings measured in the 2000 study *Commercial and Institutional End Uses of Water*, cooling towers were responsible for 50 percent of total water consumption. This figure refers to “make-up” water, water that is added to accommodate evaporative losses.



**8.1.1 Total Use of Water by Buildings (Billion Gallons per Day) (1)**

<u>Year</u>	<u>All Buildings</u>	<u>% of Total Water Use</u>	<u>Residential</u>	<u>% of Total Water Use</u>	<u>Commercial</u>	<u>% of Total Water Use</u>
1985	31.26	7.8%	24.32	6.1%	6.94	1.7%
1990	33.58	8.2%	25.29	6.2%	8.29	2.0%
1995	35.67	8.9%	26.09	6.5%	9.58	2.4%
2000 (2)	38.34	9.4%	28.03	6.9%	10.31	2.5%

Note(s): 1) Includes water from the public supply and self-supplied sources (e.g. wells). 2) In some cases USGS did not split water use by sector and source in the 2000 estimates. 2000 figures were estimated using 1995 percentage splits of water use by sector applied to the revised 2000 estimates of total use.

Source(s): U.S. Geological Survey. Estimated Use of Water in the United States in 1985. 1988. Tables 3, 5. p. 25, 29. Solley, W.B., et. al. U.S. Geological Survey Circular 1004; U.S. Geological Survey. Estimated Use of Water in the United States in 1990. 1993. Tables 11, 13. Solley, W.B., et. al. U.S. Geological Survey Circular 1081; U.S. Geological Survey. Estimated Use of Water in the United States in 1995. 1998. Tables 11, 13. p. 25, 29. Solley, W.B., et. al. U.S. Geological Survey Circular 1200; U.S. Geological Survey. Estimated Use of Water in the United States in 2000. 2004. Table 6. p. 17. Hutson, S.S., et.al. U.S. Geological Survey Circular 1268.

**8.2.1 Residential Water Use by Source (Billion Gallons per Day)**

Year	Total Residential Water Use	From Public Supply	Self-Supplied
1980	25.4	22.0	3.4
1985	24.3	21.0	3.3
1990	25.3	21.9	3.4
1995	26.1	22.7	3.4
2000	28.0 (1)	24.4 (1)	3.6

Note(s): 1) USGS did not provide estimates of residential use from public supplies in 2000. This value was estimated based on the residential split of public supply in 1995 and applied to the total public supply water use in 2000. Self-supply water use: Water withdrawn from a groundwater or surface-water source by a user rather than being obtained from a public supply. Public supply water use: water withdrawn by public and private water suppliers that furnish water to at least 25 people or have a minimum of 15 connections.

Source(s): U.S. Geological Survey. Estimated Use of Water in the United States in 1985. 1988. Table 3 p. 25. Solley, W.B., et. al. U.S. Geological Survey Circular 1004; U.S. Geological Survey. Estimated Use of Water in the United States in 1990. 1993. Table 11. Solley, W.B., et. al. U.S. Geological Survey Circular 1081; U.S. Geological Survey. Estimated Use of Water in the United States in 1995. 1998. Table 11 p. 25. Solley, W.B., et. al. U.S. Geological Survey 1200; U.S. Geological Survey. Estimated Use of Water in the United States in 2000. 2004. Table 6. p. 17. Hutson, S.S., et.al. U.S. Geological Survey Circular 1268;

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**8.2.2 1999 Single-Family Home End-Use of Water Consumption per Day (Gallons per Capita) (1)**

Fixture/End Use	Average gallons per capita per day	Total Use Percent
Toilet	18.5	18.3%
Clothes Washer	15.0	14.9%
Shower	11.6	11.5%
Faucet	10.9	10.8%
Other Domestic	1.6	1.6%
Bath	1.2	1.2%
Dishwasher	1.0	1.0%
Leaks	9.5	9.4%
<u>Outdoor Use (2)</u>	<u>31.7</u>	<u>31.4%</u>
<b>Total (2)</b>	<b>101.0</b>	<b>100%</b>

Note(s): 1) Based analysis of 1,188 single-family homes at 12 study locations. 2) Total Water use derived from USGS. Outdoor use is the difference between total and indoor uses.

Source(s): American Water Works Association Research Foundation, Residential End Uses of Water. 1999. Mayer, P.W., W.B. DeOreo, et. al.; U.S. Geological Survey. Estimated Use of Water in the United States in 1995. 1998. Table 11 p. 25. Solley, W.B., et. al. U.S. Geological Survey Circular 1200; Vickers, Amy, Handbook of Water Use and Conservation, p. 15, June 2002, WaterPlow Press.

**8.2.3 2004 Water Use in Multi-Family Housing Units, In-Rent and Submetered Billing (Gallons per Unit per Day)**

	<u>In-Rent</u>	<u>Submetering</u>	<u>Estimated Savings from Submetering</u>	<u>Estimated Potential Range of Savings from Submetering</u>
Indoor Water Use	143	121	-15.3%	6% - 24.6%

Note(s): Based on regression analysis of a sample including 7,942 properties at 13 sample locations. Results are significant at the 95th percentile. Ratio utility billing systems, which allocate water bills to tenants based on household characteristics, were also examined in this study, but differences in water use were not found to be statistically significant.

Source(s): Mayer, P.W., et al, 2004, National Multiple Family Submetering and Allocation Billing Program Study, Aquacraft, Inc., and East Bay Municipal Utility District. Boulder, CO.

**8.2.4 Per Capita Use of Hot Water in Single-Family Homes by End Use (Gallons per Capita per Day) (1)**

<u>Fixture/End Use</u>	<u>Average gallons per capita per day</u>	<u>Household Use gallons per day</u>	<u>Percent of Total Hot Water Use</u>	<u>Percent of End Use that is Hot Water</u>
Toilet	0.0	0.0	0.0%	0.0%
Clothes Washer	3.9	10.1	15.5%	27.8%
Shower	6.3	16.4	25.1%	73.1%
Faucet	8.6	22.4	34.2%	72.7%
Other	0.0	0.0	0.0%	35.1%
Bath	4.2	10.9	16.7%	78.2%
Dishwasher	0.9	2.3	3.6%	100%
<u>Leaks</u>	<u>1.2</u>	<u>3.1</u>	<u>4.8%</u>	<u>26.8%</u>
<b>Total</b>	<b>25.1</b>	<b>65.2</b>	<b>100%</b>	<b>39.6%</b>

Note(s): 1) Based analysis of 10 single family homes in Seattle, WA.

Source(s): DeOreo, W.B., Mayer, P.W. 2000. Residential End Uses of Hot Water in Single-Family Homes from Flow-Trace Analysis, Aquacraft, Inc. Boulder, CO.

**8.3.1 Commercial Water Use by Source (Billion Gallons per Day)**

Year	<u>Total Commercial Water Use</u>	<u>From Public Supply</u>	<u>Self-supplied</u>
1980	-	-	-
1985	6.94	5.71	1.23
1990	8.29	5.90	2.39
1995	9.58	6.69	2.89
2000 (1)	10.31	7.20	3.11

Note(s): 1) USGS did not provide commercial splits in 2000 data. 2000 figures were estimated using percentage splits of public and self-supply from 1995 and applying them to the revised 2000 estimates of total use. Self-supply water use: Water withdrawn from a groundwater or surface-water source by a user rather than being obtained from a public supply. Public supply water use: water withdrawn by public and private water suppliers that furnish water to at least 25 people or have a minimum of 15 connections.

