2006 Buildings Energy Data Book

U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

This version is dated: September 2006

2006 Buildings Energy Data Book

September 2006

Prepared for the
Buildings Technologies Program and
Office of Planning, Budget, and Analysis
Energy Efficiency and Renewable Energy
U.S. Department of Energy

by
D&R International, Ltd.

under contract to
Oak Ridge National Laboratory

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Foreword

The Department of Energy's 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. We would like to bring to the fore the following factoids:

- Buildings now use 71% of all electricity, and *account for 79% of all electric expenditures.*
- "Internal gains" are a significant part of cooling loads even in homes, as much as 27%.
- There are now 114 million households.
- One third of all households rent.
- That average new single-family homes have increased in size by about 500 square feet since 1980.
- In 2005, almost half (47%) of all new homes completed were completed in the South. Cooling load management emerges as a priority.
- U.S. buildings carbon dioxide emissions (608 million metric tons of carbon) approximately equal the combined emissions of Japan, France, and the United Kingdom.
- China's projected annual growth rate in carbon dioxide emissions through 2010 is five and a half times that of the US (7.5% vs. 1.3%).
- Lighting uses more energy than cooling in the residential sector, as a national average. This under scores the importance of breakthrough lighting technologies.
- The homebuilding industry shows signs of consolidating. As of 2005, the top five homebuilders are 15% of the total market, the top 20 are 26%, and the top 100 are 37%.
- In 2001, per the *U.S. Lighting Market Characterization Report 2002*, lighting consumed 756 Billion kWh. In 2001, per the *Annual Energy Review 2003*, America's 104 nuclear generating units generated 769 billion kWh, while operating at a capacity factor of 89%. We can think of the *entire nuclear fleet as existing solely to illuminate America*.
- In 2004, 33% of all refrigerator sales and 27% of all clothes washer sales were ENERGY STAR compliant.

We hope you find the *2006 Buildings Energy Data Book* useful. You are encouraged to comment on errors, omissions, emphases, and organization of this report to one of the persons 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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The *2006 Buildings Energy Data Book* can be found on the web at:

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

Acknowledgements

The authors would like to express their thanks to the many individuals who assisted in the preparation of this document. We thank Jerry Dion and the Building Technologies Program along with Phil Patterson, Randy Steer, and the Energy Efficiency and Renewable Energy staff for their continued support of the *Buildings Energy Data Book*. We also thank Stacy Davis and Pat Love at Oak Ridge National Laboratory for their support. We greatly appreciate the input and guidance received over the years from Andrew Nicholls of Pacific Northwest National Laboratory. Finally, many thanks to Brian Rigney for helping to craft the finest edition of the *Buildings Energy Data Book* to date.

Introduction

The *2006 Buildings Energy Data Book* is a statistical compendium prepared and published under contract with Oak Ridge National Laboratory (ORNL) and the Office of Planning, Budget, and Analysis 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 September of 2004. In the fall of 2004, the Oak Ridge National Laboratory began support of the *Buildings Energy Data Book*.

The Department of Energy's Office of Energy Efficiency and Renewable Energy has developed this *2006 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. Tables are organized into seven chapters: 1 – Energy Consumption Data, 2 – Characteristics Data, 3 – Environmental Data, 4 – Economic Data, Chapter 5 – Market Data, Chapter 6 – Quad Equivalents, and Chapter 7 – Buildings Profiles.

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Key Terminology

AAMA	American Architectural Manufacturers Association
ACEEE	American Council for an Energy Efficient Economy
AEO	EIA's *Annual Energy Outlook*
AFEAS	Alternative Fluorocarbons Environmental Acceptability Study
AFUE	Annual Fuel Utilization Efficiency
AHAM	Association of Home Appliance Manufacturers
ARI	Air-Conditioning and Refrigeration Institute
ASD	Adjustable Speed Drive
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BED	BTS's Office of Building Equipment (formerly the Building Equipment Division)
BNL	Brookhaven National Laboratory
BTS	DOE's Office of Building Technology, State and Community Programs
CBECS	EIA's Commercial Building Energy Consumption Survey
CF	Cubic feet
CFC	Chlorofluorocarbon
CO	Carbon monoxide
CO_2	Carbon dioxide
COP	Coefficient of Performance (dimensionless, heating/cooling capacity (Btu) over electric input (Btu))
CPS	Bureau of the Census' Current Population Survey
Delivered	Refers to energy used on *site* (including purchased electricity)
DOC	U.S. Department of Commerce
DOE	U.S. Department of Energy
DSM	Demand-Side Management
EER	Energy Efficiency Ratio (Btu/watt-hour)
EF	Energy Factor
EIA	DOE's Energy Information Administration
EPA	U.S. Environmental Protection Agency
ESCO	Energy Service Company
FEMP	DOE's Federal Energy Management Program
FT2	Square Feet
FY	Fiscal Year

Key Terminology

GAMA	Gas Appliance Manufacturers Association
GDP	Gross Domestic Product
GHG	Greenhouse Gas(es)
GWP	Global Warming Potential
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
HHS	U.S. Department of Health and Human Services
HSPF	Heating Season Performance Factor (Btu/watt-hour)
HUD	U.S. Department of Housing and Urban Development
HVAC/R	Heating, ventilating, and air-conditioning/refrigeration
IEA	International Energy Agency
LBNL	Lawrence Berkeley National Laboratory
LIHEAP	HHS' Low Income Home Energy Assistance Program
LPG	Liquid Petroleum Gas
MEF	Modified Energy Factor
MMT	Million metric tons
MMTCE	Million metric tons of carbon equivalent (Includes only energy consumption effects, unless otherwise noted.)
NAHB	National Association of Home Builders
NAIMA	North American Insulation Manufacturers Association
NEMS	National Energy Modeling System
NWWDA	National Wood Window and Door Association
NO_x	Nitrogen oxide
OBE	BTS's Office of Building Equipment
OBT	DOE's Office of Building Technology, State and Community Programs (formerly the Office of Building Technologies)
ODP	Ozone Depletion Potential
ORNL	Oak Ridge National Laboratory
PM-2.5	Particulate matter of aerodynamic diameter less than 2.5 microns
PM-10	Particulate matter of aerodynamic diameter less than 10 microns
PNNL	Pacific Northwest National Laboratory
Primary	Refers to energy used at the source (including fuel input to electric power plants)

Key Terminology

PY	Program Year
Quad	Quadrillion Btu (10^15 Btu)
R-value	Thermal resistance measured in (Btu/Hr-ft^2-^oF)$^{-1}$
RECS	EIA's Residential Energy Consumption Survey
SDHW	Solar domestic hot water
SEDS	State Energy Data System
SEER	Seasonal Energy Efficiency Ratio (Btu/watt-hour)
SEF	Solar Energy Factor
SF	Square feet
SIC	Standard Industrial Classification
Site	Refers to energy used on *site* (i.e., *delivered)*
SO_2	Sulfur dioxide
SRCC	Solar Rating & Certification Corporation
TSP	Total Suspended Particulate
U-value	Thermal conductance measured in (Btu/Hr-ft^2-^oF)
VOC	Volatile organic compounds

1. U.S. Residential and Commercial Buildings Primary Energy Consumption (quads and % of totals)

Residential Consumption

	Elec		NGas		Oil		Coal		Renew		**Total**
1990	10.5	61%	4.5	27%	1.4	8%	0.0	0%	0.64	4%	**17.0**
2000	13.3	65%	5.1	25%	1.6	8%	0.0	0%	0.48	2%	**20.5**
2004	**14.0**	**67%**	**5.0**	**24%**	**1.6**	**7%**	**0.0**	**0%**	**0.43**	**2%**	**21.1**
2010	15.7	68%	5.3	23%	1.5	6%	0.0	0%	0.47	2%	**23.0**
2020	17.6	70%	5.7	23%	1.4	6%	0.0	0%	0.48	2%	**25.2**
2030	19.1	71%	5.8	22%	1.3	5%	0.0	0%	0.48	2%	**26.7**

Commercial Consumption

	Elec		NGas		Oil		Coal		Renew		**Total**
1990	9.5	71%	2.7	20%	1.0	7%	0.1	1%	0.10	1%	**13.4**
2000	13.0	75%	3.3	19%	0.8	4%	0.1	1%	0.13	1%	**17.2**
2004	**13.3**	**77%**	**3.1**	**18%**	**0.8**	**5%**	**0.1**	**1%**	**0.11**	**1%**	**17.4**
2010	15.4	79%	3.2	16%	0.8	4%	0.1	0%	0.12	1%	**19.5**
2020	18.4	80%	3.7	16%	0.8	3%	0.1	0%	0.12	1%	**23.0**
2030	21.6	81%	4.1	15%	0.8	3%	0.1	0%	0.13	0%	**26.8**

2. U.S. Buildings Primary Energy Consumption (quads and % of total)

	Elec		NGas		Oil		Coal		Renew		**Total**
1990	19.9	66%	7.2	24%	2.4	8%	0.2	1%	0.74	2%	**30.4**
2000	26.3	70%	8.4	22%	2.3	6%	0.1	0%	0.61	2%	**37.7**
2004	**27.3**	**71%**	**8.1**	**21%**	**2.4**	**6%**	**0.1**	**0%**	**0.55**	**1%**	**38.5**
2010	31.1	73%	8.5	20%	2.3	5%	0.1	0%	0.59	1%	**42.6**
2020	36.0	75%	9.4	19%	2.2	5%	0.1	0%	0.60	1%	**48.3**
2030	40.7	76%	9.9	19%	2.1	4%	0.1	0%	0.60	1%	**53.5**

3. U.S. Buildings Generic Quad (% of total)

	Gas	Oil	Coal	Renew	Nuclear
1990	31%	11%	35%	10%	13%
2000	30%	8%	35%	14%	13%
2004	**31%**	**8%**	**37%**	**8%**	**15%**
2010	30%	7%	39%	10%	14%
2020	31%	6%	39%	10%	14%
2030	27%	6%	44%	10%	13%

4. Buildings Share of U.S. Primary Energy Consumption

	Res	Com	**Bldgs**	Indtry	Trans
1990	20%	16%	**36%**	38%	26%
2000	21%	17%	**38%**	35%	27%
2004	**21%**	**17%**	**39%**	**33%**	**28%**
2010	21%	18%	**39%**	32%	29%
2020	21%	19%	**40%**	31%	29%
2030	20%	20%	**40%**	30%	30%

5. Buildings Share of U.S. Electricity Consumption

	Res	Com	**Bldgs**	Indtry	Trans
1990	34%	31%	**65%**	35%	0%
2000	35%	34%	**69%**	31%	0%
2004	**36%**	**34%**	**71%**	**29%**	**1%**
2010	37%	36%	**73%**	27%	1%
2020	37%	38%	**75%**	25%	1%
2030	40%	40%	**81%**	24%	1%

6. U.S. Electricity Net Generation, by Plant Type (Billion Kilowatthours)

	NGas	Petro	Coal	Renew	Nucl.	Total
1990	265	118	1560	324	577	**2901**
2000	399	98	1852	316	754	**3638**
2004	**486**	**110**	**1916**	**323**	**789**	**3794**
2010	533	90	2164	370	809	**4196**
2020	814	90	2405	416	871	**4827**
2030	691	99	3178	434	871	**5497**

7. U.S. Buildings Primary Energy and Expenditure End-Use Splits, 2004

Energy (quads and % of totals)

End Use	Residential		Commercial		**Buildings**	
Space Heating	6.6	32%	2.3	13%	**8.9**	**23%**
Lighting	2.5	12%	4.3	25%	**6.8**	**18%**
Space Cooling	2.3	11%	1.9	11%	**4.2**	**11%**
Water Heating	2.7	13%	1.1	6%	**3.7**	**10%**
Refrigeration	1.7	8%	1.1	6%	**2.8**	**7%**
Electronics	1.1	5%	1.0	6%	**2.0**	**5%**
Cooking	1.0	5%	0.4	2%	**1.3**	**3%**
Wet Clean	1.0	5%			**1.0**	**3%**
Ventilation			1.0	6%	**1.0**	**3%**
Computers	0.2	1%	0.4	3%	**0.7**	**2%**
Other	0.9	4%	1.8	10%	**2.6**	**7%**
Adjustment to SEDS	1.1	5%	2.2	13%	**3.3**	**9%**
Total	21.1	100%	17.4	100%	**38.5**	**100%**

Expenditures ($2004 and % of totals)

End Use	Residential		Commercial		**Buildings**	
Space Heating	66	35%	19	14%	**85**	**26%**
Lighting	21	11%	32	23%	**52**	**16%**
Water Heating	25	13%	9	7%	**34**	**11%**
Space Cooling	19	10%	14	10%	**33**	**10%**
Refrigeration	14	7%	8	6%	**22**	**7%**
Electronics	9	5%	7	5%	**16**	**5%**
Cooking	9	4%	3	2%	**12**	**4%**
Wet Clean	9	5%			**9**	**3%**
Ventilation			7	6%	**8**	**2%**
Computers	2	1%	3	2%	**5**	**2%**
Other	9	5%	14	10%	**23**	**7%**
Adjust to SEDS	9	5%	18	14%	**28**	**8%**
Total	191	100%	135	100%	**326**	**100%**

8. Buildings Energy Prices and Expenditures

Prices ($2004/10^6 Btu)

	Residential Buildings				Commercial Buildings				Bldgs
	Elec	NGas	Petro	Avg	Elec	NGas	Petro	Avg	Avg
1990	30.46	7.47	11.61	**16.09**	28.12	6.23	7.89	**16.09**	**16.09**
2000	26.13	8.27	12.50	**15.66**	23.29	7.10	8.76	**15.30**	**15.50**
2004	**26.19**	**10.40**	**14.63**	**17.33**	**23.52**	**9.10**	**10.39**	**16.71**	**17.07**
2010	24.78	10.33	14.77	**17.00**	22.31	8.76	10.56	**16.41**	**16.75**
2020	24.44	10.16	15.94	**17.20**	22.00	8.37	11.22	**16.40**	**16.84**
2030	25.02	11.32	18.42	**18.52**	22.90	9.29	12.28	**17.63**	**18.10**

Petroleum includes distillate and residual fuel oils, LPG, kerosene, and motor gasoline.
2004 average electricity cost: resid. $0.089/kWh, comm. $0.080/kWh, and Bldgs. $0.085/kWh.

Expenditures ($2004 billion)

	Residential Buildings				Commercial Buildings				Bldgs
	Elec	NGas	Petro	Total	Elec	NGas	Petro	Total	Total
1990	96.0	33.7	16.3	**146.1**	80.4	16.8	7.5	**104.8**	**250.9**
2000	106.3	42.2	19.5	**168.0**	92.1	23.1	6.6	**121.9**	**289.9**
2004	**115.5**	**52.3**	**23.0**	**190.9**	**98.6**	**28.2**	**8.1**	**134.8**	**325.7**
2010	123.6	55.1	21.7	**200.4**	108.9	27.9	7.9	**144.6**	**345.0**
2020	141.0	57.7	22.7	**221.4**	132.3	30.8	8.7	**171.8**	**393.2**
2030	161.9	65.9	24.3	**252.0**	168.1	38.2	9.8	**216.1**	**468.1**

Expenditures exclude wood and coal costs. 2004 U.S. energy expenditures were $911.18 billion.

9. Energy Consumption Intensities, by Year

Residential

	Number of Hhold (10^6)	% Post-00 Hholds	Bldgs (10^6)	*Delivered* Energy Use (10^6Btu/Hhold)	Primary Energy Use (10^6Btu/Hhold)
1980	79.6	N.A.	65.5	124.7	198.8
1990	94.2	N.A.	74.2	103.5	181.0
2000	105.7	N.A.	82.6	106.3	193.9
2004	**113.6**	**7%**	**N/A**	**100.8**	**185.4**
2010	122.9	16%	N/A	99.9	187.3
2020	137.2	29%	N/A	97.4	183.8
2030	149.8	38%	N/A	94.1	178.2

2000 number of buildings actually from 1997.
2001 households: 69% single-family, 25% multi-family, and 6% mobile homes.
2001 *delivered* energy use: 80% single-family, 15% multi-family, and 5% mobile homes.

Commercial

	Floorspace (10^9 SF)	% Post-00 SF	Bldgs (10^6)	*Delivered* Energy Use (10^3Btu/SF)	Primary Energy Use (10^3Btu/SF)
1980	50.9	N.A.	3.1	117.8	208.2
1990	64.3	N.A.	4.5	104.7	207.7
2000	68.5	N.A.	4.7	119.4	250.8
2004	**75.0**	**N.A.**	**N/A**	**110.2**	**231.8**
2010	82.3	16%	N/A	109.7	237.4
2020	96.0	29%	N/A	111.5	240.2
2030	112.0	38%	N/A	111.4	238.9

2000 number of buildings actually from 1995.
1995 floorspace: 22% mercantile & service, 18% office, 14% warehouse, and 13% education. 1995 *delivered* energy use: 19% office, 18% mercantile & service, 12% education, and 11% health care.

10. Residential (2001) and Commercial (2003) Vintages

Residential	% of Hholds	Commercial	% of SF
1949 or Before	25%	Prior to 1960	25%
1950 to 1959	13%	1960 to 1979	27%
1960 to 1969	13%	1980 to 1989	15%
1970 to 1979	18%	1990 to 1999	25%
1980 to 1989	17%	2000 to 2003	8%
1990 to 2001	14%		

11. Stock Energy Expenditures ($2004)

	Residential ($/Household)	Commercial ($/SF)
1980	1,726	1.84
1990	1,550	1.63
2000	1,512	1.78
2004	**1,680**	**1.80**
2010	1,632	1.76
2015	1,584	1.73
2020	1,614	1.79

12. Carbon Dioxide Emissions for U.S. Buildings

(10^6 metric tons of carbon/yr)

	Buildings			Bldgs % of	Bldgs % of
	Elec	*Site* Fossil	Total	U.S. Emiss	Global Emiss
1990	317.2	153.7	470.9	35%	8%
2000	426.2	167.4	593.5	38%	9%
2004	**443.4**	**164.7**	**608.1**	**38%**	**10%**
2010	502.5	168.0	670.5	39%	9%
2020	577.2	179.6	756.8	39%	8%
2030	686.2	186.0	872.2	39%	7%

Buildings emissions equal emissions of Japan, France, and the U. K. combined.
2004 U.S. emissions = 1,610 MMTCE. 2004 Global emissions = 7,381 MMTCE.

13. EPA Emissions for U.S. Buildings, 2002

(10^6 short tons)

	Buildings			Bldgs % of
	Wood/*Site* Fossil	Elec	Total	U.S. Emiss
SO2	0.58	7.34	7.919	52%
NOx	0.73	3.35	4.078	19%
CO	2.50	0.36	2.856	3%
VOCs	0.79	0.04	0.828	5%
PM-2.5	0.38	0.42	0.8	12%
PM-10	0.41	0.50	0.901	4%

14. Value of New, Improvement & Repair Building Construction ($2004 billion)

	Value of New Construction			Bldgs % of	Value of Improvement & Repair			Bldgs % of
	Resid	Comm	Bldgs	U.S. GDP	Resid	Comm	Bldgs	U.S. GDP
1980	143.4	138.1	281.5	5.0%	92.8	N.A.	N.A.	N.A.
1985	184.4	195.5	379.9	5.8%	127.5	121.2	248.7	3.8%
1990	180.3	196.6	377.0	4.9%	153.1	123.2	276.3	3.6%
1995	206.2	178.4	384.6	4.4%	146.9	111.2	258.0	3.0%
2000	291.4	279.4	570.9	5.4%	165.6	173.4	339.0	3.2%
2004	**425.2**	**270.7**	**695.9**	**5.9%**	**198.6**	**168.0**	**366.5**	**3.1%**

2004 U.S. GDP = $11.74 trillion

15. 1998 Cost Breakdown of a 2,150-Square-Foot, New Single-Family Home ($2004)

	Cost	Percent
Finished Lot	60,040	24%
Construction Cost	139,558	55%
Financing	4,786	2%
Overhead & General Expenses	14,534	6%
Marketing	3,568	1%
Sales Commission	8,583	3%
Profit	23,377	9%

16. Residential New Single-Family Homes Completed

	# of Units	Average SF
1980	957,000	1,730
1990	966,000	2,080
2000	1,241,800	2,266
2005	**1,636,000**	**2,227**

1980 SF extrapolated from 1978 and 1981 data.

17. Design and Construction Employment

	Employees (thousands)		Builders	
	Architects	Construction (1)	(companies)	
1980	N.A.	3,065	93,600	
1990	N.A.	3,861	119,300	
2000	215	5,183	134,079	(2)
2004	**207**	**6,964**	**N.A.**	

1) Excludes industrial building and heavy construction.
2) Builders is for 1997. Builders exclude homebuilding establishments without payrolls, estimated by NAHB at an additional 210,000 in 1992.

18. FY 2004 Energy Burdens

	Mean Individual	Median Individual	Mean Group
All Hholds	6.4%	2.4%	2.6%
Fed Elgble Hhold	13.7%	8.0%	8.2%
Fed Ineligible Hhold	3.0%	2.6%	2.1%

Average income of a Federally eligible household was $16,804 in 2004.

19. Construction Waste

2 to 7 tons for each new single-family detached house.
Average of 4 pounds per square foot for new single-family detached house.
30 to 35 million tons of building construction, renovation, and demolition waste each year.
Construction of typical 2,000 sq.ft. home results in 4 tons of waste (wood/paper: 46%, drywall: 25%, masonry: 13%, other: 17%, hazardous material: 1%)

20. Weatherization Facts

5.6 million homes have been weatherized since 1976.
DOE creates an average energy savings of $358 a year with a cost-benefit ratio of 1.3.
DOE Weatherization program requires that states spend no more than an average of $2,826 per household in PY 2006. All states use energy audits to determine the most cost-effective weatherization measures.

21. 2003 U.S. Private Investment into Construction R&D

Sector	Percent of Sales
Average Construction R&D (1)	0.6
Heavy Construction	2.0
Lumber and Wood Products	0.3
Special Trade Construction	0.2
Fans Blowers and Air Cleaning Equip.	1.6
Commercial Buildings Operations	2.2
Building Technology	
Appliances	2.0
Lighting	1.2
HVAC	1.5
U.S. Industry Average	3.6

1) Includes bridges, roads, buildings, dams, etc.

22. 2005 Five Largest Residential Homebuilders

Homebuilder	Home Closings	% of Closings
D.R. Horton	51,383	3.7%
Pulte Homes	45,630	3.3%
Lennar Homes	42,359	3.1%
Centex Corporation	37,022	2.7%
KB Home	31,009	2.2%
Total of Top Five	207,403	15.0%
Habitat for Humanity	4,993	0.27%

2005 total U.S. new home closings was 1.38 million. 2005 total share of top 100 builders was 37.0%.

The summary tables correspond to the following tables in Chapters 1 through 7 of the Buildings Energy Data Book

1.	1.2.1, 1.3.1	**5.**	1.1.3, 1.5.1	**8.**	4.1.1, 4.1.3	**11.**	4.2.2, 4.3.2	**15.**	4.2.8	**19.**	3.4.1, 3.4.2
2.	1.1.1	**6.**	1.5.4	**9.**	1.2.5, 1.2.7, 1.3.4, 1.3.6,	**12.**	3.1.1	**16.**	2.1.6	**20.**	7.1.1, 7.1.3, 7.1.6
3.	1.1.4	**7.**	1.1.7, 1.2.3, 1.3.3,		2.1.1, 2.1.2, 2.2.1, 2.2.2	**13.**	3.3.1	**17.**	4.6.1	**21.**	4.5.4
4.	1.1.2		4.1.4, 4.2.1, & 4.3.1	**10.**	2.1.5, 2.2.6	**14.**	4.5.2, 4.5.3, 5.1.2	**18.**	4.2.7, 7.1.1	**22.**	5.1.1

1.1.1 U.S. Residential and Commercial Buildings Total Primary Energy Consumption (quads and percent of total)

	Natural Gas		Petroleum (1)		Coal		Renewable(2)		Electricity Sales	Electricity Losses	Electricity Total		TOTAL (2)		Growth Rate 2004-Year
1980	7.52	28%	3.04	11%	0.15	1%	0.87	3%	4.35	10.51	14.86	56%	26.43	100%	-
1990	7.22	24%	2.36	8%	0.16	1%	0.74	2%	6.01	13.92	19.93	66%	30.40	100%	-
2000	8.35	22%	2.32	6%	0.10	0%	0.61	2%	8.03	18.26	26.28	70%	37.66	100%	-
2004	**8.13**	**21%**	**2.36**	**6%**	**0.10**	**0%**	**0.55**	**1%**	**8.60**	**18.73** (3)	**27.33**	**71%**	**38.46**	**100%**	-
2010	8.51	20%	2.25	5%	0.10	0%	0.59	1%	9.87	21.26	31.12	73%	42.57	100%	1.7%
2015	8.98	20%	2.25	5%	0.10	0%	0.59	1%	10.81	22.64	33.45	74%	45.37	100%	1.5%
2020	9.36	19%	2.22	5%	0.10	0%	0.60	1%	11.78	24.20	35.99	75%	48.26	100%	1.4%
2025	9.64	19%	2.17	4%	0.10	0%	0.60	1%	12.73	25.56	38.29	75%	50.79	100%	1.3%
2030	9.93	19%	2.14	4%	0.10	0%	0.60	1%	13.81	26.89	40.70	76%	53.47	100%	1.3%

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 in Table 1.1.4. 3) 2004 *site*-to-source electricity conversion = 3.18.

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, Annual Energy Outlook (AEO) 2006, Feb. 2006, Table A2, p. 134-136 for 2004-2030 and Table A17, p. 159 for non-marketed renewable energy.

1.1.2 U.S. Buildings *Site* Renewable Energy Consumption (quads) (1)

	Wood (2)	Solar Thermal (3)	Solar PV (3)	GHP (4)	Total	Growth Rate 2004-Year
1980	0.8670	0.0000	N.A.	0.0000	0.8670	-
1990	0.6760	0.0560	N.A.	0.0090	0.7410	-
2000	0.5390	0.0610	N.A.	0.0170	0.6170	-
2004	**0.4942**	**0.0484**	**0.0009**	**0.0022**	**0.5457**	-
2010	0.5240	0.0560	0.0046	0.0053	0.5898	1.3%
2015	0.5145	0.0621	0.0050	0.0073	0.5889	0.7%
2020	0.5137	0.0673	0.0055	0.0094	0.5959	0.6%
2025	0.5080	0.0721	0.0064	0.0114	0.5978	0.4%
2030	0.5013	0.0768	0.0124	0.0132	0.6036	0.4%

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 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2006, Feb. 2006, Table A17, p. 158 for 2004-2030.

1.1.3 Buildings Share of U.S. Primary Energy Consumption (percent)

	Residential	Commercial	**Total Buildings**	Industry	Transportation	TOTAL	Total Consumption (quads)
1980 (1)	20%	14%	34%	41%	25%	100%	78.3
1990	20%	16%	36%	38%	26%	100%	84.7
2000	21%	17%	38%	35%	27%	100%	98.9
2004	**21%**	**17%**	**39%**	**33%**	**28%**	**100%**	**99.7**
2010	21%	18%	39%	32%	29%	100%	107.9
2015	21%	19%	40%	31%	29%	100%	114.3
2020	21%	19%	40%	31%	29%	100%	120.7
2025	20%	20%	40%	31%	30%	100%	127.1
2030	20%	20%	40%	30%	30%	100%	134.0

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

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2005, Feb. 2006, Table A2, p. 134-136 for 2004-2030 data and Table A17, p. 159 for non-marketed renewable energy.

1.1.4 2004 U.S. Buildings Energy End-Use Splits, by Fuel Type (quads)

	Natural Gas	Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (4)	Primary Total	Primary Percent
Space Heating (5)	4.70	1.13	0.29	0.21	0.41	0.69	7.44	37.7%	2.19	8.94	23.2%
Lighting						2.14	2.14	10.8%	6.79	6.79	17.6%
Space Cooling	0.01					1.32	1.33	6.7%	4.19	4.20	10.9%
Water Heating	1.69	0.19	0.05		0.05	0.56	2.54	12.9%	1.77	3.75	9.7%
Refrigeration (6)						0.88	0.88	4.4%	2.78	2.78	7.2%
Electronics (7)						0.64	0.64	3.3%	2.05	2.05	5.3%
Cooking	0.47		0.03			0.26	0.76	3.8%	0.81	1.31	3.4%
Wet Clean (8)	0.07					0.30	0.37	1.9%	0.96	1.03	2.7%
Ventilation (9)						0.32	0.32	1.6%	1.01	1.01	2.6%
Computers						0.21	0.21	1.1%	0.66	0.66	1.7%
Other (10)	0.37	0.02	0.27	0.05	0.09	0.57	1.37	6.9%	1.81	2.61	6.8%
Adjust to SEDS (11)	0.80	0.22				0.73	1.74	8.8%	2.32	3.33	8.7%
Total	8.13	1.57	0.63	0.26	0.55	8.60	19.73	100%	27.33	38.46	100%

Note(s): 1) Includes (1.45 quad) distillate fuel oil and (0.12 quad) residual fuel oil. 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 (0.41 quad) wood space heating, (0.09 quad) biomass, (0.05 quad) solar water heating, (less than 0.01 quad) geothermal space 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 (0.26 quad) furnace fans. 6) Includes (1.27 quad) refrigerators and (0.41 quad) freezers. Includes commercial refrigeration. 7) Includes (0.45 quad) color television and (0.68 quad) other office equipment. 8) Includes (0.10 quad) clothes washers, (0.07 quad) natural gas clothes dryers, (0.78 quad) electric clothes dryers, and (0.08 quad) dishwashers. 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, AEO 2006, Feb. 2006, Tables A2, p. 134-136, Table A4, p. 139-140, Table A5, p. 141-142, and Table A17, p. 159; EIA, National Energy Modeling System for AEO 2006, Feb. 2006; 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, AEO 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; OBT/A.D. Little, Energy Savings Potential for Commercial Refrigeration Equipment, June 1996, Figure 1-1-, p. 1-1; and EIA, AEO 1999, Dec. 1998, Table A5, p. 120 for 1996 refrigeration.

1.1.5 Shares of U.S. Buildings Generic Quad (percent) (1)

				Renewables (2)				
	Natural Gas	Petroleum	Coal	Hydroelectric	Other	Total	Nuclear	Total
1980	37%	18%	30%	7%	4%	10%	6%	100%
1990	31%	11%	35%	5%	4%	10%	13%	100%
2000	30%	8%	35%	5%	9%	14%	13%	100%
2004	**31%**	**8%**	**37%**	**5%**	**3%**	**8%**	**15%**	**100%**
2010	30%	7%	39%	5%	4%	10%	14%	100%
2015	32%	7%	38%	5%	5%	9%	14%	100%
2020	31%	6%	39%	5%	5%	10%	14%	100%
2025	29%	6%	41%	4%	6%	10%	14%	100%
2030	27%	6%	44%	4%	6%	10%	13%	100%

Note(s): 1) A generic quad is primary energy apportioned between the various primary fuels according to their relative consumption. See Table 6.1.1 for further explanation. 2) Electric imports included in renewables.

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 for 2004-2030 consumption and Table A17, p. 159 for non-marketed renewable energy.

1.1.6 Buildings Share of U.S. Electricity Consumption (percent)

	Residential	Commercial	**Total Buildings**	Industry	Transportation	TOTAL	*Delivered* Total (quads)
1980	34%	27%	61%	39%	0%	100%	7.1
1990	34%	31%	65%	35%	0%	100%	9.3
2000	35%	34%	69%	31%	0%	100%	11.7
2004 (1)	**36%**	**34%**	**71%**	**29%**	**1%**	**100%**	**12.2**
2010	37%	36%	73%	27%	1%	100%	13.6
2015	37%	37%	74%	26%	1%	100%	14.7
2020	37%	38%	75%	25%	1%	100%	15.8
2025	36%	39%	75%	24%	1%	100%	16.9
2030	40%	40%	81%	24%	1%	100%	18.2

Note(s): 1) Buildings accounted for 79% (or $214 billion) of total U.S. electricity expenditures.

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 for 2004-2030 consumption, Table A3, p. 137-138 for 2004 expenditures.

1.1.7 Buildings Share of U.S. Natural Gas Consumption (percent)

	Site Consumption				Primary Consumption			U.S. Natural Gas Total
	Buildings	Industry	Electric Generators	Transportation	**Buildings**	Industry	Transportation	(quads)
1980	37%	41%	19%	3%	50%	47%	3%	20.4
1990	37%	43%	17%	3%	49%	47%	3%	19.8
2000	35%	40%	22%	3%	53%	45%	3%	23.8
2004(1)	**37%**	**35%**	**25%**	**3%**	**55%**	**42%**	**3%**	**21.9**
2010	37%	35%	25%	3%	55%	42%	3%	22.9
2015	35%	33%	29%	3%	57%	40%	3%	25.4
2020	35%	32%	29%	3%	57%	39%	4%	26.4
2025	36%	33%	27%	3%	57%	40%	4%	26.5
2030	38%	34%	25%	3%	56%	40%	4%	26.4

Note(s): 1) Buildings accounted for 62% (or $102 billion) of total U.S. natural gas expenditures.

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 for 2004-2030 consumption, Table A3, p. 137-138 for 2004 expenditures.

1.1.8 Buildings Share of U.S. Petroleum Consumption (percent)

	Site Consumption				Primary Consumption			U.S. Petroleum Total
	Buildings	Industry	Electric Generators	Transportation	**Buildings**	Industry	Transportation	(quads)
1980	9%	28%	8%	56%	14%	30%	56%	34.2
1990	7%	25%	4%	64%	10%	26%	64%	33.6
2000	6%	24%	3%	67%	8%	24%	67%	38.4
2004	**6%**	**24%**	**3%**	**67%**	**8%**	**25%**	**67%**	**40.1**
2010	5%	23%	2%	69%	7%	24%	69%	43.1
2015	5%	23%	2%	70%	6%	23%	70%	45.7
2020	5%	22%	2%	71%	6%	23%	71%	48.1
2025	4%	22%	2%	72%	6%	22%	72%	50.6
2030	4%	22%	2%	72%	5%	22%	72%	53.6

Note(s): 1) Buildings accounted for an estimated 5.8% (or $24 billion) of total U.S. petroleum expenditures.

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 for 2004-2030 consumption, Table A3, p. 137-138 for 2004 expenditures.

1.1.9 Buildings Share of U.S. Petroleum Consumption (million barrels per day)

	Residential	Commercial	**Buildings**	Industry	Transportation	Total
1980	1.20	1.14	2.34	5.17	9.55	17.06
1990	1.23	0.75	1.98	4.44	10.89	16.99
2000	1.28	0.65	1.93	5.01	13.01	19.70
2004	**1.29**	**0.58**	**1.86**	**5.23**	**19.99**	**26.89**
2010	1.06	0.53	1.59	4.85	14.13	20.38
2015	1.06	0.54	1.60	4.98	15.20	21.58
2020	1.05	0.55	1.60	5.14	16.20	22.74
2025	1.03	0.56	1.59	5.36	17.15	23.89
2030	1.01	0.59	1.60	5.63	18.29	25.31

Source(s): EIA, Annual Energy Review 2004, August 2005, Table 5.13a for 1980-2004 buildings, Table 5.13b for 1980 to 2004 industry, Table 5.13c for 1980-2004 transportation, and Table 5.13d for 1980-2004 electricity generators; and EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 for 2004-2030 consumption; EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000.

1.1.10 World Primary Energy Consumption and Population, by Country/Region

	Energy Consumption (Quad)				Population (million)				Annual Growth Rate 1990-2003		Annual Growth Rate 2003-2010	
Region/Country	1990	2003		2010	1990	2003		2010	Energy	Pop.	Energy	Pop.
United States	84.6	98.1	23.3%	107.9	254	291	4.6%	310	1.1%	1.1%	1.4%	0.9%
OECD Europe	69.9	78.9	18.8%	84.4	497	530	8.4%	543	0.9%	0.5%	1.0%	0.3%
China	27.0	45.5	10.8%	77.0	1155	1299	20.6%	1355	4.1%	0.9%	7.8%	0.6%
Russia	39.0	29.1	6.9%	33.3	148	145	2.3%	140	-2.2%	-0.2%	1.9%	-0.5%
Other Non-OECD Asia	12.5	23.6	5.6%	29.8	743	946	15.0%	1054	5.0%	1.9%	3.4%	1.6%
Japan	18.4	22.4	5.3%	22.7	124	128	2.0%	128	1.5%	0.2%	0.2%	0.0%
Central & S. America	14.5	21.9	5.2%	28.2	360	442	7.0%	486	3.2%	1.6%	3.7%	1.4%
Middle East	11.3	19.6	4.7%	25.0	137	187	3.0%	216	4.3%	2.4%	3.5%	2.1%
Oth. Non-OECD Europe	28.3	19.4	4.6%	23.2	200	198	3.1%	198	-2.9%	-0.1%	2.6%	0.0%
India	8.0	14.0	3.3%	19.4	849	1070	17.0%	1183	4.4%	1.8%	4.8%	1.4%
Canada	11.1	13.5	3.2%	15.6	28	32	0.5%	34	1.5%	1.0%	2.1%	0.9%
Africa	9.5	13.3	3.2%	17.7	636	869	13.8%	1007	2.6%	2.4%	4.2%	2.1%
South Korea	3.8	8.6	2.0%	10.9	43	47	0.7%	49	6.5%	0.7%	3.4%	0.6%
Mexico	5.0	6.8	1.6%	7.9	84	104	1.6%	113	2.4%	1.7%	2.2%	1.2%
Australia & N. Zealand	4.4	6.0	1.4%	6.6	20	24	0.4%	25	2.4%	1.4%	1.4%	0.6%
Total World	347.3	420.7	100%	509.7	5278	6312	100%	6841	1.5%	1.4%	2.8%	1.2%

Source(s): EIA, International Energy Outlook 2006, June 2006, Table A1, p. 83 and Table A14, p. 97.

1.2.1 Residential Primary Energy Consumption, by Year and Fuel Type (quads and percents of total)

	Natural Gas		Petroleum (1)		Coal		Renewable(2)		Electricity Sales	Electricity Losses		Electricity Total		TOTAL (2)		Growth Rate 2004-Year
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%	0.48	2%	4.07	9.26		13.33	65%	20.48	100%	-
2004	**5.03**	**24%**	**1.57**	**7%**	**0.01**	**0%**	**0.43**	**2%**	**4.41**	**9.60**	(3)	**14.02**	**67%**	**21.07**	**100%**	-
2010	5.33	23%	1.48	6%	0.01	0%	0.47	2%	4.99	10.74		15.73	68%	23.03	100%	1.5%
2015	5.52	23%	1.47	6%	0.01	0%	0.47	2%	5.38	11.26		16.64	69%	24.11	100%	1.2%
2020	5.68	23%	1.43	6%	0.01	0%	0.48	2%	5.77	11.85		17.62	70%	25.22	100%	1.1%
2025	5.74	22%	1.37	5%	0.01	0%	0.48	2%	6.10	12.24		18.34	71%	25.94	100%	1.0%
2030	5.82	22%	1.32	5%	0.01	0%	0.48	2%	6.47	12.60		19.07	71%	26.70	100%	0.9%

Note(s): 1) Petroleum includes distillate oil, liquefied petroleum gas, and kerosene. 2) Includes *site* marketed and non-marketed renewable energy. 3) 2004 *site*-to-source electricity conversion = 3.18.

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2006, Feb. 2006, Table A2, p.134-136 for 2004-2030 consumption and Table A17, p. 159 for non-marketed renewable energy.

1.2.2 Residential *Site* Renewable Energy Consumption (quads) (1)

	Wood	Solar Thermal	Solar PV	GHP (2)	Total	Growth Rate 2004-Year
1980	0.8460	0.0000	N.A.	0.0000	0.8460	-
1990	0.5820	0.0560	N.A.	0.0060	0.6440	-
2000	0.4200	0.0610	N.A.	0.0090	0.4900	-
2004	**0.4073**	**0.0236**	**0.0001**	**0.0022**	**0.4332**	-
2010	0.4371	0.0294	0.0010	0.0053	0.4728	1.5%
2015	0.4276	0.0342	0.0011	0.0073	0.4703	0.7%
2020	0.4268	0.0392	0.0013	0.0094	0.4767	0.6%
2025	0.4210	0.0438	0.0014	0.0114	0.4776	0.5%
2030	0.4143	0.0482	0.0024	0.0132	0.4781	0.4%

Note(s): 1) Does not include renewable energy consumed by electric utilities (including hydroelectric). 2) GHP = Ground-Coupled Heat Pumps.

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2006, Feb. 2006, Table A17, p. 159 for 2004-2030.

1.2.3 2004 Residential Energy End-Use Splits, by Fuel Type (quads)

	Natural Gas	Fuel Oil	LPG	Other Fuel(1)	Renw. En.(2)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (3)	Primary Total	Primary Percent
Space Heating (4)	3.50	0.82	0.29	0.10	0.41	0.48	5.60	48.8%	1.53	6.64	31.5%
Water Heating	1.15	0.12	0.05		0.02	0.41	1.76	15.4%	1.31	2.66	12.6%
Lighting						0.79	0.79	6.9%	2.52	2.52	12.0%
Space Cooling	0.00					0.74	0.74	6.4%	2.34	2.34	11.1%
Refrigeration (5)						0.53	0.53	4.6%	1.67	1.67	7.9%
Electronics (6)						0.33	0.33	2.9%	1.06	1.06	5.0%
Wet Clean (7)	0.07					0.30	0.37	3.3%	0.96	1.03	4.9%
Cooking	0.21		0.03			0.22	0.47	4.1%	0.71	0.95	4.5%
Computers						0.07	0.07	0.6%	0.22	0.22	1.1%
Other (8)	0.10		0.17		0.00	0.18	0.45	4.0%	0.58	0.85	4.0%
Adjust to SEDS (9)						0.35	0.35	3.1%	1.11	1.11	5.3%
Total	5.03	0.94	0.54	0.10	0.43	4.41	11.46	100%	14.02	21.07	100%

Note(s): 1) Kerosene (0.09 quad) and coal (0.01 quad) are assumed attributable to space heating. 2) Comprised of (0.41 quad) wood space heating, (0.02 quad) solar water heating, (less than 0.01 quad) geothermal space heating, and (less than 0.01 quad) solar pv. 3) *Site*-to-source electricity conversion (due to generation and transmission losses) = 3.18. 4) Includes (0.26 quad) furnace fans. 5) Includes (1.27 quad) refrigerators and (0.40 quad) freezers. 6) Includes (0.45 quad) color television (0.61 quad), and other office equipment. 7) Includes (0.10 quad) clothes washers, (0.07 quad) natural gas clothes dryers, (0.78 quad) electric clothes dryers, and (0.08 quad) dishwashers. 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, AEO 1999, Jan, 1999, Tables A2, p.113-114 EIA, AEO 2006, Feb. 2006, Tables A2, p. 134-136, Table A4, p. 139-140 and Table A17, p. 159; and BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses.