Source(s): U.S. Geological Survey, Estimated Use of Water in the United States in 1985, 1988. Table 5 p. 29. Solley, W.B., et. al. U.S. Geological Survey Circular 1004; U.S. Geological Survey, Estimated Use of Water in the United States in 1990, 1993. Table 13. Solley, W.B., et. al. U.S. Geological Survey Circular 1081; U.S. Geological Survey, Estimated Use of Water in the United States in 1995, 1998. Table 13 p. 29. Solley, W.B., et. al. U.S. Geological Survey 1200; U.S. Geological Survey, Estimated Use of Water in the United States in 2000, 2004. Table 5. p. 14. Hutson, S.S., et.al. U.S. Geological Survey Circular 1268;

**8.3.2 Average Water Use of Commercial and Institutional Establishments (Gallons per Establishment per Day)**

	<u>Average Daily Use</u>	<u>Variation In Use (1)</u>	<u>% Total CI Use</u>	<u>% of CI Customers</u>	<u>% Seasonal Use (2)</u>
Hotels and Motels	7,113	5.41	5.8%	1.9%	23.1%
Laundries/Laundromats	3,290	8.85	4.0%	1.4%	13.4%
Car Washes	3,031	3.12	0.8%	0.4%	14.2%
Urban Irrigation	2,596	8.73	28.5%	30.2%	86.9%
Schools and Colleges	2,117	12.13	8.8%	4.8%	58.0%
Hospitals/Medical Offices	1,236	78.5	3.9%	4.2%	23.2%
Office Buildings	1,204	6.29	10.2%	11.7%	29.0%
Restaurants	906	7.69	8.8%	11.2%	16.1%
Food Stores	729	16.29	2.9%	5.2%	19.4%
Auto Shops (3)	687	7.96	2.0%	6.7%	27.2%
Membership Organizations (4)	629	6.42	2.0%	5.6%	46.2%
<b>Total</b>	<b>23,538</b>		<b>77.6%</b>	<b>83.3%</b>	

Note(s): Estimated from 24 months of water utility billing data in five Western locations: four locations in Southern California and one in Arizona. 1) ratio of standard deviation of daily use to average of daily use. 2) Percent seasonal use is the difference between the average monthly use and the lowest monthly use over the average monthly use. 3) Includes auto repair shops, dealers, and service stations. 4) Includes religious organizations and other membership-based organizations.

Source(s): American Water Works Association Research Foundation, Commercial and Institutional End Uses of Water, DeOreo, William et. al. 2000.

**8.3.3 Normalized Annual End Uses of Water in Select Restaurants in Western United States (1)**

<u>Fixture/End Use (2)</u>	<u>Range of Water Use (gal/SF)</u>	<u>Range of Water Use (gal/seat)</u>	<u>Range of Water Use (gal/meal/day)</u>
Faucets	68.9 - 250	1225 - 4630	1.1 - 2.6
Dishwashing	54.4 - 183.3	970 - 3000	0.9 - 1.4
Toilets/Urinals	25.6 - 75	455 - 1230	0.4 - 0.5
Ice Making	7.8 - 44.6	140 - 1440	0.1 - 0.9
<b>Total Indoor Use</b>	163.3 - 563.3 (3)	2910 - 15350 (4)	2.7 - 16.2 (4)
<b>Building Size (SF)</b>	1200 - 9800	<b>Seats:</b> 73 - 253	<b>Meals:</b> 190 - 800
	Logged average <u>daily use (thousand gal)</u> 1.5 - 9.7	Indoor peak instantaneous <u>demand, gpm (5)</u> 21.1 - 59.6	
<b>Benchmarking Values for Restaurants (6)</b>	<b>N</b>	<b>25th Percentile of Users</b>	
Gal./SF/year	90	130 - 331	
Gal./meal	90	6 - 9	
Gal./seat/day	90	20 - 31	
Gal./employee/day	90	86 - 122	

Note(s): Family-style dine-in establishments. Four restaurants in southern California, one in Phoenix, AZ. 1) Water use data for the buildings was collected over a few days. Estimates of annual use were created by accounting for seasonal use and other variables, billing data, and interviews with building managers. 2) Based on three restaurants. 3) Based on four restaurants. 4) Based on five restaurants. 5) gpm = gallons per minute. 6) The study derived efficiency benchmarks by analyzing measured data and audit data. The benchmark was set at the lower 25th percentile of users.

Source(s): American Water Works Association Research Foundation, Commercial and Institutional End Uses of Water, DeOreo, William et. al., 2000

**8.3.4 Normalized Annual End Uses of Water in Select Supermarkets in Western United States (1)**

<u>Fixture/End Use</u>	<u>Range of Water Use (gal/SF)</u>		
Toilets/Urinals	190 - 320		
Other/Misc. Indoor (2)	895 - 1,405		
Cooling	2,190 - 3,390		
<b>Total</b>	3,560 - 5,075		
<b>Building Size (SF)</b>	3,8000 - 66,000		
Logged average <u>daily use (thousand gal)</u> 9.71 - 14.33	Indoor peak instantaneous <u>demand (gpm)</u> 29.7 - 58.8		
<b>Benchmarking Values for Supermarkets (3)</b>	<b>N</b>	<b>25th Percentile of Users</b>	
Indoor Use with Cooling, gal./SF/year	38	52 - 64	
Indoor Use with Cooling, gal./SF/daily transaction	38	9 - 16	

Note(s): 1) Water use data for the buildings was collected over a few days. Estimates of annual use were created by accounting for seasonal use and other variables, billing data, and interviews with building managers. 2) Includes water for sinks, spraying vegetables, cleaning, etc. 3) The study derived efficiency benchmarks by analyzing measured data and audit data. The benchmark was set at the lower 25th percentile of users.

Source(s): American Water Works Association Research Foundation, Commercial and Institutional End Uses of Water, DeOreo, William et. al., 2000

**8.3.5 Normalized Annual End Uses of Water in Select Hotels in Western United States (Gallons per Room per Year) (1)**

<u>Fixture/End Use</u>	<u>Budget Hotels</u>	<u>Luxury Hotel</u>
	<u>Range of Water Use</u> (gal/room)	<u>Range of Water Use</u> (gal/room)
Bathtub	986 (2)	2,331
Faucets	2,196 - 2,683	6,297
Showers	10,203 - 13,724	32,453
Toilets	9,493 - 11,986	28,047
Leaks	439 - 8,007	5,351
Laundry	6047 - 12,027	74,480
Ice making	811 - 1,568 (3)	0
Other/misc. indoor	946 - 9,953	0
<b>Total Indoor Use</b>	<b>37,703 - 50,696</b>	<b>82,770</b>
<b>Number of Rooms</b>	<b>140 - 209</b>	<b>297</b>
Logged average daily use, kgal:	18.6 - 29.3	59.3
Peak instantaneous demand, gpm:	40.5 - 106.9	130.7
<u>Benchmarking Values for Hotels</u>	<u>N</u>	<u>25th Percentile of Users</u>
Indoor Use, gal./day/occupied room	98	60 - 115
Cooling Use, gal./year/occupied room	97	7,400 - 41,600

Note(s): Based on four budget hotels and one luxury hotel. Three budget hotels in Southern California, one in Phoenix, AZ. Luxury hotel in Los Angeles, CA. 1) Water use data for the buildings was collected over a few days. Estimates of annual use were created by accounting for seasonal use and other variables, billing data, and interviews with building managers. 2) Based on one hotel. 3) Based on three hotels. 5) The study derived efficiency benchmarks by analyzing measured data and audit data. The benchmark was set at the lower 25th percentile of users.