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

	Number of Households (10^6)	Percent Post-2000 Households (1)	*Delivered* Energy Consumption Total (quads)	*Delivered* Energy Consumption Per Household (10^6 Btu/Hhold)	Primary Energy Consumption Total (quads)	Primary Energy Consumption Per Household (10^6 Btu/Hhold)
1980	79.6	N.A.	9.9	124.7	15.8	198.8
1990	94.2	N.A.	9.8	103.5	17.1	181.0
2000	105.7	N.A.	11.2	106.3	20.5	193.9
2004	**113.6**	**7%**	**11.5**	**100.8**	**21.1**	**185.4**
2010	122.9	16%	12.3	99.9	23.0	187.3
2015	130.1	23%	12.9	98.8	24.1	185.3
2020	137.2	29%	13.4	97.4	25.2	183.8
2025	143.5	34%	13.7	95.4	25.9	180.7
2030	149.8	38%	14.1	94.1	26.7	178.2

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

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136, Table A4, p. 139-140, and Table A17, p. 159 for 2004-2030, and Table A19, p. 161 for households; and DOC, Statistical Abstract of the United States 2006, Jan. 2006, Table No. 945, p. 626 for 1980-2000 households.

1.2.5 2001 Residential *Delivered* Energy Consumption Intensities, by Vintage

Year	Per Square Foot (10^3 Btu)	Per Household (10^6 Btu)	Per Household Member (10^6 Btu)	Percent of Total Consumption
Prior to 1970	51.6	100.7	40.3	56%
1970 to 1979	45.5	79.0	31.6	15%
1980 to 1989	41.4	79.7	31.9	15%
1990 to 1999	38.5	91.3	31.2	13%
2000 to 2001	36.6	111.1	32.9	1%
Average	46.7	92.2	36.0	

Source(s): EIA, A Look at Residential Energy Consumption in 2001, April 2004, Table CE1-6.1u and TableCE1-6.2u.

1.2.6 2001 Residential *Delivered* Energy Consumption Intensities, by Housing Type

Type	Per Square Foot (10^3 Btu)	Per Household (10^6 Btu)	Per Household Members (10^6 Btu)	Percent of Total Consumption
Single-Family:	**44.8**	**107.3**	**39.8**	**80.1%**
- Detached	44.7	108.5	39.6	69.4%
- Attached	45.6	100.4	37.5	10.7%
Multi-Family:	**52.1**	**54.3**	**25.8**	**14.6%**
- 2 to 4 units	56.1	78.1	34.3	7.5%
- 5 or more units	48.5	41.0	20.5	7.1%
Mobile Homes	**72.0**	**75.9**	**29.4**	**5.3%**
				100%

Source(s): EIA, A Look at Residential Energy Consumption in 2001, April 2004, Table CE1-6.1u and Table CE1-6.2u.

1.2.7 2001 Residential *Delivered* Energy Consumption Intensities, by Census Region

Region	Per Square Foot (10^3 Btu)	Per Household (10^6 Btu)	Per Household Members (10^6 Btu)	Percent of Total Consumption
Northeast	50.4	106.6	42.3	22%
Midwest	53.6	116.7	46.0	29%
South	44.8	82.5	32.1	33%
West	42.5	70.1	24.7	17%
				100%

Source(s): EIA, A Look at Residential Energy Consumption in 2001, April 2004, Table CE1-9c, Table CE1-10c, Table CE1-11c, Table CE1-12c, Table HC1-9a, Table HC1-10a, Table HC1-11a, Table HC1-12a, Table HC2-9a, Table HC2-10a, Table HC2-11a, and Table HC2-12a.

1.2.8 1997 Residential *Delivered* Energy Consumption Intensities, by Ownership of Unit

Ownership	Per Square Foot (10^3 Btu)	Per Household (10^6 Btu)	Per Household Members (10^6 Btu)	Percent of Total Consumption
Owned	**58.3**	**114.7**	**43.3**	**77%**
Rented	**70.3**	**72.5**	**29.4**	**23%**
- Public Housing	62.7	51.0	25.3	2%
- Not Public Housing	70.9	74.8	29.8	22%
				100%

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

1.2.9 Aggregate Residential Building Component Loads as of 1998 (1)

Component	Loads (quads) and Percent of Total Loads: Heating		Cooling	
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%
NET Load	-3.99	100%	1.08	100%

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, November 1998, Figure P-1, P-1 and Appendix C: Component Loads Data Tables.

1.2.10 1997 Residential *Delivered* Energy Consumption Intensities, by Principal Building Type and Vintage

Building Type	Consumption (10^3 Btu/SF) Pre-1990	Consumption (10^3 Btu/SF) 1990-1997	Consumption (10^6 Btu/Hhold) Pre-1990	Consumption (10^6 Btu/Hhold) 1990-1997	Consumption (10^6 Btu/Member) Pre-1990	Consumption (10^6 Btu/Member) 1990-1997
Single-Family	**60.9**	**45.1**	**115.4**	**108.4**	**42.6**	**36.8**
- 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
Multi-Family	**69.0**	**42.6**	**61.1**	**40.8**	**28.8**	**22.4**
- 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
Mobile Homes	**92.2**	**50.6**	**81.7**	**70.9**	**50.5**	**45.2**

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

1.3.1 Commercial Primary Energy Consumption, by Year and Fuel Type (quads and percents of total)

	Natural Gas		Petroleum (1)		Coal		Renewable(2)		Electricity Sales	Electricity Losses		Electricity Total		TOTAL (2)		Growth Rate 2004-Year
1980	2.67	25%	1.29	12%	0.12	1%	0.02	**0%**	1.91	4.60		6.51	61%	10.6	100%	-
1990	2.70	20%	0.95	7%	0.12	1%	0.10	**1%**	2.86	6.62		9.48	71%	13.35	100%	-
2000	3.25	19%	0.76	4%	0.09	1%	0.13	**1%**	3.96	9.00		12.96	75%	17.18	100%	-
2004	**3.09**	**18%**	**0.79**	**5%**	**0.09**	**1%**	**0.11**	**1%**	**4.19**	**9.13**	(3)	**13.32**	**77%**	**17.40**	**100%**	-
2010	3.18	16%	0.77	4%	0.09	0%	0.12	1%	4.88	10.51		15.39	79%	19.54	100%	2.0%
2015	3.46	16%	0.78	4%	0.09	0%	0.12	1%	5.43	11.37		16.81	79%	21.26	100%	1.8%
2020	3.68	16%	0.79	3%	0.09	0%	0.12	1%	6.01	12.35		18.36	80%	23.05	100%	1.8%
2025	3.89	16%	0.80	3%	0.09	0%	0.12	0%	6.63	13.32		19.95	80%	24.85	100%	1.7%
2030	4.11	15%	0.82	3%	0.09	0%	0.13	0%	7.34	14.29		21.63	81%	26.77	100%	1.7%

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) 2004 *site*-to-source electricity conversion = 3.18.

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 for 2004-2030 and Table A17, p. 159 for non-marketed renewable energy.

1.3.2 Commercial *Site* Renewable Energy Consumption (quads) (1)

	Wood (2)	Solar Thermal (3)	Solar PV(3)	GHP (4)	Total	Growth Rate 2004-Year
1980	0.0210	N.A.	N.A.	N.A.	0.0210	-
1990	0.0940	N.A.	N.A.	0.0030	0.0030	-
2000	0.1190	N.A.	N.A.	0.0080	0.0080	-
2004	**0.0869**	**0.0248**	**0.0008**	**N.A.**	**0.1125**	-
2010	0.0869	0.0266	0.0035	N.A.	0.1170	0.7%
2015	0.0869	0.0279	0.0038	N.A.	0.1186	0.5%
2020	0.0869	0.0281	0.0042	N.A.	0.1192	0.4%
2025	0.0869	0.0283	0.0050	N.A.	0.1202	0.3%
2030	0.0869	0.0285	0.0100	N.A.	0.1254	0.4%

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 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2006, Feb. 2005, Table A17, p. 159 for 2004-2030.

1.3.3 2004 Commercial Energy End-Use Splits, by Fuel Type (quads)

	Natural Gas	Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (4)	Primary Total	Primary Percent
Lighting						1.34	1.34	16.2%	4.26	4.26	24.5%
Space Heating	1.20	0.31		0.11		0.21	1.84	22.2%	0.66	2.29	13.2%
Space Cooling	0.01					0.58	0.59	7.2%	1.85	1.86	10.7%
Refrigeration						0.35	0.35	4.2%	1.10	1.10	6.3%
Water Heating	0.54	0.07			0.02	0.14	0.78	9.4%	0.45	1.09	6.2%
Ventilation						0.32	0.32	3.9%	1.01	1.01	5.8%
Electronics						0.31	0.31	3.8%	0.99	0.99	5.7%
Computers						0.14	0.14	1.7%	0.44	0.44	2.5%
Cooking	0.26					0.03	0.29	3.5%	0.10	0.36	2.1%
Other (5)	0.28	0.02	0.10	0.05	0.09	0.39	0.92	11.1%	1.23	1.76	10.1%
Adjust to SEDS (6)	0.80	0.22				0.38	1.40	16.9%	1.21	2.23	12.8%
Total	3.09	0.62	0.10	0.16	0.11	4.19	8.27	100%	13.32	17.40	100%

Note(s): 1) Includes (0.50 quad) distillate fuel oil and (0.12 quad) residual fuel oil. 2) Kerosene (0.02 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 (0.09 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, automated teller machines, 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, AEO 2006, Feb. 2005, Tables A2, p. 134-136, Table A5, p. 141-142, and Table A17, p. 259; EIA, AEO 1999, Dec. 1998, Table A5, p. 120 for 1996 refrigeration; EIA, National Energy Modeling System for AEO 2006, Feb. 2006; 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; BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, 1. Sept. 2002, Table 8-2, p. 63; and OBT/A.D. Little, Energy Savings Potential for Commercial Refrigeration Equipment, June 1996, Figure 1-1, p. 1-1.

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

		Floorspace (10^9 SF)	Percent Post-2000 Floorspace (1)	*Delivered* Energy Consumption Total (quads)	*Delivered* Energy Consumption per SF (10^3 Btu/SF)	Primary Energy Consumption Total (quads)	Primary Energy Consumption per SF (10^3 Btu/SF)
1980		50.9	N.A.	6.0	117.8	10.6	208.2
1990		64.3	N.A.	6.7	104.7	13.4	207.7
2000	(2)	68.5	N.A.	8.2	119.4	17.2	250.8
2004	**(2)**	**75.0**	**10%**	**8.3**	**110.2**	**17.4**	**231.8**
2010	(2)	82.3	15%	9.0	109.7	19.5	237.4
2015	(2)	88.9	25%	9.9	111.2	21.3	239.1
2020	(2)	96.0	44%	10.7	111.5	23.0	240.2
2025	(2)	103.7	52%	11.5	111.3	24.9	239.8
2030	(2)	112.0	60%	12.5	111.4	26.8	238.9

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 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; DOE for 1980 floorspace; EIA, AEO 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 2006, Feb. 2006, Table A2, p. 134-136, Table A5, p. 141-142, and Table A17, p.159 for 2004-2030.

1.3.5 Commercial *Delivered* Energy Consumption Intensities, by Vintage (1)

Year Constructed	Consumption Per Square Foot (10^3 Btu/SF)	Percent of Total Consumption
Prior to 1960	82.9	36.1%
1960 to 1969	90.9	13.8%
1970 to 1979	95.0	15.0%
1980 to 1989	100.1	15.8%
1990 to 1999	88.8	11.1%
2000 to 2003	79.7	8.2%
Average	88.4	

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.

1.3.6 2003 Commercial *Delivered* Energy Consumption Intensities, by Principal Building Type and Vintage (1)

Building Type	Consumption (10^3 Btu/SF) Pre-1990	Consumption (10^3 Btu/SF) 1990-2003	Building Type	Consumption (10^3 Btu/SF) Pre-1990	Consumption (10^3 Btu/SF) 1990-2003
Food Service	212.0	361.2	Education	83.8	80.6
Health Care	204.5	135.7	Service	77.7	74.8
Inpatient	248.5	253.8	Retail (Other than Malls)	67.5	86.4
Outpatient	103.3	84.4	Religious Worship	43.5	43.3
Food Sales	200.2	198.3	Public Order and Safety	N.A.	110.6
Lodging	103.9	88.1	Warehouse and Storage	N.A.	33.3
Office	94.2	88.0	Other	189.7	125.3
Public Assembly	84.7	119.7	Vacant	22.3	N.A.

Note(s): 1) See Table 1.3.4 for primary versus *delivered* energy consumption. 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 C8.

1.3.7 2003 Commercial Primary Energy Consumption Intensities, by Principal Building Type (1)

Building Type	Consumption (10^3 Btu/SF)	Percent of Total Consumption	Building Type	Consumption (10^3 Btu/SF)	Percent of Total Consumption
Food Service	522.4	7%	Education	159.0	13%
Health Care	345.9	9%	Service	151.6	5%
Inpatient	438.8	7%	Mercantile (2)	172.6	6%
Outpatient	205.9	2%	Religious Worship	77.0	2%
Food Sales	535.5	6%	Public Order and Safety	221.1	2%
Lodging	193.1	8%	Warehouse and Storage	94.3	8%
Office	211.7	22%	Other	318.8	5%
Public Assembly	180.0	6%	Vacant	33.1	1%

Note(s): 1) Mall buildings are no longer included in most CBECs tables; therefore, some data is not directly comparable to past CBECs.
2) Other than malls.
Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, June 2006, Table C1.

1.3.8 2003 Commercial *Delivered* Energy Consumption Intensities, by Ownership of Unit (1)

Ownership	Consumption (10^3 Btu/SF)	Percent of Total Consumption
Nongovernment Owned	**85.1**	**72.2%**
Owner-Occupied	87.3	35.4%
Nonowner-Occupied	88.4	36.3%
Government Owned	**105.3**	**27.8%**
		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.

1.3.9 Aggregate Commercial Building Component Loads as of 1998 (1)

Component	Loads (quads) and Percent of Total Loads: Heating		Cooling	
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%
NET Load	-0.442	100%	0.963	100%

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.

1.3.10 1995 Commercial *Delivered* End-Use Energy Consumption Intensities, by Principal Building Type (1)

Building Type	Consumption (10^3 Btu/SF): Space Heating	Space Cooling	Water Heating	Lighting	Total (2)	Percent of Total Consumption
Office	24.3	9.1	8.7	28.1	90.5	21%
Mercantile and Service	30.6	5.8	5.1	23.4	69.6	14%
Education	32.8	4.8	17.4	15.8	75.0	12%
Health Care	55.2	9.9	63.0	39.3	176.4	10%
Lodging	22.7	8.1	51.4	23.2	99.5	8%
Public Assembly	53.6	6.3	17.5	21.9	81.7	7%
Food Service	30.9	19.5	27.5	37.0	241.2	8%
Warehouse and Storage	15.7	0.9	2.0	9.8	44.0	9%
Food Sales	27.5	13.4	9.1	33.9	202.2	4%
Vacant (3)	36.0	1.4	5.2	4.7	26.4	3%
Public Order and Safety	27.8	6.1	23.4	16.4	86.9	2%
Other (4)	59.6	9.3	15.3	26.7	144.0	3%
All Buildings	29.0	6.0	13.8	20.4	90.5	100%

Note(s): 1) Further detail can be found in Table 7.4.1. Parking garages and commercial buildings on multibuilding manufacturing facilities are excluded from CBECS 1995. 2) Includes all end-uses. 3) Includes vacant and religious worship. 4) Includes mixed uses, hangars, crematoriums, laboratories, and other.
Source(s): EIA, Commercial Building Energy Consumption and Expenditures 1995, April 1998, Table EU-2, p. 311.

1.4.1 FY 2004 Federal Primary Energy Consumption

Buildings and Facilities	**0.67 quads**	
Vehicles/Equipment/Energy-Intensive Operations	0.99 quads	(mostly jet fuel and diesel)
Total Federal Government Consumption	1.65 quads	

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, February 2006, Table 1-A, A-2 for total consumption and Table 4-A, p. A-7 for buildings consumption.

1.4.2 FY 2004 Federal Building Energy Use Shares, by Fuel Type Agency

Fuel Type	*Site* Percent	Primary Percent	Agency	Primary Percent		FY 2004 Quads
Electricity	45.6%	73.5%	Defense	61.2%	Total *Delivered*	
Natural Gas	33.9%	16.5%	Postal	9.5%	Energy Consumption =	0.31
Fuel Oil	10.0%	4.9%	DOE	5.4%	Total Primary	
Coal	4.1%	2.0%	VA	8.2%	Energy Consumption =	0.67
Other	6.4%	3.1%	GSA	4.6%		
	100%	100%	Other	11.1%		
				100%		

Note(s): See Table 2.3.1 for floorspace.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, September 2004, Table 5, p. A-9 for fuel types, and Table 4-A, p. A-7 for agency consumption.

1.4.3 Federal Building *Delivered* Energy Consumption Intensities, by Year (1)

Year	Consumption per Gross Square Foot (10^3 Btu/SF)	Year	Consumption per Gross Square Foot (10^3 Btu/SF)
FY 1985	139.4	FY 1996	115.0
FY 1986	132.3	FY 1997	111.9
FY 1987	137.4	FY 1998	101.9
FY 1988	137.2	FY 1999	106.7
FY 1989	133.1	FY 2000	104.8
FY 1990	125.9	FY 2001	105.9
FY 1991	123.9	FY 2002	104.4
FY 1992	125.7	FY 2003	105.2
FY 1993	122.5	FY 2004	104.9
FY 1994	120.4	FY 2005 (3)	97.6
FY 1995 (2)	117.3	FY 2010 (3)	90.6

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) Executive Order 13123 goal.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, September 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, August 2005, Table 6-A, p. A-10 for 2003; DOE/FEMP, Annual Report to Congress on FEMP, February 2006, Table 6-A, p. A-10 for 2004; and DOE/FEMP for remaining data.

1.5.1 Buildings Share of U.S. Electricity Consumption/Sales (percent)

	Residential	Commercial	**Total Buildings**	Industry	Transportation	TOTAL	*Delivered* Total (quads)
1980	34%	27%	61%	39%	0%	100%	7.1
1990	34%	31%	65%	35%	0%	100%	9.3
2000	35%	34%	69%	31%	0%	100%	11.7
2004 (1)	**36%**	**34%**	**71%**	**29%**	**1%**	**100%**	**12.2**
2010	37%	36%	73%	27%	1%	100%	13.6
2015	37%	37%	74%	26%	1%	100%	14.7
2020	37%	38%	75%	25%	1%	100%	15.8
2025	36%	39%	75%	24%	1%	100%	16.9
2030	36%	40%	76%	24%	1%	100%	18.2

Note(s): 1) Buildings accounted for 80% (or $207 billion) of total U.S. electricity expenditures.

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 for 2004-2030 consumption, and Table A3, p. 137-138 expenditures.

1.5.2 U.S. Electricity Generation Input Fuel Shares (percent)

				Renewables				Net Electric	
	Natural Gas	Petroleum	Coal	Hydro.	Oth(2)	Total	Nuclear	Imports	Total
1980	16%	11%	50%	12%	0%	12%	11%	(1)	100%
1990	11%	4%	53%	10%	2%	12%	20%	(1)	100%
2000	14%	3%	53%	7%	2%	9%	21%	(1)	100%
2004	**14%**	**3%**	**52%**	**7%**	**2%**	**9%**	**21%**	**0%**	**100%**
2010	13%	2%	54%	7%	4%	11%	20%	0%	100%
2015	16%	2%	51%	7%	4%	11%	19%	0%	100%
2020	16%	2%	52%	6%	5%	11%	19%	0%	100%
2025	14%	2%	54%	6%	6%	12%	18%	0%	100%
2030	12%	2%	57%	6%	6%	12%	17%	0%	100%

Note(s): 1) Electric imports included in renewables. 2) Includes geothermal, municipal solid waste, biomass, solar thermal, solar photovoltaic, and wind.

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 for 2004-2030 consumption and Table A17, p. 159 for renewables.

1.5.3 U.S. Electricity Generation Input Fuel Consumption (quads)

				Renewables				Net Electric		Growth Rate
	Natural Gas	Petroleum	Coal	Hydro.	Oth(2)	Total	Nuclear	Imports	Total	2004-Year
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	2.77	0.64	3.41	6.10	(1)	30.64	-
2000	5.32	1.14	20.22	2.80	0.75	3.55	7.86	(1)	38.06	-
2004	**5.45**	**1.12**	**20.26**	**2.67**	**0.89**	**3.57**	**8.23**	**0.04**	**38.67**	-
2010	5.65	0.97	22.92	2.98	1.78	4.76	8.44	0.07	42.82	1.7%
2015	7.32	0.96	23.35	2.99	2.03	5.01	8.66	0.08	45.38	1.5%
2020	7.65	0.97	25.02	2.99	2.48	5.47	9.09	0.05	48.24	1.4%
2025	7.23	1.00	27.54	2.99	2.96	5.95	9.09	0.05	50.86	1.3%
2030	6.54	6.54	30.74	2.99	3.23	6.22	9.09	0.05	53.71	1.3%

Note(s): 1) Electric imports included in renewables. 2) Includes geothermal, municipal solid waste, biomass, solar thermal, solar photovoltaic, and wind.

Source(s): EIA, State Energy Data 2002: Consumption, June 2006, Tables 8-12, p. 18-22 for 1980-2000; and EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 for 2004-2030 consumption and Table A17, p. 159 for renewables.

1.5.4 U.S. Electricity Net Generation, by Plant Type (Billion Kilowatthours)

				Renewables						Growth Rate
	Natural Gas	Petroleum	Coal	Hydr(1)	Oth(2)	Total	Nuclear	CHP(3)	Tot.(4)	2004-year
1980	346	246	1162	276	6	282	251	N.A.	2286	-
1990	265	118	1560	286	42	324	577	61	2901	-
2000	399	98	1852	266	50	316	754	165	3638	-
2004	**486**	**110**	**1916**	**269**	**54**	**323**	**789**	**182**	**3794**	**-**
2010	533	90	2164	288	81	370	809	176	4196	1.7%
2015	743	89	2209	300	93	416	829	195	4501	1.6%
2020	814	90	2405	301	115	416	871	189	4827	1.5%
2025	775	93	2728	301	133	434	871	177	5121	1.4%
2030	691	99	3178	301	133	434	871	164	5497	1.4%

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) 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, AEO 2006, Feb. 2006, Table A8, p147-148; EIA, Annual Energy Review 2003, Sept. 2004, Table 8.2c, p. 226; EIA, Annual Energy Review 2002, Oct. 2003, Table 8.2b, p. 149, for 1980 data.

1.5.5 U.S. Electric Utility and Nonutility Net Summer Electricity Generation Capacity (GW)

Electric Generator	1990	2000	2004	2010	2015	2020	2025	2030
Coal Steam	300	305	305	314	315	341	386	453
Other Fossil Steam	144	135	124	122	86	80	79	75
Combined Cycle	7	29	126	151	157	181	193	198
Comb. Turbine/Diesel	46	79	127	136	136	146	156	171
Nuclear Power (1)	100	98	100	101	104	109	109	109
Pumped Storage	18	20	21	21	21	21	21	21
Fuel Cells	0	0	0	0	0	0	0	0
Conv. Hydropower	75	78	78	78	78	78	78	78
Geothermal	3	3	2	3	3	5	6	7
Municipal Solid Waste	2	3	3	4	4	4	4	4
Biomass	7	2	2	2	2	2	3	5
Solar Thermal	0	0	0	0	0	1	1	1
Solar Photovoltaic	0	0	0	0	0	0	0	0
Wind	2	2	7	16	18	19	20	20
Distributed Generation	N.A.	0	0	0	1	1	2	6
Total	703	754	895	947	924	987	1057	1146

Note(s): 1) Nuclear capacity includes 3 GW of uprates from 2004 to 2030. New nuclear plants are expected to come on-line 2013-2019.

Source(s): EIA, AEO 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 2006, Feb. 2006, Table A9, p. 149-150 and Table A16, p. 158 for 2004-2030.

1.5.6 U.S. Electric Power Sector Cumulative Power Plant Additions Needed to Meet Future Electricity Demand (1)

Electric Generator	Typical New Plant Capacity (MW)	Number of New Power Plants to Meet Demand 2005	2010	2020	2025	2030
Coal Steam	550	21	30	77	158	281
Combined Cycle	400	64	78	139	169	181
Combustion Turbine/Diesel	160	63	106	167	229	322
Nuclear Power (2)	1000	0	2	6	6	6
Pumped Storage (2)	133 (3)	0	0	0	0	0
Fuel Cells	10	0	0	0	0	0
Conventional Hydropower	29 (3)	1	3	8	8	8
Geothermal	50	9	21	50	78	90
Municipal Solid Waste	30	10	14	18	21	22
Wood and Other Biomass	80	2	2	6	18	33
Solar Thermal	100	1	1	1	1	2
Solar Photovoltaic	5	9	22	38	55	73
Wind	50	188	217	239	259	265
Total		368	496	749	1003	1282
Distributed Generation	2	1	4	9	15	34

Note(s): 1) Cumulative additions after December 31, 2004. 2) Nuclear capacity includes 3 GW of uprates from 2004 to 2030. New nuclear plants are expected to come on-line 2013-2019. 3) Based on current stock average capacity.

Source(s): EIA, AEO 2006, Feb. 2006, Table A9, p. 149-150 and Table A16, p. 158; EIA, Assumption to the AEO 2006, Feb. 2006, Table 38, p. 73; EIA, Electric Power Annual 2002, Dec. 2003, Table 2.6, p. 18; and EIA, Inventory of Electric Utility Power Plants in the U.S. 2000, March 2002, Table 1, p. 9.

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

	Households (millions)	Percent Post-2000 Households (1)	Buildings (millions)	Floorspace (billion sf)	U.S. Population (millions)	Average Household Size (2)
1980	79.6	N/A	65.5	142.5	227	2.9
1990	94.2	N/A	74.2	169.2	250	2.6
2000	105.7	N/A	82.6 (3)	168.8 (3)	282	2.7
2004	**113.6**	**7%**	**N.A.**	**N.A.**	**291**	**2.6**
2010	122.9	16%	N.A.	N.A.	296	2.4
2015	130.1	23%	N.A.	N.A.	322	2.5
2020	137.2	29%	N.A.	N.A.	336	2.4
2025	143.5	34%	N.A.	N.A.	349	2.4
2030	149.8	38%	N.A.	N.A.	364	2.4

Note(s): 1) Percent built after December 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. 2006, Jan. 2006, No. 945, p. 626 1980-2000 households, No. 2-3, p. 8-9 for population; EIA, AEO 2006, Feb. 2006, Table A4, p. 139-140 for 2004-2030 households and Table A19, p. 161 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.

2.1.2 Share of Households, by Housing Type and Type of Ownership as of 2001 (percent)

Housing Type	Owned	Rented	Total
Single-Family:	**59.1%**	**9.8%**	**68.9%**
-Detached	52.1%	6.9%	59.0%
-Attached	7.0%	2.9%	9.9%
Multi-Family:	**3.6%**	**21.1%**	**24.8%**
- 2 to 4 units	2.0%	6.9%	8.9%
- 5 or more units	1.7%	14.2%	15.9%
Mobile Homes	**5.3%**	**1.0%**	**6.4%**
	68.0%	32.0%	100%

Source(s): EIA, A Look at Residential Energy Consumption in 2001, Oct. 2003, Table HC1-2a.

2.1.3 Share of Households, by Census Region and Vintage as of 2001 (percent)

Region	Prior to 1970	1970 to 1979	1980 to 1989	1990 to 2001	Total
Northeast	13.3%	2.0%	2.2%	1.4%	18.9%
Midwest	13.5%	3.4%	3.4%	2.6%	22.9%
South	13.8%	7.2%	8.3%	7.1%	36.3%
West	10.3%	5.0%	3.2%	3.4%	21.8%
					100%

Source(s): EIA, A Look at Residential Energy Consumption in 2001, Oct. 2003, Table HC1-2a.

2.1.4 Residential Floorspace (heated square feet) as of 2001 (percent of total households)

Fewer than 500	3.6%
500 to 999	20.4%
1,000 to 1,499	21.2%
1,500 to 1,999	15.5%
2,000 to 2,499	12.6%
2,500 to 2,999	8.7%
3,000 to 3,499	6.4%
3,500 to 4,000	3.8%
4,000 or more	7.7%
Total	100%

Note(s): The 2001 average new single-family housing floorspace was 2,324 square feet.

Source(s): EIA, A Look at Residential Energy Consumption in 2001, Oct. 2003, Table CE11-6.1u; DOC, Construction Statistics: Characteristics of New Housing: 2002, Median and Average Square Feet of Floor Area in New One-Family Houses Completed by Location for average new square footage.

2.1.5 Housing Vintage as of 2001

Vintage	
1949 or Before	25%
1950 to 1959	13%
1960 to 1969	13%
1970 to 1979	18%
1980 to 1989	17%
1990 to 2001	14%
	100%

Source(s): EIA, A Look at Residential Energy Consumption in 2001, Oct. 2003, Table HC1-2a.

2.1.6 Construction Statistics of New Homes Completed/Placed

	Single-Family		Multi-Family		Mobile Homes	Total
	1000 Units	Average SF	1000 Units	Average SF	1000 Units	1000 Units
1971	1014	1520	692	1011	N.A.	N.A.
1975	875	1645	442	1000	229	1547
1980	957	1740	545	979	234	1735
1981	819	1720	447	980	229	1495
1985	1073	1073	631	922	283	1987
1986	1120	1825	636	911	256	2012
1990	966	2080	342	1005	195	1503
1991	838	2075	253	1020	174	1265
1992	964	2095	194	1040	212	1370
1993	1039	2095	153	1065	242	1435
1994	1160	2100	187	1035	304	1651
1995	1066	2095	247	1080	340	1652
1996	1129	2120	284	1070	338	1751
1997	1116	2150	284	1095	336	1737
1998	1160	2190	315	1065	374	1848
1999	1270	2225	335	1105	338	1943
2000	1242	2266	332	1092	281	1855
2001	1256	2324	315	1122	196	1767
2002	1325	2320	323	1104	174	1823
2003	1386	2330	292	1117	140	1818
2004	1532	2140	310	1118	124	1967
2005	1636	2227	296	1149	123	2054

Source(s): U.S. Census Bureau, Manufacturing, Mining and Construction Statistics, New Residential Construction: New Privately Owned Housing Units Completed for 1999-2005 single and multi-family unit; DOC, Current Construction Reports: Housing Completions - Annual Data, March 2001 for 1980-1998 single- and multi-family units; DOC, Manufactured Housing Statistics: Manufactured Homes Placements by Region, Nov. 2000 for 1980-1993 mobile homes; DOC Manufactured Housing Statistics: Manufactured Homes Placements by Region and Size of Home 1994-2001 for 1994; DOC, Manufactured Housing Statistics: Manufactured Homes Placements by Region, June 2006 for 1995-2005; NAHB, Housing Economics, March 1995 for 1981-1993 average floorspace; NAHB, Housing Facts, Figures and Trends, 1997 for 1971 and 1975, Characteristics of New Single Family Homes, p. 7; NAHB, Housing Facts, Figures and Trends, 1997 for 1971 and 1975, Characteristics of Multifamily Buildings, p. 7; DOC, Current Construction Reports: Characteristics of New Housing, C25/98-A, Table 16, p. 37 and Table 18, p. 44 for 1994 floorspace; DOC, Current Construction Reports: Characteristics of New Housing, C25/99-A, Table 16, p. 37 and Table 18, p. 44 for 1995-1999 floorspace; DOC Characteristics of New One-Family Houses Completed, May 2004 for 2000-2005 floorspace; and, DOC, Characteristics of New Multifamily Units Completed by Square Foot per Unit for 2003-2005 multi-family average square footage.

2.1.7 Materials Used in the Construction of a 2,272-Square-Feet Single-Family Home, 2000

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

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

2.1.8 2005 New Homes Completed/Placed, by Census Region (thousand units and percent of total units by housing type)(1)

	Single-Family		Multi-Family		Mobile Homes		
Region	Units	% of Total	Units	% of Total	Units	% of Total	Total
Northeast	132	8%	38	13%	9	7%	179
Midwest	307	19%	45	15%	17	14%	369
South	761	46%	143	49%	68	55%	972
West	437	27%	69	23%	28	23%	534
Total	1,636	100%	295	100%	123	100%	2,054

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, March 2006 for mobile home placements.

2.1.9 2005 Construction Method of Single-Family Homes, by Region (thousand units and percent of total units by construction method)

	Stick Built		Modular		Panelized/Precut		
Region	Units	% of Total	Units	% of Total	Units	% of Total	Total
Northeast	112	7%	15	34%	5	19%	132
Midwest	288	18%	13	30%	6	23%	307
South	734	47%	14	32%	14	54%	760
West	432	28%	2	5%	2	8%	437
Total	1,565	100%	44	100%	26	100%	1,636

Source(s): DOC, Manufacturing, Mining and Construction Statistics, New Residential Construction: Type of Construction Method of New One-Family Houses Completed, March 2006.

2.2.1 Total Commercial Floorspace and Number of Buildings, by Year

	Commercial Sector Floorspace (10^9 square feet)	Percent Post-2000 Floorspace (2)	Buildings (10^6)
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)
2003 (4)	**75.0**	**10%**	N.A.
2005 (4)	82.3	15%	N.A.
2010 (4)	88.9	25%	N.A.
2020 (4)	96.0	44%	N.A.
2025 (4)	103.7	52%	N.A.

Note(s): 1) Based on PNNL calculations. 2) Percent built after December 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 = 64.6 billion square feet.

Source(s): EIA, AEO 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 2005, Feb. 2005, Table A5, p. 147-148 for 2003-2025 floorspace; EIA Commercial Building Characteristics 1989, June 1991, Table A4, p. 17 for 1990 number of buildings; EIA, Commercial Building Characteristics 1999, August 2002, Table 3 for 1999 number of buildings and floorspace; and EIA, Buildings and Energy in the 1980's, June 1995, Table 2.1, p. 23 for number of buildings in 1980.

2.2.2 Principal Commercial Building Types as of 2003 (percent of total floor space) (1)

	Total Floorspace	Total Buildings	Primary Energy Consumption
Office	19%	17%	6%
Warehouse/Storage	16%	12%	8%
Mercantile (2)	7%	14%	6%
Education	15%	8%	14%
Public Assembly	6%	6%	2%
Lodging	8%	3%	8%
Service	6%	13%	22%
Health Care (3)	5%	3%	9%
Food Service	3%	6%	7%
Public Order/Safety	2%	1%	2%
Food Sales	2%	5%	6%
Vacant (4)	10%	11%	6%
Other (5)	3%	2%	4%
	100%	100%	100%

Note(s): 1) For primary energy intensities by building type, see Table 1.3.7. Total CBECS 1999 commercial building floorspace is 64.8 billion square feet. 2) Does not include encolosed and strip malls. 3) Health Care includes Inpatient (3%) and Outpatient Health Care (2%). 4) Includes Vacant (4%) and Religious Worship (6%). 5) Includes mixed uses, hangars, crematoriums, laboratories, and other.

Source(s): EIA, Commercial Building Characteristics 2003, June 2006, Table A1 and Table C1.

2.2.3 Number of Floors and Type of Ownership as of 2003 (percent of total floorspace)

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

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

2.2.4 Share of Commercial Floorspace, by Census Region and Vintage as of 2003 (percent)

Region	Prior to 1980	1980 to 1989	1990 to 1999	2000 to 2003	Total
Northeast	11%	3%	5%	2%	20%
Midwest	16%	3%	5%	2%	26%
South	23%	5%	5%	3%	36%
West	11%	2%	4%	2%	18%
					100%

Source(s): EIA, Commercial Building Characteristics 2003, June 2006, Table B3.

2.2.5 Commercial Building Size as of 2003 (percent of total floorspace)

Square Foot Range	Percent	Total Number of Buildings (1000s)
1,001 to 5,000	11.9%	2552
5,001 to 10,000	11.6%	889
10,001 to 25,000	20.2%	738
25,001 to 50,000	1.5%	241
50,001 to 100,000	15.9%	129
100,001 to 200,000 (2)	15.9%	65
200,001 to 500,000 (2)	12.6%	25
Over 500,000 (2)	10.4%	7
	100%	4657

Note(s): 1) 38.9% of commercial floorspace is found in 2.1% of commercial buildings that are larger than 100,000 square feet.
Source(s): EIA, Commercial Building Characteristics 2003, June 2003, Table B2.

2.2.6 Commercial Building Vintage as of 2003

	Percent of Total Floorspace
Prior to 1960	25%
1960 to 1979	27%
1980 to 1989	15%
1990 to 1999	25%
2000 to 2003	8%
	100%

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

2.2.7 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 2006, Feb. 2006, Table 12, p. 30; EIA, Model Documentation Report: Commercial Sector Demand Module of the National Energy Modeling System, March 2006, p. 32-36; and PNNL, Memorandum: New Constructionin the Annual Energy Outlook 2003, April 24, 2003 for Note 2.

2.2.8 2003 Average Commercial Building Floorspace, by Principal Building Type and Vintage (1)

	Average Floorspace/Building (1000 SF)			
Building Type	Pre-1990	1990-1999	2000-2003	All
Mercantile and Service	7.9	15.9	23.9	9.7
Education	27.2	20.6	24.3	25.6
Warehouse/Storage	15.8	16.6	13.4	16.9
Office	15.6	13.5	16.7	14.8
Public Assembly	28.3	17.5	16.7	14.2
Lodging	35.8	26.9	81.5	35.9
Health Care	N.A.	36.0	N.A.	24.5
Food Service	N.A.	5.8	N.A.	5.6
Food Sales	N.A.	5.0	N.A.	5.6
Public Order and Safety	N.A.	15.6	N.A.	15.4
Service	6.4	7.1	6.3	6.5
Vacant (2)	N.A.	N.A.	N.A.	12.8

Note(s): 1) Parking garages and commercial buildings on multibuilding manufacturing facilities are excluded from CBECS 1999. 2) Includes vacant and religious worship.

Source(s): EIA, Commercial Building Energy Consumption and Expenditures 1999, July 2002, Tables 3 and 8; and EIA, Commercial Buildings Characteristics 1999, Table A10, p. 70 for buildings.

2.3.1 Federal Building Gross Floorspace, by Year and Agency

	Floorspace (10^9 square feet)
FY 1985	3.37
FY 1986	3.38
FY 1987	3.40
FY 1988	3.23
FY 1989	3.30
FY 1990	3.40
FY 1991	3.21
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

Agency	2004 Percent of Total Floorspace
Defense	65.3%
Postal	11.8%
GSA	5.9%
VA	5.2%
DOE	2.4%
Other	9.5%
	100%

Note(s): The Federal Government owns/operates over 500,000 buildings, including 422,000 housing structures (for the military) and 51,000 non-residential 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, December 11, 2002, Table 8-A, p. 83 for FY 1985 and FY 2000; DOE/FEMP, Annual Report to Congress on FEMP, February 4, 2004, Table 8-A, p. 66 for 2001; DOE/FEMP, Annual Report to Congress on FEMP, September 29, 2004, Table 8-A, p. 65 for 2002; DOE/FEMP, Annual Report to Congress on FEMP, August 9, 2005, Table 6-A, p. 65 for 2003; and DOE/FEMP, Annual Report to Congress on FEMP, Febrary 24, 2006, Table 6-A, p. A-10 for 2004.

3.1.1 Carbon Dioxide Emissions for U.S. Buildings, by Year (10^6 metric tons of carbon) (1)

	Buildings				U.S.			
	Site Fossil	Electricity	Total	Growth Rate 2004-Year	Total	Growth Rate 2004-Year	Buildings % of Total U.S.	Buildings % of Total Global
1980	172.0	255.2	427.1	-	1281.7	-	33%	8.5%
1990	153.7	317.2	470.9	-	1359.7	-	35%	8.1%
2000	167.4	426.2	593.5	-	1581.3	-	38%	9.1%
2004	**164.7** (2)	**443.4** (2)	**608.1**	-	**1610.2**	-	**38%**	**9.8%** (3)
2010	168.0	502.5	670.5	1.6%	1737.1	1.3%	39%	8.6%
2015	174.8	535.3	710.1	1.4%	1833.4	1.2%	39%	7.7%
2020	179.6	577.2	756.8	1.4%	1942.9	1.2%	39%	7.5%
2025	182.5	627.0	809.5	1.4%	2070.6	1.2%	39%	7.4%
2030	186.0	686.2	872.2	1.4%	2214.6	1.2%	39%	7.3%

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) Emissions differ from EIA, AEO 2006, Feb. 2006 by less than 0.1%. 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 AEO 2006, Mar. 2006, Table 2, p. 9 for carbon coefficients; EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 for 2004-2030 energy consumption and Table A18, p. 160 for 2004-2030 emissions; EIA, International Energy Outlook 2006, June 2006, Table A10, p. 93 for 2003-2030 global emissions; and EIA, International Energy Annual 2004, July 2006, Table H1, www.eia.doe.gov for 1980-2000 global emission.