Source(s): American Water Works Association Research Foundation, Commercial and Institutional End Uses of Water, DeOreo, William et. al., 2000.

**8.3.6 Normalized Annual End Uses of Water in Two California High Schools**

<u>Fixture/End Use</u>	<u>Range of Water Use</u> (gal/room)	<u>Range of Water Use</u> (gal/person)	
Toilet	2.9 - 3.2	206 - 271	
Urinal	1.2 - 2.6	106 - 186	
Faucet	1.0 - 2.3	87 - 165	
Shower	0.5 - 0.7	44 - 47	
Kitchen	0.7 - 1.0	58 - 58	
Misc. uses (2)	0.9	68	
Cooling	-	-	
Leaks	1.6 - 3.6	112	
Swimming Pool	0.4 - 0.9	31	
<b>Total Use</b>	<b>11.1 - 12.3</b>	<b>883</b>	
	<u>Average</u> <u>Building Size (SF)</u> 222326	<u>Logged average</u> <u>daily use (thousand gal)</u> 9.1 - 16.4	<u>Indoor peak instantaneous</u> <u>demand (gpm)</u> 41 - 60
<u>Benchmarking Values for Schools (3)</u>	<u>N</u>	<u>25th Percentile of Users</u>	
Indoor Use, Gal./sq. ft./year	142	8 - 16	
Indoor Use, Gal./school day/student	141	3 - 15	
Cooling Use, Gal./sq. ft./year	35	8 - 20	

Note(s): 1) Water use data for the buildings was collected over a few days. Estimates of annual use were created by accounting for seasonal use and other variables, billing data, and interviews with building managers. 2) One high school. 3) The study derived efficiency benchmarks by analyzing measured data and audit data. The benchmark was set at the lower 25th percentile of users.

Source(s): American Water Works Association Research Foundation, Commercial and Institutional End Uses of Water, DeOreo, William et. al., 2000.

**8.4.1 WaterSense List of Covered Products and Efficiency Specifications**

<u>Covered Product</u>	<u>Specification</u> <u>Effective Date</u>	<u>WaterSense</u> <u>Criteria</u>	<u>Federal Standard</u> <u>Level</u>
Lavatory Faucets	October 2007	1.5 gpm (1)	2.2 gpm
Toilets	January 2007	1.28 gpf (2)	1.6 gpf
Urinals	In Progress	0.5 gpf (3)	1.0 gpf
Shower Heads	In Progress	1.5 -2.0 gpm (3)	2.5 gpm

WaterSense Landscape Irrigation Partners as of 5/19/2008 (4): 452

Note(s): 1) GPM = gallons per minute. 2) GPF = gallons per flush. 3) Final criteria for these urinals and shower heads have not been set. These are criteria levels that WaterSense is considering. 4) WaterSense qualifies individuals as partners via private programs certified by WaterSense.

Source(s): EPA, High-Efficiency Lavatory Faucet Specification, October 1, 2007; EPA, Tank-Type High-Efficiency Toilet Specification, January, 2007. EPA, Notification of Intent to Develop Draft Performance Specifications for Showerheads and Related Devices, August, 2007; EPA, Notification of Intent to Develop Draft Performance Specifications for High-Efficiency Urinals, May 22, 2008; EPA, Find a WaterSense Irrigation Partner list, Current as of 5/19/2008. Accessed from [http://www.epa.gov/watersense/pp/lists/irr\\_partners.htm](http://www.epa.gov/watersense/pp/lists/irr_partners.htm).

Chapter 9 examines programs and organizations that are working to increase the energy efficiency of buildings. This chapter includes programmatic data from ENERGY STAR and LEED. Home performance statistics and case studies of efficient buildings will also be presented here. By differentiating efficient or well-designed buildings, or equipment from the rest of the stock, it may be possible to increase demand for them, spurring the general market to choose more efficient designs and products.

- To qualify as an ENERGY STAR home, a residential building must be at least 15 percent more efficient than the 2004 International Residential Code.
- 71 percent of homes placed in Nevada were ENERGY STAR-qualified in 2006. Nationally, the rate was 12 percent.
- As of May, 2008, only 4,686 buildings went through the process to become qualified for the ENERGY STAR.
- The ENERGY STAR program has served well in advancing efficiency criteria of electronics and residential HVAC. Criteria updates occur every three to four years – and a few have happened over shorter timeframes.
- The Leadership in Energy and Environmental Design (LEED) Green Building Rating System is a program of the United States Green Building Council. This program certifies buildings based on a tiered scale which takes into account energy efficiency, material use, site planning, and indoor air quality.
- 1,082 new buildings have been certified by LEED as of July, 2008. California leads the U.S. with 129 total buildings certified in the new construction category. Pennsylvania follows with 69 certified buildings.
- The North American Technical Excellence Program certifies program has issued over 29,000 certificates for servicing specific HVAC equipment types and 3,400 certificates for the installation of HVAC equipment.
- Compared with the average educational facility built between 2000 and 2003, the Adam Joseph Lewis Center for Environmental Studies at Oberlin College uses almost 80 percent less energy per square foot.
- The office buildings examined in the High Performance Buildings section use between 55 and 74 percent less energy per square foot than office buildings built between 2000 and 2003.



- Public assembly spaces built between 2000 and 2003 consume 119.7 kBtu per square foot. The Visitor Center at Zion National Park, a combined public assembly, retail and office space, uses just 27 kBtu per square foot – 77 percent less.
- The Solaire, a 27 floor multi-family building in New York City, was predicted to use 24 percent less energy than state code requires for a building of similar size.

**9.1.1 Market Indices for 2006 ENERGY STAR Qualified New Single-Family Homes, by Selected State (Thousands)**

	<u>ENERGY STAR Qualified New Homes</u>	<u>New Single-Family Housing Permits</u>	<u>Market Penetration</u>
Nevada	18.9	26.7	71%
Alaska	1.0	1.6	64%
Iowa	5.9	10.3	57%
Texas	60.8	162.8	37%
Hawaii	2.1	5.6	37%
Arizona	20.1	55.6	36%
New Jersey	5.4	17.1	31%
Delaware	1.2	5.0	24%
Vermont	0.5	2.1	24%
Connecticut	1.6	7.1	23%
California	18.1	107.7	17%
New Hampshire	0.8	4.8	17%
Utah	3.6	22.6	16%
Ohio	3.5	27.5	13%
New York	2.6	20.0	13%
Florida	3.3	146.2	2%
<b>United States</b>	<b>169.8</b>	<b>1,378.2</b>	<b>12%</b>

Source(s): EPA, ENERGY STAR Qualified New Homes Market Indices for States, <http://www.energystar.gov/index.cfm?fuseaction=qhmi.showHomesMarketIndex> for top states; e-mail correspondence with EPA ENERGY STAR program for complete data set.