3.1.2 2004 Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (10^6 metric tons of carbon equivalent) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Space Heating (4)	67.8	20.1	2.5	4.9	2.2	29.7	2.5	35.5	135.6	22.3%
Lighting								110.1	110.1	18.1%
Space Cooling	0.2							67.9	68.1	11.2%
Water Heating	24.4	3.7		0.9		4.6		28.6	57.7	9.5%
Refrigeration (5)								45.1	45.1	7.4%
Electronics (6)								33.2	33.2	5.5%
Cooking	6.8			0.5		0.5		13.2	20.5	3.4%
Wet Clean (7)	1.0							15.5	16.6	2.7%
Ventilation (8)								16.5	16.5	2.7%
Computers								10.8	10.8	1.8%
Other (9)	5.4	0.5		4.6	0.9	6.0		29.4	40.7	6.7%
Adjust to SEDS (10)	11.5	4.3				4.3		37.6	53.4	8.8%
Total	117.1	28.6	2.5	10.9	3.1	45.1	2.5	443.4	608.1	100%

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 2006, and differ by as much as 0.3% from EIA, AEO 2006, Table A18. Buildings sector total varies by 0.1% from EIA, AEO 2005. 2) Includes kerosene space (2.2 MMTCE) heating and motor gasoline other uses (0.9 MMTCE). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (4.2 MMTCE). 5) Includes refrigerators (24.9 MMTCE) and freezers (20.2 MMTCE). 6) Includes color television (7.2 MMTCE) and other office equipment. 7) Includes clothes washers (1.7 MMTCE), natural gas clothes dryers (1.0 MMTCE), electric clothes dryers (12.6 MMTCE), and dishwashers (1.3 MMTCE). 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, automated teller machines, telecommunications equipment, medical equipment, pumps, lighting, 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, AEO 2006, Feb. 2006, Table A2, p. 134-136, Table A4, p. 139-140 and Table A5, p. 141-142 for energy consumption, and Table A18, p. 160 for emissions; EIA, National Energy Modeling System for AEO 2006, Feb. 2006; EIA, Assumptions to the AEO 2006, Mar. 2006, Table 2, p. 9 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; OBT/A.D. Little, Energy Savings Potential for Commercial Refrigeration Equipment, June 1996, Figure 1-1, p. 1-1; EIA, AEO 1998, Dec. 1997, Table A5, p. 108-109 for 1995 data; and EIA, AEO 1999, Dec. 1998, Table A4, p. 118-119 and Table A5, p. 120-121 for 1996 data.

3.1.3 2004 Residential Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (10^6 metric tons of carbon equivalent) (1)

	Natural	Petroleum							
	Gas	Distil.	LPG	Kerosene	Total	Coal	Electricity (2)	Total	Percent
Space Heating (3)	50.4	16.2	4.9	1.7	22.9	0.3	24.8	98.4	29.8%
Water Heating	16.6	2.4	0.9		3.3		21.3	41.2	12.5%
Lighting							40.9	40.9	12.4%
Space Cooling	0.0						37.9	37.9	11.5%
Refrigeration (4)							27.1	27.1	8.2%
Electronics (5)							17.1	17.1	5.2%
Wet Clean (6)	1.0						15.5	16.6	5.0%
Cooking	3.1		0.5		0.5		11.5	15.1	4.6%
Computers							3.6	3.6	1.1%
Other (7)	1.4		3.0		3.0		9.4	13.8	4.2%
Adjust to SEDS (8)							18.1	18.1	5.5%
Total	72.5	18.7	9.2	1.7	29.6	0.3	227.4	329.8	100%

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 2006, and differ by as much as 0.2% from EIA, AEO 2006, Table A18. Buildings sector total varies by 0.1% from EIA, AEO 2006. 2) Excludes electric imports by utilities. 3) Includes furnace fans (4.2 MMTCE). 4) Includes refrigerators (20.5 MMTCE) and freezers (6.6 MMTCE). 5) Includes color television (7.2 MMTCE) and other office equipment (9.9 MTCE). 6) Includes clothes washers (1.7 MMTCE), natural gas clothes dryers (1.0 MMTCE), electric clothes dryers (12.6 MMTCE), and dishwashers (1.3 MMTCE). Does not include water heating energy. 7) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. 8) Emissions related to a discrepancy between data sources. Energy attributable to the sector, but not directly to specific end-uses.

Source(s): EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136, Table A4, p. 139-140 for energy consumption, and Table A18, p. 160 for emissions; EIA, Assumptions to the AEO 2006, Mar. 2006, Table 2, p. 9 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; and EIA, AEO 1999, Dec. 1998, Table A4, p. 118-119 for 1996 data.

3.1.4 2004 Commercial Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (10^6 metric tons of carbon equivalent) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Lighting								69.2	69.2	24.9%
Space Heating	17.4	3.8	2.5		0.5	6.9	2.2	10.8	37.2	13.4%
Space Cooling	0.2							30.0	30.1	10.8%
Refrigeration (4)								18.0	18.0	6.5%
Ventilation								16.5	16.5	5.9%
Water Heating	7.8	1.3				1.3		7.3	16.4	5.9%
Electronics								16.1	16.1	5.8%
Computers								7.2	7.2	2.6%
Cooking	3.7							1.6	5.4	1.9%
Other (5)	4.0	0.5		1.6	0.9	3.0		20.0	27.0	9.7%
Adjust to SEDS (6)	11.5	4.3				4.3		19.5	35.3	12.7%
Total	44.6	9.9	2.5	1.6	1.3	15.4	2.2	216.1	278.3	100%

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 2006, and differ by as much as 0.3% from EIA, AEO 2006, Table A18. Buildings sector total varies by 0.1% from EIA, AEO 2006. 2) Includes kerosene space (0.5 MMTCE) heating and motor gasoline other uses (0.9 MMTCE). 3) Excludes electric imports by utilities. 4) Includes refrigerators (4.4 MMTCE) and freezers (13.7 MMTCE). 5) Includes service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 6) Emissions related to a discrepancy between data sources. Energy attributable to the sector, but not directly to specific end-uses.

Source(s): EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136, Table A5, p. 141-142 for energy consumption, and Table A18, p. 160 for emissions; EIA, National Energy Modeling System for AEO 2006, Feb. 2006; EIA, Assumptions to the AEO 2006, Mar. 2006, Table 2, p. 9 for emission coefficients; 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; OBT/A.D. Little, Energy Savings Potential for Commercial Refrigeration Equipment, June 1996, Figure 1-1, p. 1-1; EIA, AEO 1998, Dec. 1997, Table A5, p. 108-109 for 1995 data; and EIA, AEO 1999, Dec. 1998, Table A5, p. 120-121 for 1996 data.

3.1.5 World Carbon Dioxide Emissions (1)

	Emissions (10^6 metric tons of carbon equivalent)				Annual Growth Rate	
Nation/Region	1990	2003		2010	1990-2003	2003-2010
United States	1,359	1,582	23.2%	1,737	1.2%	1.3%
OECD Europe	1,116	1,164	17.0%	1,221	0.3%	0.7%
China	612	966	14.1%	1,599	3.6%	7.5%
Russia	637	438	6.4%	491	-2.8%	1.6%
Other Non-OECD Asia	220	412	6.0%	506	4.9%	3.0%
Japan	276	329	4.8%	328	1.4%	-0.1%
Middle East	192	323	4.7%	399	4.1%	3.1%
Other Non-OECD Eurasia	507	305	4.5%	359	-3.8%	2.3%
India	158	279	4.1%	374	4.5%	4.2%
Central & S. America	184	275	4.0%	347	3.1%	3.4%
Africa	177	244	3.6%	324	2.5%	4.2%
Australia & New Zealand	79	113	1.7%	126	2.8%	1.5%
South Korea	64	128	1.9%	166	5.5%	3.7%
Canada	129	163	2.4%	186	0.0%	0.0%
Mexico	82	111	1.6%	125	2.3%	1.7%
Total World	5,792	6,831	100%	8,286	1.3%	2.8%

Source(s): EIA, International Energy Outlook 2006, June 2006, Table A10, p. 93.

3.1.6 2004 Methane Emissions for U.S. Buildings Energy Production, by Fuel Type (10^6 metric tons of carbon equivalent) (1)

Fuel Type	Residential	Commercial	Buildings Total
Petroleum	0.3	0.1	0.4
Natural Gas	9.8	6.0	15.8
Coal	0.0	0.1	0.1
Wood	1.8	0.0	1.8
Electricity (2)	10.0	9.5	19.5
Total	21.9	15.7	37.7

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

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 2004, December 2005, Table 15, p. 44 for energy production emissions, and Table 19, p. 48 for stationary combustion emissions; and EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 for energy consumption.

3.1.7 2004 Carbon Dioxide Emission Coefficients for Buildings (10^6 metric tons of carbon per quad) (1)

	All Buildings	Residential Buildings	Commercial Buildings
Coal			
Average (2)	25.80	25.80	25.80
Natural Gas			
Average (2)	14.41	14.41	14.41
Petroleum Products			
Distillate Fuel Oil/Diesel	19.76	-	-
Kerosene	19.54	-	-
Motor Gasoline	19.15	-	-
Liquefied Petroleum Gas	17.13	-	-
Residual Fuel Oil	21.29	-	-
Average (2)	19.11	18.85	19.63
Electricity Consumption (3)			
Average - Primary (4)	16.24	16.24	16.24
Average - *Site* (5)	51.59	51.59	51.59
New Generation			
Gas Combined Cycle - *Site* (6)	31.34	31.34	31.34
Gas Combustion Turbine - *Site* (6)	47.22	47.22	47.22
Stock Gas Generator - *Site* (7)	38.38	38.38	38.38
All Fuels (3)			
Average - Primary	15.82	15.67	16.01
Average - *Site*	30.91	28.79	33.67

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 2006 and were adjusted using Assumptions to the AEO 2006. 3) Excludes electricity imports from utility consumption. Includes nuclear and renewable (including hydroelectric) generated electricity. 4) Use this coefficient to estimate carbon emissions resulting from the consumption of energy by electric generators. 5) Use this coefficient to estimate carbon emissions resulting from the consumption of electricity by end-users. 6) Use this coefficient to estimate emissions of the next-built (2005) 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, AEO 2006, Feb. 2006, Table A2, p. 134-136, Table A8, p. 147-148, Table A17, p. 159 for consumption and Table A18, p. 160 for emissions; EIA, Assumptions to the AEO 2006, March 2006, Table 2, p. 9 for coefficients and Table 38, p. 73 for generator efficiencies; EIA, Annual Energy Review 2004, Aug. 2005, Diagram 5, p. 223 for T&D losses.

3.2.1 Halocarbon Environmental Coefficients and Principal Uses

Compound	100-Year Global Warming Potential (CO2 = 1)	Ozone Depletion Potential (Relative to CFC-11)	Principal Uses
Chlorofluorocarbons			
CFC-11	4600	1.00	Blowing Agent, Chillers
CFC-12 (1)	10600	1.00	Auto A/C, Chillers, & Blowing Agent
CFC-113	6000	0.80	Solvent
CFC-114	9800	1.00	Solvent
CFC-115 (2)	7200	0.60	Solvent, Refrigerant
Hydrochlorofluorocarbons			
HCFC-22 (2)	1700	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	2400	0.07	CFC Replacement
Bromofluorocarbons			
Halon-1211	1300	3.00	Fire Extinguishers
Halon-1301	6900	10.00	Fire Extinguishers
Hydrofluorocarbons			
HFC-23	12000	0.00	HCFC Byproduct
HFC-125	3400	0.00	CFC/HCFC Replacement
HFC-134a	1300	0.00	Auto A/C, Refrigeration
HFC-152a (1)	140	0.00	Aerosol Propellant
HFC-227ea	2900	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, January 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 Greehouse Gases in the U.S. 2005, Table ES-1, p ES-3 for GWP of HFCs.

3.2.2 Phase Out Schedule of Halocarbons in the U.S. (1)

Gas	Manufacturing Base Level (2)	Manufacturing Freeze (3)	Reduction %	Reduction By
Chlorofluorocarbons (CFCs)	1996	1989	75%	1994
			100%	1996 (4)
Bromofluorocarbons (Halons)	1996	1992	100%	1994 (4)
Hydrochlorofluorocarbons (HCFCs)	1989 HCFC consumption + 2.8 %	1996	35%	2004
			65%	2010
			90%	2015
			100%	2030 (4)
Hydrofluorocarbons (HFCs)	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. In order 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): United Nations Ozone Environmental Programme, Ozone Secretariet, 2005, http://www.unep.ch/ozone/index.asp; and Title VI, The Clean Air Act of 1990, S.1630, 101st Congrs., 2nd Session.

3.2.3 Conversion and Replacements of Centrifugal CFC Chillers

	Conversions	Replacements	Total	Cumulative Percent of 1992 Chillers (1)
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%
Total	9,533	45,450	54,983	

Note(s): 1) In 1992, approximately 80,000 centrifugal CFC chillers were in service, of which 82% 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, April 25, 2005; ARI, New Legislation Would Spur Replacement of CFC Chillers, March 31, 2004; ARI, Economy Affects CFC Chiller Phaseout, April 2, 2003; ARI, Half-way Mark in Sight for Replacement and Conversion of CFC Chiller Used for Air Conditioning of Buildings, April 11, 2001; ARI, Replacement and Conversion of CFC Chillers Dipped in 1999 Assuring Steady Demand for Non-CFC Units for a Decade, March 29, 2000; ARI, Survey Estimates Long Use of CFC Chillers Nearly Two-Thirds of Units Still in Place, April 15, 1999; ARI, CFCs Widely Used to Cool Buildings Despite 28-Month Ban on Production, April 8, 1998; ARI, 1997 Chiller Survey, April 9, 1997; Air Conditioning, Heating and Refrigeration News, April 1996, p. 1; and ARI's Internet Home Page, Chiller Manufacturer Survey Confirms Slow Pace of Conversion and Replacements of CFC Chillers, April 12, 1995.

3.2.4 Estimated U.S. Emissions of Halocarbons, 1987-2001 (10^6 metric tons of carbon equivalent)

Gas	1987	1990	1992	1995	1998	2000	2001 (1)
Chlorofluorocarbons							
CFC-11	107	67	57	45	31	29	29
CFC-12	318	326	233	150	61	50	62
CFC-113	136	43	28	14	0	0	0
CFC-114	N.A.	13	8	4	0	N.A.	N.A.
CFC-115	N.A.	8	7	6	5	N.A.	N.A.
Bromofluorocarbons							
Halon-1211	N.A.	0	0	0	0	N.A.	N.A.
Halon-1301	N.A.	3	3	3	4	N.A.	N.A.
Hydrochlorofluorocarbons							
HCFC-22	32	37	37	34	35	37	37
HCFC-123	N.A.	0	0	0	0	N.A.	N.A.
HCFC-124	0	0	0	1	1	N.A.	N.A.
HCFC-141b	N.A.	0	0	4	5	1	1
HCFC-142b	N.A.	0	0	5	6	7	7
Hydrofluorocarbons							
HFC-23	13	10	10	8	11	9	6
HFC-125	N.A.	0	0	0	1	1	2
HFC-134a	N.A.	0	0	5	10	12	11
Total	605	508	384	279	170	145	154

Note(s): 1) Preliminary.

Source(s): Intergovernmental Panel for Climate Change, Climate Change 2001: The Scientific Basis, January 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.

3.3.1 2002 EPA Emissions Summary Table for U.S. Buildings Energy Consumption (thousand short tons) (1)

	Buildings				Buildings Percent
	Wood/SiteFossil	Electricity	Total	U.S. Total	of U.S. Total
SO2	575	7,343 (2)	7,918	15,353	52%
NOx	725	3,353	4,078	21,102	19%
CO	2,498	356	2,854	112,049	3%
VOCs	790	37	827	16,544	5%
PM-2.5	384	415	799	6,803	12%
PM-10	405	496	901	22,154	4%

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 SO2 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 SO2 emissions dropped 27% from 1994 to 2002.

Source(s): EIA, AEO 2005, Feb. 2005, Table A2, p. 140-142; and EPA, 2002 Average Annual Emissions, All Criteria Pollutants, August 2005, Tables A-2 to A-8.

3.3.2 2002 EPA Criteria Pollutant Emissions Coefficients (million short tons/*delivered* quad, unless otherwise noted)

Residential

	Electricity (1)	Gas	Oil(3)	Coal	Electricity (per primary quad) (1)
SO2	0.870	(2)	0.086	(2)	0.270
NOx	0.397	0.047	0.036	(2)	0.123
CO	0.042	(2)	(2)	(2)	0.013

Commercial

	Electricity (1)	Gas	Oil(3)	Coal	Electricity (per primary quad) (1)
SO2	0.870	(2)	0.351	(2)	0.270
NOx	0.397	0.072	0.102	(2)	0.123
CO	0.042	(2)	(2)	(2)	0.013

All Buildings

	Electricity (1)	Gas	Oil(3)	Coal	Electricity (per primary quad) (1)
SO2	0.870	(2)	0.171	(2)	0.270
NOx	0.397	0.056	0.058	(2)	0.123
CO	0.042	(2)	(2)	(2)	0.013

Note(s): 1) Emissions of SO2 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 SO2 emissions dropped 27% from 1994 to 2002. 2) Data not available, significant enough, or reliable. 3) Oil includes distillate and residual fuel oils, LPG, motor gasoline, and kerosene.

Source(s): EPA, 2002 Average Annual Emissions, All Criteria Pollutants, August 2005, Tables A-2 to A-8 for emissions; and EIA, AEO 2005, Feb. 2005, Table A2, p. 140-142 for energy consumption.

3.4.1 Characteristics of U.S. Construction Waste

- 2 to 7 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 (at 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.

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

	Weight		
Material	(pounds)	(percent)	Volume (cu. yd.) (2)
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
Total	8,000	100%	50

Note(s): 1) See Table 2.1.7 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.

Source(s): NAHB's Internet Home Page, Residential Construction Waste: From Disposal to Management, Oct. 1996.

3.4.3 1996 Construction and Demolition Debris Generated from Construction Activities and Debris Generation Rates

	Debris (million tons)			Debris Generation Rates (lbs/ sq. ft.)	
	Residential	Commercial	Buildings	Residential	Commercial
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
Total	58.2	77.4	135.5		

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.

4.1.1 Building Energy Prices, by Year and Major Fuel Type ($2004/10^6 Btu)

	Residential Buildings				Commercial Buildings				Buildings
	Electricity	Natural Gas	Petroleum (1)	Avg	Electricity	Natural Gas	Petroleum (1)	Avg	Average (2)
1980	31.46	7.21	14.54	15.18	32.16	6.65	11.30	15.97	15.49
1990	30.46	7.47	11.61	16.09	28.12	6.23	7.89	16.09	16.09
2000	26.13	8.27	12.50	15.66	23.29	7.10	8.76	15.30	15.50
2004	**26.19**	**10.40**	**14.63**	**17.33**	**23.52**	**9.10**	**10.39**	**16.71**	**17.07**
2010	24.78	10.33	14.77	17.00	22.31	8.76	10.56	16.41	16.75
2015	24.24	9.80	14.72	16.66	21.66	8.12	10.65	15.92	16.34
2020	24.44	10.16	15.94	17.20	22.00	8.37	11.22	16.40	16.84
2025	24.76	10.76	17.31	17.90	22.52	8.83	11.78	17.06	17.51
2030	25.02	11.32	18.42	18.52	22.90	9.29	12.28	17.63	18.10

Note(s): 1) Petroleum products include distillate fuel, oil, residual fuel oil, LPG, kerosene, and motor gasoline. 2) In 2004, buildings average electricity price was $24.86/10^6 Btu or ($0.085/kWh), average natural gas price was $8.79/10^6 Btu ($9.90/1000 CF), and petroleum was $13.22/10^6 Btu ($1.68/gal.). Averages do not include wood or coal prices.

Source(s): EIA, State Energy Data 2002: Prices and Expenditures, June 2006, p. Tables 2-3, p. 24-25 for 1980-2000 and prices for note, Tables 8-9, p. 18-19 for 1980-2000 consumption; EIA, AEO 2006 Feb. 2006, Table A2, p. 134-136, Table A3, p. 137-138, Table A12, p. 154, and Table A13, p. 155 for 2004-2030 consumption and prices; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price deflators.

4.1.2 Building Energy Prices, by Year and Fuel Type ($2004)

	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	10.7	72.1	1.95	1.36	11.0	66.5	1.79	1.24
1990	10.4	74.7	1.47	1.24	9.6	62.3	1.10	0.68
2000	8.9	82.7	1.49	1.35	7.9	71.0	1.12	0.73
2004	**8.9**	**104.0**	**1.89**	**1.48**	**8.0**	**91.0**	**1.39**	**0.95**
2010	8.5	103.3	1.78	1.56	7.6	87.6	1.41	0.92
2015	8.3	98.0	1.77	1.54	7.4	81.2	1.44	0.90
2020	8.3	101.6	1.88	1.66	7.5	83.7	1.51	0.94
2025	8.4	107.6	1.97	1.82	7.7	88.3	1.57	1.00
2030	8.5	113.2	2.02	1.95	7.8	92.9	1.63	1.04

Source(s): EIA, State Energy Data 2002: Prices and Expenditures, June 2006, p. Tables 2-3, p. 24-25 for 1980-2000; EIA, AEO 2006, Feb. 2006, Table A3, p. 137-138 for 2004-2030 and Table H1, p. 233 for fuels' heat content; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price deflators.

4.1.3 Buildings Aggregate Energy Expenditures, by Year and Major Fuel Type ($2004 billion) (1)

	Residential Buildings				Commercial Buildings				Total Building
	Electricity	Natural Gas	Petroleum (2)	Total	Electricity	Natural Gas	Petroleum (2)	Total	Expenditures
1980	77.0	35.0	25.4	137.5	61.3	17.7	14.6	93.6	231.1
1990	96.0	33.7	16.3	146.1	80.4	16.8	7.5	104.8	250.9
2000	106.3	42.2	19.5	168.0	92.1	23.1	6.6	121.9	289.9
2004	**115.5**	**52.3**	**23.0**	**190.9**	**98.6**	**28.2**	**8.1**	**134.8**	**325.7**
2010	123.6	55.1	21.7	200.4	108.9	27.9	7.9	144.6	345.0
2015	130.4	54.2	21.5	206.0	117.7	28.1	8.2	153.9	359.9
2020	141.0	57.7	22.7	221.4	132.3	30.8	8.7	171.8	393.2
2025	151.0	61.8	23.6	236.4	149.4	34.4	9.3	193.0	429.4
2030	161.9	65.9	24.3	252.0	168.1	38.2	9.8	216.1	468.1

Note(s): 1) Expenditures exclude wood and coal. 2004 U.S. energy expenditures were $911.1 billion. 2) Petroleum products include distillate fuel oil, residual fuel oil, LPG, kerosene, and motor gasoline.

Source(s): EIA, State Energy Data 2002: Prices and Expenditures, June 2006, p. 24-25 for 1980-2000; EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 and Table A3, p. 137-138 for 2004-2030; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price deflators.

4.1.4 FY 2004 Federal Buildings Energy Prices and Expenditures, by Fuel Type ($2004)

Fuel Type	Average Fuel Prices ($/million Btu)	Total Expenditures ($million) (2)
Electricity	19.48 (1)	2,763.5
Natural Gas	6.86	723.3
Fuel Oil	6.76	210.9
Coal	2.79	35.7
Purchased Steam	13.69	182.0
LPG/Propane	10.90	29.8
Other	10.61	40.6
Average	12.81	Total 3,985.8

Note(s): 1) $0.066/kWh. 2) Energy used in buildings FY 2004 accounted for 35.4% of the total Federal energy bill.

Source(s): DOE, Annual Report to Congress on FEMP, February 2006, Table 5, p A-9 for prices and expenditures, and Figure 2, p. 4 for Federal buildings energy expenditures share.

4.1.5 2004 Buildings Energy End-Use Expenditure Splits, by Fuel Type ($2004 billion) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity	Total	Percent
Space Heating (3)	47.3	13.1	0.8	5.0	1.0	19.9	0.2	17.5	84.9	26.1%
Lighting								52.4	52.4	16.1%
Water Heating (4)	16.9	2.3		0.9		3.2		14.2	34.3	10.5%
Space Cooling	0.1							33.0	33.1	10.1%
Refrigeration (5)								22.0	22.0	6.7%
Electronics (6)								16.0	16.0	4.9%
Cooking	4.6			0.5		0.5		6.6	11.7	3.6%
Wet Clean (7)	0.7							7.9	8.6	2.7%
Ventilation (8)								7.5	7.5	2.3%
Computers								5.1	5.1	1.6%
Other (9)	3.5	0.2		4.4	0.7	5.4		13.9	22.8	7.0%
Adjust to SEDS (10)	7.3	2.2				2.2		18.1	27.5	8.4%
Total	80.5	17.9	0.8	10.8	1.7	31.1	0.2	214.1	325.9	100%

Note(s): 1) Expenditures include coal and exclude wood (unlike Table 4.1.3). 2) Includes kerosene space heating ($1.0 billion) and motor gasoline other uses ($0.7 billion). 3) Includes furnace fans ($2.2 billion). 4) Includes residential recreation water heating ($1.1 billion). 5) Includes refrigerators ($12.4 billion) and freezers ($9.6 billion). 6) Includes color televisions ($3.7 billion) and other electronics ($5.0 billion). 7) Includes clothes washers ($0.9 billion), natural gas clothes dryers ($0.7 billion), electric clothes dryers ($6.4 billion) and dishwashers ($.6 billion). 8) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling ($0.5 billion). 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, automated teller machines, 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 2006, Feb. 2006, Table A2, p. 134-136, Table A3, p. 137-138 for prices, Table A4, p. 139-140 for residential energy consumption, and Table A5, p. 141-142 for commercial energy consumption; EIA, National Energy Modeling System for AEO 2006, Feb 2006; EIA, State Energy Data 2002: Prices and Expenditures, June 2006, p. 24-25 for coal prices; EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 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; BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, Sept. 2002, Table 8-2, p. 63 for commercial lighting; OBT/A.D. Little, Energy Savings Potential for Commercial Refrigeration Equipment, June 1996, Figure 1-1-, p. 1-1; and EIA, AEO 1999, Dec. 1998, Table A5, p. 120 for 1996 commercial refrigeration.

4.1.6 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	1.08
1985	0.70	1995	0.92		
1986	0.71	1996	0.94		
1987	0.73	1997	0.95		
1988	0.76	1998	0.96		
1989	0.79	1999	0.98		

Source(s): EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373.

4.2.1 2004 Residential Energy End-Use Expenditure Splits, by Fuel Type ($2004 billion) (1)

	Natural	Petroleum							
	Gas	Distil.	LPG	Kerosene	Total	Coal	Electricity	Total	Percent
Space Heating (2)	36.4	11.2	5.0	0.8	17.0	0.03	12.6	66.0	34.6%
Water Heating (3)	12.0	1.7	0.9		2.5		10.8	25.4	13.3%
Lighting							20.8	20.8	10.9%
Space Cooling (4)	0.0						19.3	19.3	10.1%
Refrigeration (5)							13.8	13.8	7.2%
Wet Clean (6)	0.7						7.9	8.6	4.5%
Electronics (7)							8.7	8.7	4.6%
Cooking	2.2		0.5		0.5		5.9	8.6	4.5%
Computers							1.8	1.8	1.0%
Other (8)	1.0		3.0		3.0		4.8	8.8	4.6%
Adjust to SEDS (9)							9.2	9.2	4.8%
Total	52.3	12.9	9.3	0.8	23.0	0.03	115.5	190.9	100%

Note(s): 1) Expenditures include coal and exclude wood (unlike Table 4.1.3). 2) Includes furnace fans ($2.2 billion). 3) Includes residential recreation water heating ($1.1 billion). 4) Fan energy use included. 5) Includes refrigerators ($10.4 billion) and freezers ($3.3 billion). 6) Includes clothes washers ($0.9 billion), natural gas clothes dryers ($0.7 billion), electric clothes dryers ($6.4 billion), and dishwashers ($0.6 billion). 7) Includes color televisions ($3.7 billion) and other electronics ($5.0 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 2006, Feb. 2006, Table A2, p. 134-136 and Table A4, p. 139-140 for energy, Table A3, p. 137-138 for prices; EIA, State Energy Data 2002: Prices and Expenditures, June 2006, p. 24 for coal price; EIA, Annual Energy Review 2004, August 2005, Appendix D, p. 373 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.

4.2.2 Average Annual Energy Expenditures per Household, by Year ($2004)

1980	1,726
1990	1,550
2000	1,512
2004	**1,680**
2010	1,632
2015	1,584
2020	1,614
2025	1,648
2030	1,683

Source(s): EIA, State Energy Data 2002: Prices and Expenditures, June 2006, p. 24 for 1980-2000; EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136, Table A4, p. 139-140 for consumption, Table A3, p. 137-138 for prices 2004-2030; EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price deflators; and DOC, Statistical Abstract of the United States 2003, Feb. 2004, Table No. 953, p. 615 for 1980 and 1990 occupied units.

4.2.3 2001 Energy Expenditures per Household, by Housing Type and Square Footage ($2004)

	Per Household	Per Square Foot
Single Family	**1,793**	**0.75**
-Detached	1,823	0.75
-Attached	1,619	0.74
Multi-Family	**1,023**	**0.98**
-2 to 4 units	1,333	0.96
-5 or more units	849	1.00
Mobile Home	**1,412**	**1.34**

Source(s): EIA, A Look at Residential Energy Consumption in 2001, Oct. 2003, Table CE1-6.2u; and EIA, Annual Energy Review 2004, Aug 2005, Appendix D, p. 373 for price inflators.

4.2.4 2001 Energy Expenditures per Household, by Census Region ($2004)

Northeast	1,841
Midwest	1,629
South	1,617
West	1,235

Source(s): EIA, A Look at Residential Energy Consumption in 2001, Oct. 2003, Tables CE1-9c, CE1-10c, CE1-11c and CE1-12c; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price inflators.

4.2.5 2001 Household Energy Expenditures, by Vintage ($2004)

Year	Per Household	Per Square Foot	Per Household Member	Percent of Residential Sector Expenditures
Prior to 1970	1,605	0.82	628	52%
1970 to 1979	1,467	0.84	587	16%
1980 to 1989	1,520	0.79	608	16%
1990 to 1999	1,665	0.70	570	14%
2000 to 2001	1,951	0.65	578	1%
				100%
Average	1,578	0.80	609	

Source(s): EIA, A Look at Residential Energy Consumption in 2001, Oct. 2003, Tables CE1-6.1u and CE1-6.2u; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price inflators.

4.2.6 2001 Households and Energy Expenditures, by Income Level ($2002)

	Households		Energy Expenditures by		Percent of Income for
Household Income	Number(10^6)	Percent	Household	Household Member	Energy Expenditures (1)
Less than $9,999	11.0	10%	1,039	554	16%
$10,000 to $14,999	7.7	7%	1,124	528	9%
$15,000 to $19,999	8.9	8%	1,290	565	7%
$20,000 to $29,999	14.0	13%	1,315	561	5%
$30,000 to $39,999	13.9	13%	1,398	547	4%
$40,000 to $49,999	13.2	12%	1,518	562	3%
$50,000 to $74,999	21.7	20%	1,683	577	3%
$75,000 to $99,999	8.1	8%	1,825	624	2%
$100,000 or more	8.6	8%	2,231	732	2%
Total	107.1	100%			3%

Note(s): 1) See Tables 4.2.7 and 7.1.10 for more on energy burdens. 2) A household is defined as a family, an indvidual, or a group of up to nine unrelated individuals, occupying the same housing unit.

Source(s): EIA, A Look at Residential Energy Consumption in 2001, Oct. 2003, Tables CE1-5.1u.

4.2.7 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 2004 (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%	6.4%	2.4%	2.6%
Federally Eligible	13.0%	14.4%	10.1%	12.1%	7.9%	7.7%	13.7%	8.0%	8.2%
Federally Ineligible	4.0%	3.5%	N.A.	3.0%	2.6%	2.0%	3.0%	2.6%	2.1%
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) 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 2004, HDD, CDD, and fuel prices.

Source(s): HHS, LIHEAP Home Energy Notebook for Fiscal Year 2004, June 2006, Tables A-2a, A-2b, and A-2c, p. 56-58 for FY 2004; 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.

4.2.8 1998 Cost Breakdown of a 2,150-Square-Foot, New Single-Family Home ($2004) (1)

	Cost	Percent
Finished Lot	**60,040**	**24%**
Construction Cost		
Inspection/Fees	**3,923**	**2%**
Shell/Frame		
Framing	28,732	11%
Windows/Doors	9,543	4%
Exterior Finish	10,502	4%
Foundation	14,986	6%
Wall/Finish Trim	26,210	10%
Flooring	6,699	3%
Equipment		
Plumbing	8,210	3%
Electrical Wiring	5,238	2%
Lighting Fixtures	1,449	1%
HVAC	5,733	2%
Appliances	2,012	1%
Property Features	16,320	6%
Financing	**4,786**	**2%**
Overhead & General Expenses	**14,534**	**6%**
Marketing	**3,568**	**1%**
Sales Commission	**8,583**	**3%**
Profit	**23,377**	**9%**
Total	254,445	100%

Note(s): 1) Based on a NAHB survey asking builders to provide a detailed breakdown of the cost of constructing a 2,150-sq.ft. house with 3 or 4 bedrooms on a 7,500- to 10,000-sq.ft. 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 2004, August 2005, Appendix D, p. 373 for price inflators.

4.3.1 2004 Commercial Energy End-Use Expenditure Splits, by Fuel Type ($2004 billion) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity	Total	Percent
Lighting								31.6	31.6	23.4%
Space Heating	11.0	1.9	0.8		0.2	2.9	0.1	4.9	18.9	14.0%
Space Cooling	0.1							13.7	13.8	10.2%
Water Heating	4.9	0.7				0.7		3.3	8.9	6.6%
Refrigeration								8.2	8.2	6.1%
Ventilation								7.5	7.5	5.6%
Electronics								7.3	7.3	5.4%
Computers								3.3	3.3	2.4%
Cooking	2.4					0.0		0.8	3.1	2.3%
Other (3)	2.5	0.2		1.4	0.7	2.4		9.1	14.0	10.4%
Adjust to SEDS (4)	7.3	2.2				2.2		8.9	18.3	13.6%
Total	28.2	5.0	0.8	1.4	0.9	8.1	0.1	98.6	135.0	100%

Note(s): 1) Expenditures include coal and exclude wood (unlike Table 4.1.3). 2) Includes kerosene space heating ($0.2 billion) and motor gasoline other uses ($0.7 billion). 3) Includes service station equipment, automated teller machines, medical equipment, telecommunications equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 4) 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 2006, Feb. 2006, Table A2, p. 134-136, Table A3, p. 137-138 for prices, and Table A5, p. 141-142 for energy consumption; EIA, National Energy Modeling System for AEO 2006, April 2006; EIA, State Energy Data 2002: Prices and Expenditures, June 2006, p. 25 for coal price; EIA, Annual Energy Review 2004, August 2005, Appendix D, p. 373 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; BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, Sept. 2002, Table 8-2, p. 63; OBT/A.D. Little, Energy Savings Potential for Commercial Refrigeration Equipment, June 1996, Figure 1-1-, p. 1-1; and EIA, AEO 1999, Dec. 1998, Table A5, p. 120 for 1996 refrigeration.

4.3.2 Average Annual Energy Expenditures per Square Foot of Commercial Floorspace, by Year ($2004)

1980	1.84
1990	1.63
2000	1.78
2004	**1.80**
2010	1.76
2015	1.73
2020	1.79
2025	1.86
2030	1.93

Source(s): EIA, State Energy Data 2002: Prices and Expenditures, June 2006, p. 25 for 1980-2000; EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 and Table A5, p. 141-142 for consumption, Table A3, p. 137-138 for prices for 2004-2030; EIA, Annual Energy Review 2004, August 2005, Appendix D, p. 373 for price deflators; EIA, AEO 1994, Jan. 1994, Table A5, p. 62 for 1990 floorspace; and PNNL for 1980 floorspace.

4.3.3 2003 Energy Expenditures per Square Foot of Commercial Floorspace and per Building, by Building Type ($2004) (1)

	per Square Foot	per Building (10^3)		per Square Foot	per Building (10^3)
Food Service	4.25	23.7	Mercantile	1.42	13.8
Food Sales	4.08	22.6	Education	1.25	31.9
Health Care	2.41	59.2	Service	1.21	7.9
Public Order and Safety	1.80	27.9	Warehouse and Storage	0.70	11.8
Office	1.75	25.9	Religious Worship	0.67	6.8
Public Assembly	1.51	21.4	Vacant	0.30	4.2
Lodging	1.50	53.6	Other	2.60	57.0

Note(s): 1) Mall buildings are no longer included in most CBECs tables; therefore, some data is not directly comparable to past CBECs.
2) Other than mall.
Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, June 2006, Table 4; and EIA, Annual Energy Review 2004, August 2005, Appendix D, p. 373 for price deflators.

4.3.4 2003 Energy Expenditures per Square Foot of Commercial Floorspace, by Vintage ($2004) (1)

Prior to 1960	1.24
1960 to 1969	1.43
1970 to 1979	1.54
1980 to 1989	1.72
1990 to 1999	1.56
2000 to 2003	1.41
Average	1.46

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, Table C4; and EIA, Annual Energy Review 2004, August 2005, Appendix D, p. 373 for price inflators.

4.4.1 Annual Energy Expenditures per Gross Square Foot of Federal Floorspace Stock, by Year ($2004)

FY 1985	1.85	FY 2003	1.27
FY 2000	1.19	FY 2004	1.34
FY 2002	1.26		

Note(s): Total Federal buildings and facilities energy expenditures in FY 2004 were $3.99 billion (in $2004).
Source(s): DOE/FEMP, Annual Report to Congress on FEMP, April 2004, Table 7-B, p. 62 for energy costs and Table 8-A, p. 65 for floorspace.

4.4.2 Direct Appropriations on Federal Buildings Energy Conservation Retrofits and Capital Equipment ($2004 million)

FY 1985	404.3	FY 1991	140.7	FY 1997	226.5	FY 2003	176.7
FY 1986	297.0	FY 1992	174.8	FY 1998	294.8	FY 2004	173.8
FY 1987	85.6	FY 1993	142.2	FY 1999	226.9		
FY 1988	94.2	FY 1994	265.3	FY 2000	130.5		
FY 1989	72.2	FY 1995	325.2	FY 2001	138.3		
FY 1990	79.1	FY 1996	198.3	FY 2002	126.1		

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, February 2006, Table 3-B, p. A-6; and EIA, Annual Energy Review 2004, Aug. 2005, Appedix D, p. 373 for price deflators.

4.5.1 Estimated Value of All U.S. Construction Relative to the GDP ($2004)

- 2004 estimated value of all U.S. construction is $1.67 trillion (including renovation; heavy construction; public works; residential, commercial, and industrial new construction; and non-contract work).
- Compared to the $11.7 trillion U.S. gross domestic product (GDP), all construction holds a 14.2% share.
- In 2004, residential and commercial building renovation (valued at $367 billion) and new building construction (valued at $696 billion) is estimated to account for just over 70% (or around $1.06 trillion, including an additional $114 billion for non-contract work) of the $1.67 trillion.

Source(s): National Science and Technology Council, Construction & Building: Interagency Program for Technical Advancement in Construction and Building, 1999, p. 5; National Science and Technology Council, Construction & Building: Federal Research and Development in Support of the U.S. Construction Industry, 1995, p. 5 for value of total U.S. construction and non-contract work; DOC, Current Construction Reports: Value of Construction Put in Place (C30), Jan. 2002, Table 1, p. 3 for 1997; DOC/NIST, An Approach for Measuring Reductions in Operations, Maintenance, and Energy Costs: Baseline Measures of Construction Industry Practices for the National Construction Goals, July 1998, p. 27-35; DOC, 1997 Census of Construction Industries: Industry Summary, Jan. 2000, Table 7, p. 15; DOC, Annual Value of Private Construction Put in Place, July 2006; DOC, Annual Value of Public Construction Put in Place, July 2006; DOC, Expenditures for Residential Improvements and Repairs by Property Type, Table S2, 2006 ; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price deflators.

4.5.2 Value of New Building Construction Relative to GDP, by Year ($2004 billion)

	Value of New Construction Put in Place				Bldgs. Percent of
	Residential	Commercial (1)	All Bldgs. (1)	GDP	Total U.S. GDP
1980	143.4	138.1	281.5	5,587	5.0%
1985	184.4	195.5	379.9	6,552	5.8%
1990	180.3	196.6	377.0	7,698	4.9%
1995	206.2	178.4	384.6	8,693	4.4%
2000	291.4	279.4	570.9	10,625	5.4%
2004	425.2	270.7	695.9	11,734	5.9%

Note(s): 1) New buildings construction differs from Table 4.5.1 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, July 2006 for 1995-2004; DOC, Annual Value of Public Construction Put in Place, July 2006 for 1995-2004; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for GDP and price deflators.