**9.1.2 ENERGY STAR Commercial and Institutional Buildings**

Newly Qualified ENERGY STAR Buildings by Year	<u>ENERGY STAR labeled buildings by type</u>		
			<u>% of Total</u>
1999	87	Office	1,772 37.8%
2000	424	Supermarket/Grocery	1,366 29.2%
2001	213	School	1,026 21.9%
2002	348	Hotel	301 6.4%
2003	385	Hospital	75 1.6%
2004	658	Bank	69 1.5%
2005	594	Courthouse	32 0.7%
2006	790	Residence Hall/Dormitory	16 0.3%
2007	1,002	Medical Office	13 0.3%
<u>2008</u>	<u>185</u>	Warehouse	12 0.3%
<b>Total</b>	<b>4,686</b>	Retail	4 0.1%
		<b>Total</b>	<b>4,686 100%</b>

Note(s): Current as of May 27, 2008

Source(s): EPA. ENERGY STAR Labeled Buildings. Accessed May 27, 2008.

**9.1.3 Top Property Managers of ENERGY STAR Commercial and Institutional Buildings**

	<u>Buildings</u>
Food Lion	732
Marriott International, Inc	262
Energy Education, Inc.	258
HEB	177
CB Richard Ellis	155
San Diego City Schools	154
Giant Eagle, Inc.	130
Arden Realty, Inc.	126
SUPERVALU, Inc	101
Hines	82

Note(s): Current as of June 19, 2008.

Source(s): EPA. ENERGY STAR Labeled Buildings. Accessed June 19, 2008.

**9.1.4 Specification Dates for ENERGY STAR-Labeled Consumer Electronics and Office Equipment**

<u>Labeled (Covered) Product</u>	<u>Inception - End Date</u>	<u>Dates of updated standard</u>	<u>Managed By</u>
Computers	1992	1995, 1999, 2000, 2007, 2009	EPA
Computer Monitors	1992	1995, 1998, 1999, 2005, 2006	EPA
Printers	1993	1995, 2000, 2001, 2007, 2009	EPA
Fax Machines	1995	1995, 2000, 2001, 2007, 2009	EPA
Copiers	1995	1997, 1999, 2007, 2009	EPA
Scanners	1997	2007, 2009	EPA
Multi-Function Devices	1997	1999, 2007, 2009	EPA
TVs	1998	2002, 2004, 2005, 2008	EPA
VCRs	1998 - 2008 (proposed)	2002, 2004, 2005, 2008 (proposed) (1)	EPA
TV-VCRs	1998	2002, 2004, 2005, 2008 (proposed) (1)	EPA
Consumer Audio Equipment	1999	2003	EPA
DVD Players	1999	2003	EPA
Bottled Water Coolers	2000	2004	EPA
Set-Top Boxes	2001-2005	2009	EPA
Telephony	2002	2004, 2006, 2008	EPA
External Power Adapters	2005	2008	EPA
Battery Charging Systems	2006	-	EPA

Note(s): 1) Proposed specification update will result in program suspension.

Source(s): Kathleen Vokes, EPA. Personal correspondence. 2008; LBNL, Sanchez et. al, DRAFT 2008 Status Report: Savings Estimates for the ENERGY STAR Voluntary Labeling Program, November 2007.

**9.1.5 Specification Dates for ENERGY STAR-Labeled HVAC and Residential Appliances**

<u>Heating and Cooling Equipment</u>	<u>Inception - End Date</u>	<u>Dates of updated standard</u>	<u>Managed By</u>
Central AC	1995	2002, 2006, 2009	EPA
Air-Source Heat Pumps	1995	2002, 2006, 2009	EPA
Oil Furnaces	1995	2006, 2008	EPA
Gas Furnaces	1995	2006, 2008	EPA
Programable Thermostats	1995	2010	EPA
Insulation	1996-2002	-	EPA
Gas Boilers	1996	2002	EPA
Oil Boilers	1996	2002	EPA
Gas-Fired Heat Pumps	1995-2000	-	EPA
Roof Products	1999	2005, 2007	EPA
Geothermal Heat Pumps	2001	2001	EPA
Exhaust Fans	2001	2003	EPA
Ceiling Fans	2001	2003, 2006	EPA
<u>Residential Appliances</u>			
Dishwashers	1996	2001, 2007	DOE
Room AC	1996	2000, 2003, 2005	DOE
Refrigerators	1996	2001, 2003, 2004, 2008	DOE
Clothes Washers	1997	2001, 2004, 2007, 2009	DOE
Dehumidifiers	2001	2007, 2008	EPA
Air Cleaners	2004	-	EPA
Water Heaters	2009	-	DOE
<u>Other Home Products</u>			
Residential Lighting Fixtures	1997	2001, 2002, 2003, 2005, 2007	EPA
Windows	1997	2003, 2005, 2009	DOE
Screw base CFLs	1999	2001, 2004, 2008	DOE
Decorative Light Strings	2007	-	EPA

Source(s): EPA, Kathleen Vokes, Personal correspondence, 2008; LBNL, Sanchez et. al, DRAFT 2008 Status Report: Savings Estimates for the ENERGY STAR Voluntary Labeling Program, November 2007.

**9.1.6 Specification Dates for ENERGY STAR-Labeled Commercial and Miscellaneous Products**

<u>Commercial Products</u>	<u>Inception - End Date</u>	<u>Dates of updated standard</u>	<u>Managed by</u>
Commercial Refrigerators and Freezers	2001	-	EPA
Hot Food Holding Cabinets	2003	-	EPA
Commercial Steam Cookers	2003	-	EPA
Commercial Fryers	2003	-	EPA
Cold Beverage Vending Machines	2004	2006, 2007	EPA
Solid State Lighting	2008	-	DOE
Commercial Dishwashers	2007	-	EPA
Commercial Icemakers	2008	-	EPA
<u>Other Products</u>			
Transformers	1995-2007	-	EPA
Exit Signs	1996 -2008	1999, 2004	EPA
Traffic Signals	2000-2007	2003	EPA

Source(s): EPA, Kathleen Vokes, Personal correspondence, 2008; LBNL, Sanchez et. al, DRAFT 2008 Status Report: Savings Estimates for the ENERGY STAR Voluntary Labeling Program, November 2007.