4.5.3 Value of Building Improvements and Repairs Relative to GDP, by Year ($2004 billion) (1)

	Value of Improvements and Repairs				Bldgs. Percent of
	Residential	Commercial	All Bldgs.	GDP	Total U.S. GDP
1980	92.8	N.A.	N.A.	5,587	N.A.
1985	127.5	121.2 (2)	248.7	6,552	3.8%
1990	153.1	123.2 (3)	276.3	7,698	3.6%
1995	146.9	111.2	258.0	8,693	3.0%
2000	165.6	173.4	339.0	10,625	3.2%
2004	198.6	168.0	366.5	11,734	3.1%

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, 2006 for 1995-2004; DOC, Current Construction Reports: Expenditures for Nonresidential Improvements and Repairs: 1992, CSS/92, Sept. 1994, Table A, p. 2 for 1986-1990 expenditures; DOC/NIST, An Approach for Measuring Reductions in Operations, Maintenance, and Energy Costs: Baseline Measures of Construction Industry Practices for the National Construction Goals, July 1998, p. 27-35; DOC, 1992 Census of Construction Industries: United States Summary, June 1996, Table 11, p. 16; DOC, 1997 Censusof Construction Industries: Industry Summary, Jan. 2000, Table 7, p. 15; DOC, Annual Value of Private Construction Put in Place, July 2006 for 1995-2004; DOC, Annual Value of Public Construction Put in Place, July 2006 for 1995-2004; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for GDP and price deflators.

4.5.4 2003 U.S. Private Investment into Construction R&D

Sector	Percent of Sales		Building Technology	Percent of Sales
Average Construction R&D (1)	**0.6**	(2)		
Heavy Construction	2.0		Appliances	2.0
Special Trade Construction	0.2		Lighting	1.2
			HVAC	1.5
U.S. Average of All Private R&D (2)	**3.6**	(2)	Fans, Blowers, & Air Cleaning Equipment	1.6
Manufacturing Average	3.2	(2)	Lumber and Wood Products	0.3
Service Industry Average	4.1	(2)	Commercial Building Operations	2.2

Note(s): 1) Includes all construction (e.g., bridges, roads, dams, buildings, etc.). 2) 2002.

Source(s): National Science Foundation, Research and Development in Industry: 2002, July 2006, Table 27, p. 76-77; and Schonfeld & Associates, R&D Ratios & Budgets, June 2003, p. 219-222.

4.5.5 1997/1998 International Investment into Construction and Energy R&D

	Construction Percent of Private R&D to Total Private R&D	Gas, & Water Percent of Private R&D to Total Private R&D	Mining Percent of Private R&D to Total Private R&D
U.S.	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.

4.6.1 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.	3065	1982	14.4	21.7	57.5	93.6
1990		N.A.	3861	1987	38.4	32.8	48.1	119.3
2000	(4)	215	5183	1992	36.3	43.3	51.0	130.6
2003		180	6735	1997	46.6	33.6	52.1	134.1
2004		207	6964	2002	95.4	28.0	47.7	167.4

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 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.

4.6.2 Heating, Cooling, and Ventilation Equipment Trades, by Year (1000 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.

5.1.1 2005 Five Largest Residential Homebuilders

Homebuilder	Number of Home Closings (1)	Gross Revenue ($million)	Market Share of Total New Home Closings (%) (2)
D.R. Horton	51,383	14,247	3.7%
Pulte Homes	45,630	14,695	3.3%
Lennar Homes	42,359	13,867	3.1%
Centex Corporation	37,022	14,673	2.7%
KB Home	31,009	9,442	2.2%
Total of Top Five	207,403	66,924	15.0%
Habitat for Humanity (3)	4,993	198	0.3%

Note(s): 1) 2005 total U.S. new home closings were 1.38 million (includes single-family and multi-family). 2) Total share of closings of top 20 builders was 26% and the total share of the top 100 builders was 37%. 3) Habitat for Humanity built more than 400 homes during the week of June 5. 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 2006, Builder 100; and Habitat for Humanity, http://www.habitat.org/, for note 3

5.1.2 Value of New Building Construction, by Year ($2004 billion)

	Residential	Commercial	All Bldgs.
1980	143.4	138.1	281.5
1985	184.4	195.5	379.9
1990	180.3	196.6	377.0
1995	206.2	178.4	384.6
2000	291.4	279.4	570.9
2003	361.2	259.7	620.9
2004 (1)	425.2	270.7	695.9

Note(s): 1) In 2004, new buildings construction accounted for 6.2% of the $11.7 trillion U.S. GDP. Refer to Chapter 2 for more new building statistics.

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, July 2006 for 1995-2004; DOC, Annual Value of Public Construction Put in Place, July 2006 for 1995-2004; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price deflators.

5.2.1 2005 Top Five Manufacturers of Factory Built Housing Units (1)

Company	Units Produced	Gross Sales Volume ($million)	Market Share of Top 25 Company Sales (2)
Champion Enterprises, Inc.	22,978	1002.2	17%
Clayton Homes, Inc.	25,900	951.0	16%
Fleetwood Enterprises, Inc.	24,385	854.9	14%
Palm Harbor Homes, Inc.	8,216	557.1	9%
Skyline Corporation	7,723	311.4	5%

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 2005, surveyed factory built home sales were estimated at $5.9 billion and 140,063 units.

Source(s): HousingZone.com, 2006 Factory Built Housing Results, August 2006, http://www.housingzone.com/factory.html.

5.2.2 2005 Top Five Manufacturers of Modular/3D Housing Units (1)

Company	Units Produced	Gross Sales Volume ($million)	Market Share of Top 25 Company Sales (2)
All American Homes, LLC	2,610	220.0	18%
Champion Enterprises, Inc.	3,274	184.1	15%
Clayton Homes, Inc.	3,500	175.0	14%
Excel Homes LLC	1,300	109.2	9%
New Era Building Systems	1,829	107.9	9%

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 2005, surveyed modular/3D home sales were estimated at $1.2 billion and 20,253 units.

Source(s): HousingZone.com, 2006 Factory Built Housing Results, August 2006, http://www.housingzone.com/factory.html.

5.2.3 2005 Top Five Manufacturers of HUD-Code (Mobile) Homes (1)

Company	Units Produced	Gross Sales Volume ($million)	Market Share of Top 25 Company Sales (2)
Fleetwood Enterprises	24,385	855	19%
Clayton Homes	22,400	776	17%
Champion Enterprises	22,978	818	18%
Skyline Corporation	7,723	311	7%
Palmer Harbor Homes	7,100	160	4%

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 2005, surveyed HUD-Code home sales were estimated at $4.53 billion and 115,684 units.

Source(s): HousingZone.com, 2006 Factory Built Housing Results, August 2006, http://www.housingzone.com/factory.html.

5.2.4 2004 Top Five Manufacturers of Factory-Fabricated Components (trusses, wall panels, doors) (1)

Company	Gross Sales Volume ($million)	Market Share of Top 26 Company Sales (2)	Number of Employees (3)
Carpenter Contractors	175.0	26%	1130
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, September 2005, p. 40-41.

5.2.5 2004 Number of Industrialized Housing Manufacturers versus Production Companies (stick-builders)

Type	Number of Companies
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, March 2005, p. 34-35; Automated Builder Magazine, Jan. 2004, p. 16 for Note 1.

5.2.6 2005 HUD-Code (Mobile) Home Placements, by Census Region and Top Five States (percent of national total)

Region		Top Five States	
Northeast	8%	Florida	13.4%
Midwest	15%	California	9.2%
South	57%	Texas	7.2%
West	24%	Arizona	4.4%
Total	100%	Lousiana	4.1%

Source(s): DOC, Manufactured Housing Statistics, 2006 New Manufactured Homes Placed by Size of Home, by State, June 2006; Automated Builder Magazine, March 2005, p. 9.

5.3.1 Value of Building Improvements and Repairs, by Sector ($2004 billion) (1)

	Value of Improvements and Repairs		
	Residential	Commercial	All Bldgs.
1980	92.8	N.A.	N.A.
1985	127.5	121.2 (2)	248.7
1990	153.1	123.2 (3)	276.3
1995	146.9	111.2	258.0
2000	165.6	173.4	339.0
2003	181.2	161.2	342.3
2004	198.6 (4)	168.0 (5)	366.5

Note(s): 1) Improvements includes additions, alterations, reconstruction, and major replacements. Repairs include maintenance. 2) 1986. 3) 1989. 4) Includes 75% improvements and 25% maintenance & repairs. 5) Includes 76% improvements and 24% maintenance and repairs.

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, 2006 for 1995-2004; DOC, Current Construction Reports: Expenditures for Nonresidential Improvements and Repairs: 1992, CSS/92, Sept. 1994, Table A, p. 2 for 1986-1990 expenditures; DOC/NIST, An Approach for Measuring Reductions in Operations, Maintenance, and Energy Costs: Baseline Measures of Construction Industry Practices for the National Construction Goals, July 1998, p. 27-35; DOC, 1992 Census of Construction Industries: United States Summary, June 1996, Table 11, p. 16; DOC, 1997 Censusof Construction Industries: Industry Summary, Jan. 2000, Table 7, p. 15; DOC, Annual Value of Private Construction Put in Place, July 2006 for 1995-2004; DOC, Annual Value of Public Construction Put in Place, July 2006 for 1995-2004; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price deflators.

5.3.2 2003 Professional and Do-It-Yourself Improvements, by Project ($2004)

	Professional Installation			Do-It-Yourself Installation		
Repair/Improvement	Homeowners (10^6)	Total Expenditures ($10^9)	Mean Expenditures ($)	Homeowners (1000)	Total Expenditures ($10^9)	Mean Expenditures ($)
Disaster Repairs	0.37	4.4	11,994	0.11	0.7	6,229
Kitchen Remodeled	0.95	8.1	8,521	1.04	4.6	4,419
Additions Built	1.12	21.3	18,995	1.50	8.8	5,875
Bathroom Remodeled or Added	0.98	5.1	5,267	1.36	2.7	2,004
Exterior Improvements	3.44	18.4	5,339	3.19	7.2	2,267
Siding Replaced or Added	0.75	4.2	5,559	0.38	1.1	2,995
Roof Replacement	2.23	9.6	4,323	0.75	2.0	2,672
HVAC Replacement	2.50	7.2	2,893	0.56	1.0	1,837
Windows/Doors Installed	2.25	6.1	2,696	1.74	2.1	1,182
Flooring/Paneling/Ceiling Replacement	4.72	10.4	2,207	3.40	3.5	1,024
Electric System Replacement	1.24	1.2	959	0.84	0.5	550
Plumbing Replacement	0.79	1.0	1,243	1.96	0.8	407
Insulation Added	0.52	0.3	582	0.68	0.3	486
Appliance/Major Equipment Replacement	3.38	1.8	535	2.37	0.8	359

Note(s): Expenditures are $45.9 billion higher in Table 4.5.3 and 5.3.1. 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 2005, June 2005, Table A-2, p. 34; and, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price deflators.

5.3.3 Single-Family Residential Renovations by Age of Home

	Year Home was Built					
	Pre-1946	1946-60	1961-73	1974-80	1981-98	1999 or later
Remodel kitchen	60%	57%	54%	60%	44%	8%
Remodel bathroom	59%	52%	59%	55%	40%	4%
Add room(s)	29%	18%	14%	24%	21%	15%
Complete exterior facelift	21%	15%	15%	16%	9%	4%
Finish room in basement	14%	10%	6%	12%	16%	65%
Redesign/Restructure	14%	8%	11%	10%	5%	4%
Enclose porch/patio/breezeway	12%	7%	12%	13%	9%	4%
Add interior bathroom	8%	7%	6%	7%	6%	27%
Add a sun room	4%	6%	3%	4%	5%	8%

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

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

5.4.1 U.S. Insulation Demand, by Type (million pounds) (1)

Insulation Type	1992		2001		2006 (1)	
Fiberflass	2938	55%	3760	54%	4085	53%
Foamed Plastic	1223	23%	1775	25%	1955	26%
Cellulose	485	9%	665	9%	730	10%
Mineral Wool	402	8%	445	6%	480	6%
Other	309	6%	370	5%	395	5%
Total	5357	100%	7015	100%	7645	100%

Note(s): 1) Projected.
Source(s): National Insulation Association, www.insulation.org, August 2006.

5.4.2 Industry Use Shares of Mineral Fiber (Glass/Wool) Insulation (1)

	1997	1999	2001	2003	2004
Insulating Buildings (2)	69.8%	70.7%	71.7%	65.3%	64.0%
Industrial, Equipment, and Appliance Insulation	26.8%	26.0%	24.9%	28.7%	30.0%
Unknown	3.3%	3.4%	3.5%	5.9%	5.9%
	100%	100%	100%	100%	100%

Note(s): 1) Based on value of shipments. 2) Including industrial.
Source(s): DOC, Annual Survey of Manufacturers: Value of Product Shipments 2005, March 2006, Table 1, p. 43 for 2003 and 2004; and DOC, 2001 Annual Survey of Manufacturers: Value of Product Shipments, Dec. 2002, p. 65 for 1997-2001.

5.4.3 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-ft2-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, March 1995, p. 17; and ORNL for vacuum insulation panel.

5.5.1 Residential Prime Window Sales, by Type (million units) (1)

	New Construction				Remodeling/Replacement				Total Construction			
Type	1990	1995	2000	2005	1990	1995	2000	2005	1990	1995	2000	2005
Aluminum (2)	5.9	4.7	3.7	6.5	3.6	3.9	4.0	2.4	9.5	8.6	7.7	8.9
Wood (3)	9.4	11.6	12.8	9.2	7.6	9.4	10.2	10.0	17.0	21.0	23.0	19.2
Vinyl	1.2	4.8	9.0	17.4	7.1	9.6	14.8	23.2	8.3	14.4	23.8	40.6
Other	0.1	0.3	0.4	1.0	0.1	0.2	0.2	0.9	0.2	0.5	0.6	1.9
Total	16.6	16.6	25.8	34.1	18.4	23.1	29.2	36.4	35.0	44.5	55.0	70.5

Note(s): 1) Average window life span is 35 to 45 years. 2) In 1993, 65% of aluminum-framed windows were thermally broken. 3) Includes vinyl-clad and metal-clad units.

Source(s): AAMA/Ducker Research, Industry Statistical Review and Forecast 1992, 1993 for Note 2; AAMA/NWWDA/Ducker Research, Industry Statistical Review and Forecast 1996, 1997, Table 6, p. 6 for 1990; American Architectural Manufacturers Association/Window & Door Manufacturers Association, 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/Ducker, Study of U.S. Market For Windows, Doors, and Skylights, April 2006, p. 41 for 2005.

5.5.2 Residential Storm Window and Door Shipments, by Type (million units)

	Windows				Doors				Total			
Type	1990	1995	2000	2004	1990	1995	2000	2004	1990	1995	2000	2004
Aluminum	9.9	9.2	8.0	7.1	1.9	3.8	4.3	4.4	11.8	13.0	12.3	11.5
Wood	0.5	1.8	2.3	2.2	0.4	1.3	1.4	1.8	1.1	0.9	3.1	4.0
Other (1)	0.1	0.3	3.0	0.2	0.1	0.1	0.1	0.1	0.7	0.2	0.4	0.3
Total	10.5	11.3	10.6	9.5	2.4	5.2	5.8	6.3	12.9	16.5	19.1	15.8

Note(s): 1) "Other" includes metal over wood/foam core or vinyl, etc.

Source(s): AAMA/NWWDA/Ducker Research, Industry Statistical Review and Forecast 1996, 1997, Table 7, p. 7 for 1990; American Manufacturers Association/ Window & Door Manufacturers Association, 2000 AAMA/WDMA Industry Statistical Review and Forecast, Fed. 2001, p. 7 for 1995; and 2003 AAMA/WDMA Industry Statistical Review and Forecast, June 2004, p. 6 for 2000 and 2003; AAMA/WDMA/Ducker, Study of U.S. Market For Windows, Doors, and Skylights, April 2006, p. 100, Exhibit G.1 U.S. Historic Storm Windows and Door Shipments for 2004

5.5.3 Nonresidential Window Usage, by Type and Census Region (million square feet of vision area) (1)

	Northeast		Midwest		South		West		Total	
Type	1995	2005	1995	2005	1995	2005	1995	2005	1995	2005
New Construction										
Commercial Windows (2)	4	32	16	31	21	52	13	30	54	141
Curtain Wall	7	13	6	12	16	23	8	15	33	64
Store Front	14	19	11	20	14	42	11	24	43	104
Total	14	63	33	62	51	117	32	68	130	310
Remodeling/Replacement										
Commercial Windows (2)	18	24	25	24	46	30	27	15	116	45
Curtain Wall	4	3	6	2	8	5	10	3	28	18
Store Front	12	8	18	9	24	19	22	10	76	34
Total	34	35	49	34	78	53	59	29	220	97
Total										
Commercial Windows (2)	22	57	41	54	67	82	40	45	170	238
Curtain Wall	7	15	12	14	24	27	18	18	61	75
Store Front	19	27	29	29	38	61	33	34	119	150
Total	48	99	82	97	129	171	91	97	350	463

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.

Source(s): AAMA/Ducker Research, Industry Statistical Review and Forecast 1996, March 1997, p. 17 for 1995; and AAMA/WDMA/Ducker, Study of U.S. Market For Windows, Doors, and Skylights, April 2006, p. 81 for 2005.

5.5.4 Insulating Glass Historical Penetration, by Sector (percent of total U.S. usage) (1)

Sector	1985	1990	1995	2000	2005
Residential	73%	86%	89%	92%	94%
Nonresidential	63%	80%	84%	86%	88%

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; American Architectural Manufacturers Association/Window & Door Manufacturers Association, 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; and AAMA/WDMA/Ducker, Study of U.S. Market For Windows, Doors, and Skylights, April 2006, for 2005.

5.5.5 Residential Prime Window Sales, by Type (million units)

Type	1980	1990	1995	1999	2001	2003	2005
Single Lite	8.6	4.9	5.5	4.8	3.9	4.7	4.2
Two Lite, Sealed, IG	0.0	12.0	37.8	55.2	50.9	55.9	63.8
Other	16.6	18.7	1.3	2.0	1.5	2.2	2.5
Total	25.2	35.6	44.5	62.0	56.3	62.8	70.5

Source(s): AAMA/NWWDA, Study of the U.S. Market for Windows and Doors, 1996, Table 22, p.49; AAMA/WDMA Ducker, Study of U.S. and Canadian Market for Windows and Doors, April 2000, Exhibit E.7, p. 55; AAMA/WDMA, Study of the Market for U.S. Market Doors, Window and Skylights, April 2004, Exhibit D.4, p. 46; and, AAMA/WDMA/Ducker, Study of U.S. Market For Windows, Doors, and Skylights, April 2006, Exhibit D.8 Conventional Window Glass Usage, p. 50.

5.5.6 2005 Residential Prime Window Stock, by Type

Type	Existing U.S. Stock (1) (% of households)
Single Lite	49%
Two Lite, Non-Sealed	15%
Two Lite, Sealed, IG	35%
Other	1%
Total	100%

Note(s): 1) Assumes 14 single-pane windows are replaced in housing units receiving replacement or remodeled windows. Windows in demolished housing units are assumed to be single-pane.

Source(s): EIA, Housing Characteristics 1993, June 1995, Table 3.29a for existing stock data; AAMA/NWWDA, Study of the U.S. Market for Windows and Doors, 1996, Table 22, p.49; AAMA/WDMA Ducker, Study of U.S. and Canadian Market for Windows and Doors, April 2000, Exhibit E.7, p. 55; AAMA/WDMA, Study of the Market for U.S. Market Doors, Window and Skylights, April 2004, Exhibit D.4, p. 46; U.S. Census Bureau, Manufacturing, Mining and Construction Statistics, New Residential Construction: New Privately Owned Housing Units Completed for 1999-2004 single and multi-family unit; and DOC, Current Construction Reports: Housing Completions - Annual Data, March 2001 for 1993-1998 single- and multi-family units. AAMA/WDMA/Ducker, Study of U.S. Market For Windows, Doors, and Skylights, April 2006, for 2005.

5.5.7 Nonresidential Window Stock and Usage, by Type (1)

Type	Existing U.S. Stock (% of buildings)	Glass Area Usage (million square feet) 1992	1995	2001	2003	2005
Single-Pane	53%	42	56	57	48	56
Insulating Glass (2)	47%	188	294	415	373	407
Total	100%	230	350	472	421	463
Clear	65%	9%	36%	49%	43%	44%
Tinted	28%	54%	40%	24%	17%	15%
Reflective	7%	20%	7%	8%	6%	4%
Low-e	(3)	17%	17%	19%	34%	37%
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 1994 Combined Study of the Residential and Nonresidential Markets for Windows and Skylights, Table 5, p. 5, for 1992 usage values; 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; and AAMA/WDMA/Ducker, Study of U.S. Market For Windows, Doors, and Skylights, April 2006, Exhibit D.31 and Exhibit D.32, p. 73 for 2003 and 2005.

5.5.8 Typical Thermal Performance of Residential Windows, by Type (1)

	U-Value (2)	Solar Heat Gain Coefficient (2)
Single-Pane	0.93-1.23	0.69-0.84
Single-Pane, Tinted	0.90-1.21	0.50-0.61
Double-Pane	0.49-0.73	0.62-0.76
Double-Pane, Tinted	0.48-0.73	0.40-0.54
Double-Pane, Low-e, Gas-fill	0.34-0.42	0.48-0.58
Double-Pane, Spectrally Selective Low-e, Gas-fill	0.32	0.35
Triple Pane	0.38-0.60	0.54-0.68
Triple-Pane, 2 Low-e, Gas-fill	0.24	0.40

Note(s): 1) Residential windows available in 1999 had an average U-Value of 0.47 and a SHGC of 0.45. 2) U-Value and SHGC are whole-window values calculated using Window 4.0 and standard assumptions about frame and glazing dimensions. Ranges reflect differences in frame material and design; aluminum-frame windows are on the higher end of the ranges, while wood- and vinyl-framed windows have the lowest values.