**9.1.7 ENERGY STAR Appliance Shipments (Million) and Penetration Rates**

	<u>Dishwashers</u>		<u>Room AC</u>		<u>Refrigerators</u>		<u>Clothes Washers</u>		<u>Dehumidifiers</u>		<u>Air Cleaners</u>	
1997	0.3	6%	0.5	12%	2.3	25%	0.3	4%	N/A	-	N/A	-
1998	1.0	19%	0.6	13%	1.7	19%	0.4	6%	N/A	-	N/A	-
1999	0.7	12%	0.8	13%	2.2	24%	0.6	9%	N/A	-	N/A	-
2000	0.6	11%	1.2	19%	2.5	27%	0.7	9%	N/A	-	N/A	-
2001	1.1	20%	0.6	12%	1.6	17%	0.8	10%	0.1	19%	N/A	-
2002	2.3	36%	2.2	36%	2.0	20%	1.3	16%	0.3	39%	N/A	-
2003	3.7	57%	2.4	29%	2.6	26%	1.9	23%	1.1	85%	N/A	-
2004	5.6	78%	3.1	35%	3.6	33%	2.4	27%	1.3	76%	0.1	5%
2005	6.1	82%	4.2	52%	3.7	33%	3.4	36%	1.8	92%	0.2	13%
2006	6.7	92%	3.6	36%	3.5	31%	3.6	38%	1.2	60%	0.3	14%

Note(s): N/A: Year is before date of ENERGY STAR specification.

Source(s): LBNL, Climate Change Action Plan spreadsheet (updated 2007) Air Cleaners and Dehumidifiers; D&R International, Ltd. for dishwashers, room AC, refrigerator, clothes washers.

**9.1.8 ENERGY STAR Residential Lighting Shipments (Millions) and Penetration Rates**

	<u>Indoor</u>		<u>Outdoor</u>		<u>Screw-based CFLs</u>	
1997	1.6	1%	0.4	1%	N/A	-
1998	2.3	1%	0.5	2%	N/A	-
1999	3.0	2%	2.1	7%	2.5	0%
2000	2.8	2%	3.5	13%	13.1	1%
2001	2.3	1%	3.9	14%	56.9	5%
2002	5.4	3%	2.8	10%	45.5	4%
2003	4.7	2%	4.0	14%	58.0	5%
2004	7.5	3%	3.1	11%	82.5	6%
2005	8.1	4%	3.2	11%	89.8	7%
2006	8.5	4%	3.4	12%	145.8	11%

Note(s): N/A: Year is before date of ENERGY STAR specification.

Source(s): LBNL, Climate Change Action Plan spreadsheet (updated 2007);

**9.1.9 ENERGY STAR Residential Cooling Equipment Shipments (thousands) and Penetration Rate**

	<u>Central AC</u>		<u>Air-Source Heat Pump</u>		<u>Geothermal Heat Pump</u>		<u>Exhaust Fan</u>		<u>Ceiling Fan</u>	
1995	494	15%	227	27%	N/A	-	N/A	-	N/A	-
1996	698	16%	341	30%	N/A	-	N/A	-	N/A	-
1997	679	17%	323	29%	N/A	-	N/A	-	N/A	-
1998	822	18%	387	31%	N/A	-	N/A	-	N/A	-
1999	985	20%	384	30%	N/A	-	N/A	-	N/A	-
2000	969	19%	373	29%	N/A	-	N/A	-	N/A	-
2001	1,048	22%	416	29%	N/A	-	92	2%	1,459	8%
2002	747	14%	212	14%	14	40%	192	3%	1,623	8%
2003	896	17%	314	19%	11	29%	385	6%	3,311	18%
2004	1,045	19%	416	22%	15	42%	663	11%	2,822	14%
2005	1,246	19%	568	27%	25	62%	829	13%	3,521	18%
2006	1,019	18%	482	22%	33	66%	773	12%	1,974	10%

Note(s): N/A: Year is before date of ENERGY STAR specification.

Source(s): LBNL, Climate Change Action Plan spreadsheet (updated 2007).

**9.1.10 ENERGY STAR Residential Heating Equipment Shipments (Thousands) and Penetration Rate**

	<u>Oil Boiler</u>		<u>Oil Furnace</u>		<u>Gas Furnace</u>		<u>Gas Boiler</u>	
1995	N/A	-	1	1%	568	22%	N/A	-
1996	77	48%	1	1%	689	24%	8	4%
1997	79	49%	1	1%	758	27%	12	6%
1998	81	55%	2	1%	875	29%	16	8%
1999	83	56%	2	1%	984	31%	19	10%
2000	85	59%	3	3%	1,089	35%	33	15%
2001	87	58%	5	4%	1,189	39%	38	17%
2002	89	60%	7	6%	1,286	40%	44	21%
2003	91	55%	8	7%	1,379	42%	50	21%
2004	115	71%	10	7%	1,661	47%	96	41%
2005	83	51%	8	7%	1,312	37%	55	25%
2006	109	67%	6	6%	1,167	35%	68	34%

Note(s): N/A: Year is before date of ENERGY STAR specification.

Source(s): LBNL, Climate Change Action Plan spreadsheet (updated 2007).

**9.1.11 ENERGY STAR Commercial Product Shipments (Thousands) and Penetration Rate**

	<u>Exit Signs</u>		<u>Comm. Refrigeration</u>		<u>Hot Food Holding Cabinets</u>		<u>Comm. Steam Cookers</u>		<u>Cold Beverage Vending Machines</u>		<u>Bottled Water Coolers</u>	
1996	185	10%	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
1997	275	13%	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
1998	494	20%	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
1999	759	27%	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
2000	1,071	34%	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
2001	1,429	41%	25	11%	N/A	-	N/A	-	N/A	-	0.0	1%
2002	1,669	44%	28	12%	N/A	-	N/A	-	N/A	-	0.0	1%
2003	3,502	91%	40	17%	10	9%	0	0%	N/A	-	0.0	1%
2004	2,457	63%	70	30%	12	11%	4	10%	67	26%	0.4	40%
2005	1,955	50%	104	44%	11	10%	4	11%	69	28%	0.6	56%
2006	1,426	36%	83	35%	17	15%	3	8%	77	31%	0.7	68%

Note(s): N/A: Year is before date of ENERGY STAR specification.

Source(s): LBNL, Climate Change Action Plan spreadsheet (updated 2007).

**9.1.12 ENERGY STAR Consumer Electronics Shipments (Millions) and Penetration Rate**

	<u>TV</u>		<u>VCR</u>		<u>TV-VCR</u>		<u>Audio Equipment</u>		<u>DVD Player</u>	
	Millions	Penetration Rate	Millions	Penetration Rate	Millions	Penetration Rate	Millions	Penetration Rate	Millions	Penetration Rate
1998	4.8	17%	6.0	33%	0.5	17%	N/A	-	N/A	-
1999	9.8	39%	19.5	85%	2.9	71%	1.6	12%	1.4	35%
2000	11.7	46%	21.6	94%	3.8	76%	2.6	17%	3.1	37%
2001	10.3	45%	14.2	95%	3.6	77%	3.0	20%	7.5	59%
2002	10.3	45%	12.7	91%	4.6	82%	3.4	27%	12.1	71%
2003	12.0	47%	12.1	76%	3.4	78%	6.2	48%	9.0	72%
2004	19.1	83%	3.7	31%	6.1	85%	1.8	13%	5.4	52%
2005	10.2	39%	3.1	28%	3.7	55%	2.6	21%	3.8	32%
2006	17.4	64%	0.2	2%	0.1	2%	2.8	24%	0.7	8%

	<u>Telephony</u>		<u>External Power Adaptors</u>		<u>Battery Charging Systems</u>	
	Millions	Penetration Rate	Millions	Penetration Rate	Millions	Penetration Rate
1998	N/A	-	N/A	-	N/A	-
1999	25.5	51%	N/A	-	N/A	-
2000	30.3	58%	N/A	-	N/A	-
2001	18.5	34%	N/A	-	N/A	-
2002	14.7	26%	N/A	-	N/A	-
2003	6.8	12%	N/A	-	N/A	-
2004	7.1	13%	N/A	-	N/A	-
2005	8.4	15%	16.2	4%	N/A	-
2006	9.8	17%	148.4	31%	0.1	0%

Note(s): N/A: Year is before date of ENERGY STAR specification.

Source(s): LBNL, Climate Change Action Plan spreadsheet (updated 2007).

**9.1.13 ENERGY STAR Office Equipment Shipments (Millions) and Penetration Rate**

	<u>Computer</u>		<u>Monitor</u>		<u>Printer</u>		<u>Fax</u>		<u>Copier</u>		<u>Scanner</u>		<u>Multi-Function Device</u>	
	Millions	Penetration Rate	Millions	Penetration Rate	Millions	Penetration Rate	Millions	Penetration Rate	Millions	Penetration Rate	Millions	Penetration Rate	Millions	Penetration Rate
1992	N.A.	-	N.A.	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A	-
1993	4.9	41%	2.3	19%	5.5	80%	N/A	-	N/A	-	N/A	1%	N/A	-
1994	7.3	50%	7.3	50%	9.2	98%	N/A	-	N/A	-	N/A	1%	N/A	-
1995	13.4	73%	16.9	93%	11.1	98%	0.2	12%	0.4	24%	N/A	2%	N/A	-
1996	16.2	79%	19.3	95%	13.1	100%	1.2	56%	0.6	35%	N/A	2%	N/A	-
1997	22.1	86%	23.3	95%	15.1	100%	2.5	73%	0.8	45%	1.3	8%	0.0	30%
1998	29.9	92%	28.7	95%	18.3	100%	3.0	91%	1.0	65%	1.6	9%	0.1	30%
1999	21.3	48%	16.1	48%	23.0	100%	2.9	99%	0.9	87%	3.4	15%	1.2	91%
2000	43.0	87%	31.7	95%	22.6	100%	2.6	99%	0.8	94%	4.7	21%	1.6	92%
2001	45.4	86%	34.1	95%	24.4	85%	2.5	99%	0.6	90%	5.0	17%	2.0	92%
2002	44.9	85%	34.9	95%	18.8	95%	2.2	99%	0.3	90%	5.9	30%	7.5	98%
2003	49.5	86%	33.3	95%	16.0	98%	2.0	99%	1.3	90%	6.7	41%	13.0	98%
2004	54.7	86%	34.8	95%	16.3	100%	1.5	99%	1.3	90%	6.9	42%	14.7	98%
2005	60.0	86%	24.7	65%	17.4	100%	1.3	99%	1.3	90%	7.0	40%	16.8	98%
2006	64.1	86%	13.9	35%	13.9	100%	1.2	99%	1.2	90%	7.1	51%	18.3	98%

Note(s): N/A: Year is before date of ENERGY STAR specification.

Source(s): LBNL, Climate Change Action Plan spreadsheet (updated 2007).

**9.2.1 LEED for New Construction, by Selected States**

	<u>Certified</u>	<u>Bronze</u>	<u>Silver</u>	<u>Gold</u>	<u>Platinum</u>	<u>Total</u>
California	40	0	35	41	11	127
Pennsylvania	17	0	30	22	0	69
Oregon	13	1	16	33	3	66
Washington	21	0	20	21	1	63
Michigan	34	0	15	11	1	61
Virginia	20	0	13	10	0	43
Massachusetts	21	0	8	15	3	47
Texas	17	0	16	12	2	47
Illinois	16	0	15	9	4	44
New York	15	0	14	9	3	41
All Other States	167	2	175	105	25	474
<b>National Totals</b>	<b>381</b>	<b>3</b>	<b>357</b>	<b>288</b>	<b>53</b>	<b>1082</b>

Source(s): U.S. Green Building Council Web site, accessed July 2008, <http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx>.

**9.2.2 LEED for New Construction, by Version**

	<u>NC 1.0</u>	<u>NC 2.0</u>	<u>NC 2.1</u>	<u>NC 2.2</u>	<u>All New Construction</u>
Platinum	3	12	35	3	53
Gold	1	75	187	25	288
Silver	1	76	239	41	357
Bronze	3	0	0	0	3
<u>Certified</u>	<u>0</u>	<u>98</u>	<u>264</u>	<u>19</u>	<u>381</u>
<b>Total</b>	<b>8</b>	<b>261</b>	<b>725</b>	<b>88</b>	<b>1,082</b>

Source(s): U.S. Green Building Council Web site, accessed July 2008, <http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx>.

**9.2.3 LEED for Core and Shell 2.0**

Platinum	3
Gold	4
Silver	10
<u>Certified</u>	<u>2</u>
<b>Total</b>	<b>19</b>

Source(s): U.S. Green Building Council Web site, accessed July 2008, <http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx>.

**9.2.4 LEED for Commercial Interiors 2.0**

Platinum	9
Gold	68
Silver	66
<u>Certified</u>	<u>47</u>
<b>Total</b>	<b>190</b>

Source(s): U.S. Green Building Council Web site, accessed July 2008, <http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx>.

**9.2.5 LEED for Existing Buildings 2.0**

Platinum	10
Gold	19
Silver	21
<u>Certified</u>	<u>11</u>
<b>Total</b>	<b>61</b>

Source(s): U.S. Green Building Council Web site, accessed July 2008, <http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx>.



**9.2.6 U.S. LEED Registered Projects as of 2003, by Ownership Category**

Private-Sector Corporations	33%
Local Governments	25%
Nonprofit Corporations	14%
State Governments	13%
Federal Government	10%
<u>Other</u>	<u>5%</u>
<b>Total</b>	<b>100%</b>

Source(s): Building Design and Construction, White Paper on Sustainability, Nov. 2003.

**9.3.1 North American Technician Excellence Program(1)**

**Individuals Certified:** 25,906  
**Number of Certificates (2):** 49,014

<b>Certifications</b>	<b>Installation</b>	<b>Service</b>
Air Conditioning	1,054	5,425
Air Distribution	243	1,499
Heat Pump	645	12,015
Gas Furnance	1,364	8,577
Oil Furnance	51	966
Hydronics Gas	39	388
Hydronics Oil	10	187

<b>Regional Breakdown</b>	<b>Individuals Certified</b>
Northeast	4,231
South	10,469
Midwest	5,956
West	4,068

Note(s): 1)Third party certification program for heating and cooling professionals to ensure knowledge of proper installation and servicing of HVAC/R equipment. 2) Includes individuals holding refrigeration certifications.

Source(s): Phone correspondence with Pat Murphy, vice president of certifications, North American Technician Excellence program; North American Technician Excellence Program web site, <http://www.natex.org/about.htm>

**9.4.1 Case Study, The Adam Joseph Lewis Center for Environmental Studies, Oberlin College; Oberlin, Ohio (Education)****Building Design**

Floor Area: 13,600 SF Floors: 2 Footprint: 140 ft. x 45 ft. with attached 100-seat auditorium

3 Classrooms (1) 1 Conference Room 1 Administration Office  
 Auditorium, 100 seats 6 Small Offices Atrium  
 Wastewater Treatment Facility

**Shell**

**Windows** Material: Green Tint Triple Pane Argon Fill Insulating Glass  
 Grey Tint Double Pane Argon Fill Insulating Glass

Fenestration(square feet)

	<u>Window</u>	<u>Wall(2)</u>	<u>window/wall</u>		<u>Atrium, Triple Pane (3)</u>	<u>Building, Double Pane</u>
North	1,675	4,372	38%		U-Factor 0.34	U-Factor 0.46
South	2,553	4,498	58%		SHGC 0.26	SHGC 0.46
East	1,084	2,371	46%			
West	350	2,512	14%			
Overall	6,063	14,153	43%			

**Wall/Roof**

	<u>Main Material</u>	<u>R-Value</u>
Wall :	Face Brick	19
Roof:	Steel/Stone Ballast	30

**HVAC**

		<u>COP(4)</u>
Offices/Classrooms:	Individual GSHPs (5)	3.9-4.6
	1 Large GSHP for ventilation	3.8
Atrium:	Radiant Flooring Hydronic Heating System	
Auditorium:	1 Standard Range Water Heat Pump	4.2

**Lighting Power Densities (W/SF)**

Offices:	0.88	Corridors/Others:	0.45	Total Building:	0.79
Classroom/Lecture Halls:	1.18	Atrium:	0.93		

**Energy/Power**

PV System: 60 kW grid-tie roof system  
 Net Annual Energy Usage (thousand Btu/SF\*ye 16.4

Note(s): 1) Two classrooms seat 36 and one seats 18. 2) Wall total area includes window area. 3) Atrium has only south, north, and east facing windows.  
 4) Coefficient of performance ranges due to various sizes; GSHPs have the greatest COP 5) GSHP is Ground water Source Heat Pump.

Source(s): NREL, Energy Performance Evaluation of an Educational Facility: The Adam Joseph Lewis Center for Environmental Studies, Oberlin College, Oberlin, Ohio, November 2004, Table 4.1 p. 10 Table 4.2 p.12 and Table 6.5 p. 94; NREL, Lessons Learned from Case Studies of Six High-Performance Buildings, June 2006, p. 5 Table A-2 p. 130

**9.4.2 Case Study, The Cambria Department of Environmental Protection Office Building, Ebensburg, Pennsylvania (Office)****Building Design**

Floor Area: 34,500 SF Floors: 2

Open office space (1)	File storage area	Two small laboratories	Conference rooms
Break room	Storage areas	Two mechanical rooms	Telecom room

**Shell****Windows**

Material: Triple Pane, low-e with Aluminum Frames and Wood Frames

Triple Pane <u>Aluminum Frames</u>	U-Factor	0.24	Triple Pane <u>Wood Frames</u>	U-Factor	0.26
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**Wall/Roof**

	<u>Main Material</u>	<u>R-Value</u>
Wall :	Insulating Concrete Forms	27.0
Roof:	Decking and Insulation	33.0

**HVAC**

	<u>Total Capacities(thousand Btu/hr)</u>
12 Ground Source Heat Pumps	644 (2)
12 Auxiliary Electric Resistance Heaters	382 (3)

**Lighting Power Densities(W/SF)**

Open Office Area:	0.75
Office Area Task Lighting(4):	0.5

**Energy/Power**

PV System:	18.2 kW grid-tie system (5)
Net Annual Energy Usage (thousand Btu/SF*year)	36.0

Note(s): 1) Office space is for 100 people. This accounts for approximately 20,000 SF of the total building floorspace. 2) Cooling capacity 3) Auxiliary heating capacity. 4) Task lighting is in addition to the open office area LPD and is only in select cubicals and offices. 5) Includes 17.2 kW of roof PV array and two 0.5 kW ground level single axis tracking PV arrays.

Source(s): NREL, Analysis of the Design and Energy Performance of the Pennsylvania Department of Environmental Protection Cambria Office Building, March 2005, p. ; NREL, Lessons Learned from Case Studies of Six High-Performance Buildings, June 2006, p. 5 Table A-2 p. 130.

**9.4.3 Case Study, The Visitor Center at Zion National Park, Utah  
(Public Assembly/Retail/Office)****Building Design**

Vistors Center (1)	8,800 SF	Comfort Station (2)	2,756 SF	Fee Station	170 SF
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**Shell****Windows**

	<u>Type</u>	<u>U-Factor</u>	<u>SHGC (3)</u>
South/East Glass	Double Pane Insulating Glass, Low-e, Aluminum Frames, Thermally Broken	0.44	0.44
North/West Glass	Double Pane Insulating Glass, Heat Mirror, Aluminum Frames, Thermally Broken	0.37	0.37

Window/Wall Ratio: 28%

**Wall/Roof**

	<u>Materials</u>	<u>Effective R-Value</u>
Trombe Walls:	Low-iron Patterned Trombe Wall, CMU (4)	2.3
Vistor Center Walls:	Wood Siding, Rigid Insulation Board, Gypsum	16.5
Comfort Station Walls:	Wood Siding, Rigid Insulation Board, CMU (4)	6.6
Roof:	Wood Shingles; Sheathing; Insulated Roof Panels	30.9

**HVAC****Heating**

Trombe Walls  
Electric Radiant Ceiling Panels

**Cooling**

Operable Windows  
3 Cooling Towers

**Lighting Power Densities(W/SF)**

Main Area:	(5)
Offices:	1.0
Bookstore:	0.9

**Energy/Power:**

PV System:	7.2 kW grid-tie system
Net Annual Energy Usage (thousand Btu/SF*year):	27.0

Note(s): 1) Includes office, bookstore, and service areas 2) restroom complex 3) Solar heat gain coefficient 4) Concrete masonry unit 5) The main vistors center area is handled almost entirely with daylighting. Auxiliary fluorescent lighting is used only occasionally to supplement.

Source(s): NREL, Evaluation of the Low-Energy Design and Energy Performance of the Zion National Park Visitors Center, Feb. 2005, p. 23-37;  
NREL, Lessons Learned from Case Studies of Six High-Performance Buildings, June 2006, p. 5 Table A-2 p. 130.

**9.4.4 Case Study, The Philip Merrill Environmental Center, Annapolis, Maryland (Offices)****Building Design**

Floor Area: 31,000 SF      Floors: 2      Footprint: 220 ft. x (1)

2 Floors of open office space

Attached pavilion containing: Meeting space      Kitchen      Staff dining      Conference room

**Shell****Windows**

Type:		<u>U-Factor</u>	<u>SHGC (2)</u>
Double Pane, Low-e, Argon Filled Insulating Glass		0.244	0.41

**Wall/Roof**

	<u>Material</u>	<u>Effective R-Value</u>
Interior Wall	plywood, gypsum, SIP foam, and sheathing	28.0
Exterior Wall	gypsum and insulated metal framing	9.3
Roof	plywood, gypsum, SIP foam, and sheathing	38.0

**HVAC**

18 ground source heat pumps

fin and tube radiators connected to a propane boiler

1 air conditioning unit

**Lighting Power Densities (W/SF)**

First Floor:	1.2
Second Floor:	1.6
Conference Room:	1.4

**Energy/Power**

PV System: 4.2 kW thin-film system

Net Annual Energy Usage (thousand Btu/SF\*year): 39.9

Note(s): 1) Width varies from about 74 ft. to 59 ft. along different sections of the length. 2) Solar heat gain coefficient

Source(s): NREL, Analysis of the Energy Performance of the Chesapeake Bay Foundation's Philip Merrill Environmental Center, April 2005, p. 6-24;

NREL, Lessons Learned from Case Studies of Six High-Performance Buildings, June 2006, p. 5 Table A-2 p. 130.

**9.4.5 Case Study, The Thermal Test Facility, National Renewable Energy Laboratory, Golden, Colorado (Office/Laboratory)****Building Design**

Floor Area:	10,000 SF	Floors(1):	2	Aspect Ratio:	1.75
Offices	Laboratories	Conference Room		Mechanical Level	

**Shell****Windows**

	<u>Material</u>	<u>U-factor</u>	<u>SHGC(2)</u>
Viewing Windows:	Double Pane, Grey Tint, Low-e	0.42	0.44
Clerestory Windows:	Double Pane, Clear, Low-e	0.45	0.65

Window Area(SF)

North	38
South(3)	1134
East	56
West	56

**Wall/Roof**

	<u>Material</u>	<u>Effective R-Value</u>
North Wall	Concrete Slab/Rigid Polystyrene	5.0
South/East/West	Steel Studs/Batt Insulation/Concrete	23.0
Roof:	Built-up/Polyisocyanurate Covering/Steel Supports	23.0

**HVAC**

VAV air handling unit  
 Hot water supply parallel VAV boxes  
 Direct and Indirect evaporative cooling system  
 Single zone roof top unit(4)  
 Hot Water Coil(4)

**Lighting Power Densities(W/SF)**

Interior Overhead	0.73	Exterior	0.05
Emergency	0.02	Building	0.80

**Energy/Power**

Net Annual Energy Usage (kBtu/SF\*year): 23.02

Note(s): 1) That second floor is actually and mechanical mezzanine level. 2) Solar heat gain coefficient 3) Includes 492 SF of viewing windows and 642 SF of clerestory windows. 4) Only used to handle the conference room.

Source(s): NREL, Evaluation of the Energy Performance and Design Process of the Thermal Test Facility at the National Renewable Energy Laboratory, February 2005, p. 29-54; NREL, Lessons Learned from Case Studies of Six High-Performance Buildings, June 2006, p. 5 Table A-2 p. 130.

**9.4.6 Case Study, The Solaire, New York, New York  
(Apartments/Multi-Family)****Building Design**

Floor Area: 357,000 SF                      Units: 293                      Maximum Occupancy: 700  
 Floors: 27                                      Site Size: 0.38 Acres                      Typical Occupancy(1): 578  
 Black-Water Treatment Facility (2)

**Shell****Windows**

Material: Double Glazed, Low-e, Thermal Breaks with Insulated Spacers

	<u>Operable windows</u>	<u>Fixed Windows</u>
Visual Transmittance	0.68	0.68
Solar Heat Gain Coefficient	0.35	0.35
U-Factor	0.47	0.41

**Wall/Roof**

	<u>Material</u>	<u>R-Value</u>
Exterior Walls:	Insulated brick and concrete block	8.4
Roof:	Roof top garden(green roof)	22.7

**HVAC**

Two direct-fired natural gas absorption chillers  
 4-Pipe fan-coil units in individual apartments

**Power/Energy(3)**

PV System(4): 1,300 SF (76 custom panels) of west facing PV rated for 11 kW . These panels are integrated into the building façade.  
 151 SF PV located in the entrance canopy. Rated for 662 W.  
 286 standard PV modules mounted on the south and west walls. Rated for 21 kW.

Unit Average Electricity Consumption(5): 15,681 kBTu/year  
 Building Natural Gas Consumption(6): 104.1 kBTu/SF\*year

**Predicted End-Use Consumption(kBTu/SF\*year)**

Heating	60.8	Plug Loads and Equipment	6.7
Cooling	20.7	Domestic Hot Water	7.9
Lighting	7.4	Cooking, Vertical Transportation, and Other	6.8
Fans/Pumps	11.4	<b>Total</b>	<b>121.7</b>

Note(s): 1) 84 hours per person weekly, 89 visitors weekly, 8 hours per visitor weekly. 2)30,000 gallon storage tank. Water is used for toilets and cooling tower. 3) Appliances in units are ENERGY STAR qualified. 4) PV system designed to handle 5% of building peak non-residential electrical load (i.e. corridor lighting). 5) Includes only electric that was submetered to each apartment. 6) 2007 building consumption.

Source(s): ASHRAE, High Performance Buildings, NYC's Living Lesson, p. 56-65, Summer 2008; USGBC, LEED Case Studies, The Solaire, <http://leedcasestudies.usgbc.org/overview.cfm?ProjectID=273>.



## Thermal Conversion Factors

Fuel	Units	Approximate Heat Content
<b>Coal</b>		
Production	million Btu per short ton	20.310
Consumption	million Btu per short ton	20.183
Coke Plants	million Btu per short ton	26.263
Industrial	million Btu per short ton	21.652
Residential and Commercial	million Btu per short ton	22.016
Electric Power Sector	million Btu per short ton	19.952
Imports	million Btu per short ton	25.073
Exports	million Btu per short ton	25.378
<b>Coal Coke</b>	million Btu per short ton	24.800
<b>Crude Oil</b>		
Production	million Btu per barrel	5.800
Imports	million Btu per barrel	5.980
<b>Petroleum Products</b>		
Consumption	million Btu per barrel	5.338
Motor Gasoline	million Btu per barrel	5.218
Jet Fuel	million Btu per barrel	5.670
Distillate Fuel Oil	million Btu per barrel	5.790
Residual Fuel Oil	million Btu per barrel	6.287
Liquefied Petroleum Gas	million Btu per barrel	3.605
Kerosene	million Btu per barrel	5.670
Petrochemical Feedstocks	million Btu per barrel	5.554
Unfinished Oils	million Btu per barrel	6.118
Imports	million Btu per barrel	5.450
Exports	million Btu per barrel	5.727
Ethanol	million Btu per barrel	3.539
Biodiesel	million Btu per barrel	5.376
<b>Natural Gas Plant Liquids</b>		
Production	million Btu per barrel	3.712
<b>Natural Gas</b>		
Production, Dry	Btu per cubic foot	1,029
Consumption	Btu per cubic foot	1,029
End-Use Sectors	Btu per cubic foot	1,030
Electric Power Sector	Btu per cubic foot	1,028
Imports	Btu per cubic foot	1,024
Exports	Btu per cubic foot	1,009
<b>Electricity Consumption</b>	Btu per kilowatthour	3,412

Note(s): Conversion factors vary from year to year.

Source(s): DOE, EIA, Annual Energy Outlook 2008, Mar. 2008, Table G1, p. 215.



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