Source(s): ACEEE, 1996 ACEEE Proceedings, The National Energy Requirements of Residential Windows in the U.S.: Today and Tomorrow, Summer 1996, p. 10.48-10.50; and NFRC, Directory of Certified Products, Dec. 1999, U-Factor Chart from www.nfrc.org for Note 1.

5.6.1 U.S. Heating and Air Conditioning System Manufacturer Shipments, by Type (including exports)

Equipment Type	1990 (1000s)	2000 (1000s)	2004 (1000s)	2004 Value of Shipments ($million) (6)
Air Conditioners (1)	**2,920.0**	**5,346.0**	**5,515.0**	**4,896**
Heat Pumps	**808.7**	**1,539.2**	**2,093.8**	**1,767**
Air-to-Air Heat Pumps	808.7	1,339.4	1,886.1	1,486
Water-Source Heat Pumps (2)	N.A.	199.8	207.7	281
Chillers	**N.A.**	**38.1**	**41.8**	**1,064**
Reciprocating	N.A.	24.8	30.7	447
Centrifugal/Screw	5.0	8.5	6.2	564
Absorption	N.A.	4.8	4.8	52
Furnaces	**2,368.9**	**3,680.7**	**3,648.7**	**1,936**
Gas-Fired (3)	1,950.5	3,104.2	3,519.0	1,862
Electric	280.0	455.0	N.A.	N.A.
Oil-Fired (4)	138.5	121.5	129.7	75
Boilers (5)	**316.1**	**368.4**	**419.6**	**N.A.**

Note(s): 1) Includes exports and gas air conditioners (gas units <10,000 units/yr) and rooftop equipment. It excludes heat pumps, packaged terminal A/C 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 (GSHPs), which numbered around 75,500 units shipped in 2004. 3) Gas-fired furnace value of shipments are based on Census unit shipment data, which is about 586,000 units higher than the industry data shown. 4) Oil-fired furnace value of shipments are based on Census unit shipment data, which is approximately 34,700 units lower than the industry data shown. 5) 56% of shipments were gas-fired and 44% were oil-fired. 95% of shipments are cast iron and 5% are steel. 6) Total 2004 value of shipments for refrigeration, air-conditioning, and heating equipment was $22.0 billion,including industrial and excluding boilers and electric furnaces.

Source(s): ARI, Statistical Profile, October 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, February 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, January 2005 for 2004 boiler shipments; GAMA, Statistical Highlights, March 2005, p. 4 for 2004 furnace shipments; Appliance Manufacturer, Feb. 1998 for electric furnace; and DOC, Current Industrial Reports: Refrigeration, Air Conditioning and Warm Air Heating Equipment, MA333M(04)-1, August 2005, Table 2 for water-source heat pumps, chillers, and value of shipments.

5.6.2 Minimum Efficiency Standards for Residential Heating and Cooling Equipment

			Maximum Energy Use for Space Heating a Typical Single-Family Residence (2)							
			1992				2006			
	Minimum Efficiency (1)		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

			Maximum Electricity Use for Space Cooling a Typical Single-Family Residence							
			1992				2006			
	Minimum Efficiency (3)		New		Existing		New			
Cooling Equipment	1992	2006	North	South	North	South	North	South	North	South
Central Air-Conditioning	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, January 22, 2001, p. 7170 for central air conditioner and heat pump.

5.6.3 Residential Furnace Efficiencies (percent of units shipped) (1)

Gas-Fired				Oil-Fired	
AFUE Range	1985	AFUE Range	2004	AFUE Range	1985
Below 65%	15%	75% to 88%	68%	Below 75%	10%
65% to 71%	44%	88% and Over	32%	75% to 80 %	56%
71% to 80%	10%		100%	Over 80%	35%
80% to 86%	19%				100%
over 86%	12%				
	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 2005:	97% AFUE	Best Available in 2004:	86% AFUE

Note(s): 1) Federal appliance standards effective January 1, 1992 require a minimum of 78% AFUE for furnaces. 2) Includes boilers.
Source(s): GAMA's Internet Home Page for 2004 AFUE ranges; GAMA News, Feb. 24, 1987 for 1985 AFUE ranges; LBNL for average shipped AFUE; and GAMA, Consumer's Directory of Certified Efficiency Ratings, May 2004, p. 12 and 72-73 for 2004 best-available AFUEs.

5.6.4 Residential Boiler Efficiencies (1)

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 2005:	95% AFUE	Best Available in 2005:	89% AFUE

Note(s): 1) Federal appliance standards effective January 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, August 2005, p. 88 and 106 for best-available AFUE; and GAMA for 1985 average AFUEs.

5.6.5 Residential Air Conditioner and Heat Pump Cooling Efficiencies (1)

Equipment Type	Efficiency Parameter	2004 U.S. Average New Efficiency	2004 Best-Available New Efficiency
Air Conditioners	SEER	11.2 (2)	19.5
Heat Pump - Cooling			
Air-Source	SEER	11.5 (2)	18.6
Ground-Source	EER	16.0	27.0
Heat Pump - Heating			
Air-Source	HSPF	6.8	10.6
Ground-Source	COP	3.5	4.9

Note(s): 1) Federal appliance standards effective January 1, 1992 require a minimum SEER of 10. 2) 2003.
Source(s): EIA/Navigant Consulting, Technology Forecast Updates - Residential and Commercial Building Technologies - Reference Case, September 2004, p. 22-27; and ARI, Statistical Profile of the Air-Conditioning, Refrigeration, and Heating Industry, Oct. 2004, p. 27 for shipment-weighted SEERs.

5.6.6 Commercial Equipment Efficiencies

Equipment Type	Efficiency Parameter	2003 Stock Efficiency	2004 U.S. Average New Efficiency	2004 Best-Available New Efficiency
Chiller				
Reciprocating	COP	2.6	2.9	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	2.0	N.A.
Rooftop A/C	COP	2.7	3.0	4.0
Rooftop Heat Pump	EER	9.3	10.3	11.7
Boilers				
Gas-Fired	Thermal Efficiency	76	80	90
Oil-Fired	Thermal Efficiency	79	83	89
Electric	Thermal Efficiency	98	98	98
Gas-Fired Furnace	AFUE	76	80	92
Water Heater				
Gas-Fired	Thermal Efficiency	76	80	99
Electric Resistance	Thermal Efficiency	96	98	98
Gas-Fired Instantaneous	Thermal Efficiency	76	80	87

Source(s): EIA/Navigant Consulting, EIA - Technology Forecast Updates - Residential and Commercial Buildings Technologies Reference Case, September 2004, p. 38-68.

5.6.7 2005 Air-Conditioner/Heat Pump Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
UTC/Carrier	28%
Goodman (Amana)	16%
American Standard (Trane)	15%
Lennox	12%
Rheem	11%
York	10%
Nordyne	7%
Others	2%
	100%

Total Units Shipped: 8,607,525 (1)

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, Sep. 2006, p. P-2.

5.6.8 2005 Gas Furnace Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
UTC/Carrier	30%
Goodman (Amana)	15%
Lennox	14%
American Standard (Trane)	13%
Rheem	11%
York	9%
Nordyne	6%
Others	2%
	100%

Total Units Shipped: 3,512,464

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sep. 2006 p. P-2.

5.6.9 Major Residential HVAC Equipment Lifetimes, Ages, and Replacement Picture

Equipment Type	Typical Service Lifetime Range	Average Lifetime	1990 Average Stock Age	Units to be Replaced During 2007
Central Air Conditioners	**8 - 15**	**12**	**9**	**4,063,176**
Heat Pumps	**8 - 15**	**12**	**8**	**1,024,885**
Furnaces				**2,286,504**
Electric	10 - 20	15	11	N.A.
Gas-Fired	12 - 17	15	12	2,106,898
Oil-Fired	15 - 20	18	N.A.	179,606
Steam or Hot-Water Boilers (gas and oil)	**20 - 40**	**N.A.**	**14**	**N.A.**

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, Sep. 2006, p. P-5 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.

5.6.10 Major Commercial HVAC Equipment Lifetimes and Ages

Equipment Type	Median Lifetime
Air Conditioners	
Through-the-Wall	15
Water-Cooled Package	15
Roof-Top	15
Chillers	
Reciprocating	20
Centrifugal	23
Absorption	23
Heat Pumps	
Air-to-Air	15
Water-to-Air	19
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)	20

Source(s): ASHRAE, 2003 ASHRAE Handbook: HVAC Applications, Table 3, p. 36.3 for median service lifetimes.

5.6.11 Main Residential Heating Fuel by Vintage as of 2001 (percent of total households)

Heating Fuel	1990 to 2001	1980 to 1989	1970 to 1979	1960 to 1969	1950 to 1959	1949 or Before
Natural Gas	56%	41%	42%	63%	67%	68%
Electricity	36%	50%	45%	22%	16%	11%
Fuel Oil	2%	2%	4%	8%	13%	14%
LPG	5%	5%	4%	4%	3%	6%
Other (1)	1%	2%	4%	2%	1%	2%
	100%	100%	100%	100%	100%	100%

Note(s): 1) Other includes wood and kerosene.

Source(s): EIA, A Look at Residential Energy Consumption in 2001, Apr. 2004, Table HC3-2a.

5.6.12 Main Residential Heating Equipment as of 1987, 1993, 1997, and 2001 (percent total households)

Equipment Type	1987	1993	1997	2001
Natural Gas	**55%**	**53%**	**53%**	**55%**
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%
Electricity	**20%**	**26%**	**29%**	**29%**
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%
Fuel Oil	**12%**	**11%**	**9%**	**7%**
Steam or Hot-Water System	7%	6%	5%	4%
Central Warm-Air Furnace	4%	5%	4%	3%
Other	1%	0%	0%	0%
Other	**13%**	**11%**	**9%**	**8%**
	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, April 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.

5.6.13 Main Commercial Heating and Cooling Equipment as of 1995 and 1999 (percent of total floorspace) (1)

Heating Equipment	1995	1999	2003 (2)
Packaged Heating Units	29%	38%	28%
Boilers	29%	29%	32%
Individual Space Heaters	29%	26%	19%
Furnaces	25%	21%	30%
Heat Pumps	10%	13%	14%
District Heat	10%	8%	8%
Other	11%	6%	5%

Cooling Equipment	1995	1999	2003 (2)
Packaged Air Conditioning Units	45%	54%	46%
Individual Air Conditioners	21%	21%	19%
Central Chillers	19%	19%	18%
Residential Central Air Conditioners	16%	12%	17%
Heat Pumps	12%	14%	14%
District Chilled Water	4%	4%	4%
Swamp Coolers	4%	3%	2%
Other	2%	2%	2%

Note(s): 1) Heating and cooling equipment percentages of floorspace add to over 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, October 1998, Tables B34 and B36 for 1995, and EIA, Commercial Building Characteristics 1999, August 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.

5.6.14 Main Commercial Primary Energy Use of Heating and Cooling Equipment as of 1995

Heating Equipment	
Packaged Heating Units	25%
Boilers	21%
Individual Space Heaters	2%
Furnaces	20%
Heat Pumps	5%
District Heat	7%
Unit Heater	18%
PTHP & WLHP	2%
	100%

Cooling Equipment	
Pakaged Air Conditioning Units	54%
Room Air Condtioning	5%
PTAC	3%
Centrifugal Chillers	14%
Reciprocating Chillers	12%
Rotary Screw Chillers	3%
Absorption Chillers	2%
Heat Pump	7%
	100%

Source(s): BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume 1: Chillers, Refrigerant Compressors, and Heating Systems, April 2001, Figure 5-5, p. 5-14 for cooling and Figure 5-10, p. 5-18 for heating.

5.7.1 U.S. Commercial Buildings Conditioned Floorspace, Building Type and System Type (million square feet)

	Individual AC	Packaged	Central VAV	Central FCU	Central CAV	Not Cooled	Total
Education	805	2,204	551	466	212	3,522	7,760
Food Sales	0	534	0	0	0	20	554
Food Service	83	1,100	0	0	0	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	10,231
Public Buildings	371	3,337	847	0	751	2,168	7,464
Warehouse/Storage	119	1,482	0	0	102	2,285	3,988
Totals	4,771	19,767	5,287	2,822	3,352	12,065	48,064

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 A2-1, p. A2-1.

5.7.2 Thermal Distribution Design Load and Electricity Intensities, by Building Activity

	Design Load Intensity (W/SF)	End Use Intensity (kWh/SF)
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
Total	1.0	2.8

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.

5.7.3 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.

5.7.4 Typical Commercial Building Thermal Energy Distribution Design Load Intensities (W/SF)

Distribution System Fans		**Other**	
Central System Supply Fans	0.3 - 1.0	Cooling Tower Fan	0.1 - 0.3
Central System Return Fans	0.1 - 0.4	Air-Cooled Chiller Condenser Fan	0.6
Terminal Box Fans	0.5	Exhaust Fans (2)	0.05 - 0.3
Fan-Coil Unit Fans (1)	0.1 - 0.3	Condenser Fans	0.6
Packaged or Split System Indoor Blower	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.

5.7.5 Market Share of Major HVAC Equipment Manufacturers ($2003 million)

	Total Market Size
Air Handling Units	873
Cooling Towers	450
Pumps	281
Central System Terminal Boxes	162
Classroom Unit Ventilator	135
Fan Coil Units	104

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 2003, Sept. 2004, Appendix D, p. 367 for price deflators.

5.7.6 1999 Energy Efficient Motors, Replacements and Sales by Horsepower Class

	Existing		Replacements	
	Units in Use			Energy Efficient
Horsepower Range	(1000s)	Horsepower	% Retired	Share of New Motors
1-5	20,784	59,613,173	2.5%	17%
5.1-20	6,927	81,812,936	2.0%	29%
21-50	2,376	78,226,027	1.5%	45%
51-100	738	59,594,854	1.0%	52%
101-200	412	56,486,620	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

5.7.7 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%

Source(s): Electrical Apparatus Service Association, Past Trends and Probably Future Changes in the Electric Motor Industry 1990-1999, 2001, p. 30.

5.8.1 Solar Collector Shipments, by Type and Market (thousand square feet, unless noted) (1)

Type	1980	1990	2000	2003	2004 (2)	2004 Value of Shipments ($million)
Solar Thermal Collectors (3)	19,398	11,409	8,354	11,444	14,114	34.3
Residential	N.A.	5,851	7,473	10,506	12,864	N.A.
Commercial	N.A.	295	810	864	1,178	N.A.
Industrial	N.A.	(4)	57	71	70	N.A.
Utility	N.A.	5,236	5	0	0	N.A.
Other	N.A.	26	10	2	3	N.A.
Photovoltaics (kW) (5)	6897 (6)	13,837	88,221	109,357	181,116	492.7

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 2004, November 2005, Table 37 and Table 38, p. 15 and 16 for 2003-2004 collector data, Table 47, p. 25 for 2000-2004 PV shipments, and Table 50, p. 28 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) (1000 Square Feet) (1)

Type	2000	2002	2003	2004
Pool Heating	7,868	11,073	10,800	13,634
Hot Water	367	423	511	452
Space Heating	99	146	76	13
Combined Space/Water Heating	2	17	23	16
Process Heating	20	4	34	0
Electricity Generation	3	0	0	0
Total	8,354	11,663	11,444	14,114

Note(s): 1) 5.8% of shipments are exported. 2) Approximately 30,000 systems in 2004.

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 2002; and EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2004, Nov. 2005, Table 38, p. 16 for 2003-2004, Table 30, p. 10 for Note 1, and Table 39, p. 17 for Note 2.

5.8.3 2004 Top Five Destinations of Thermal Solar Collector Shipments (1)

State or Territory	Percent of U.S. Unit Shipments
Florida	35%
California	31%
Arizona	5%
New Jersey	4%
Illinois	3%

Note(s): 1) Preliminary.

Source(s): EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2004, November 2005, Table 32, p. 10.

5.8.4 Thermal Solar Collector Manufacturer Statistics (1)

- Number of Manufacturers in 2004: 24
- Percentage of Shipped Solar Collectors Produced by Top 5 Manufacturers: 94%
- Percentage of Shipped Solar Collectors Produced by Top 10 Manufacturers: 99%

Note(s): 1) Preliminary.

Source(s): EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2004, November 2005, Table 41, p. 19.

5.8.5 Shipments of Photovoltaic Cells and Modules by Market (Peak Kilowatts)

Market	2,002	2,003	2004 (1)
Industrial	32,218	27,951	30,493
Residential	29,315	23,389	53,900
Commercial	20,578	32,604	67,751
Transportation	12,932	11,089	1,380
Utility	7,640	8,474	9,991
Government	8,565	5,538	3,257
Other	841	313	14,316
Total	12,090	109,357	181,116

Note(s): 1) Preliminary.

Source(s): EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2004, November 2005, Table 51, p. 29; and, EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2003, September 2004, Table 30, p.14.

5.8.6 Annual Shipments of Photovoltaic Cells and Modules (Peak Kilowatts)

Year	Number of Companies	Domestic	Exports	Total
1995	24	11,188	19,871	31,059
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 (1)	19	78,346	102,770	181,116

Note(s): 1) Preliminary.

Source(s): EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2004, November 2005, Table 45 and Table 47, p. 23 and p. 25.

5.8.7 2004 Top 5 Destinations of U.S. Photovoltaic Cell and Module Export Shipments by Country

Country	Peak Kilowatts	Percent of U.S. Exports
Germany	42,128	41%
Netherlands	28,744	28%
Hong Kong	11,793	11%
Spain	3,662	4%
Canada	2,452	2%
Total	102,770	100%

Source(s): EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2004, November 2005, Table 53, p. 31.

5.9.1 2001 Total Lighting Technology Electricity Consumption, by Sector (10^9 kWh/year) (1)

	Residential		Commercial		Industrial		Other (2)		Total	
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%	71	9%
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%
Total (3)	202	100%	391	100%	108	100%	56	100%	756	100%

Note(s): 1) Lumen-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 10^9 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 Operatrions, p. 271, for note 3.

5.9.2 2001 Total Lighting Technology Light Output, by Sector (10^12 lumen-hour/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%	358	2%	8	0%	23	0%	491	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 Vapor	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%
Total	3,797	100%	21,575	100%	8,100	100%	4,723	100%	38,194	100%

Note(s): 1) Lumen-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.

5.9.3 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	(2) 0	12	1	2	10	14	8
Fluorescent											
T5	N.A.	8	10	N.A.	N.A.	8	10	N.A.	13	18	N.A.
T8	N.A.	32	30	105	N.A.	32	30	N.A.	10	13	7
T12	N.A.	51	66	190	N.A.	51	66	N.A.	10	13	7
CFL	17	19	27	N.A.	17	19	27	2	11	14	N.A.
Miscellaneous	41	18	34	83	41	18	34	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.

5.9.4 1995 Lighting Energy Intensities, by Commercial Building Type

Building Types	Percent of Total Lighted Floorspace	Percent of Total Annual Lighting Energy	Annual Lighting End-Use Intensity per Total Lighted Floorspace (kWh/ft2)
Education	13.6%	10.1%	4.6
Food Sales	1.1%	1.8%	9.9
Food Service	2.4%	4.2%	10.8
Health Care	4.1%	7.7%	11.5
Lodging	6.4%	7.0%	6.8
Mercantile and Service	22.4%	24.8%	6.9
Office	18.6%	24.5%	8.2
Public Assembly	7.0%	7.2%	6.4
Public Order and Safety	2.3%	1.7%	4.8
Warehouse and Storage	14.0%	6.9%	2.9
Other	1.8%	2.2%	7.8
Vacant	6.2%	1.9%	1.3
	100%	100%	

Note(s): Total lighted floorspace in 1995 was 56.3 billion square feet. Total lighted floorspace for 1999 was 67.3 billion square feet.
Source(s): EIA, A Look at Commercial Buildings in 1995: Characteristics, Energy Consumption, and Energy Expenditures, Oct. 1998, Table BC-40, p. 187, Table EU-1, p. 306-310, and Table EU-2, p. 311-315.

5.9.5 2003 Lighted Floorspace for the Stock of Commercial Buildings, by Type of Lamp (1)

Type of Lamp	Lighted Floorspace (million square feet) (2)	Percent of Lighted Floorspace
Standard Fluorescent	59,688	96%
Incandescent	38,525	62%
Compact Fluorescent	27,571	44%
High-Intensity-Discharge	20,643	33%
Halogen	17,703	29%

Note(s): 1) Mall buildings are no longer included in most CBECs tables; therefore, some data is 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.

5.9.6 Value of Shipments of Electric Lighting Fixtures ($million)

Lighting Fixture Type	1985	1990	1995	2000	2001
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, January 2003 for 2000 and 2001; DOC, Current Industrial Reports: Electric Lighting Fixtures, MA335L(99)-1, December 2000, Table 1 for 1990-1999; and DOC, Current Industrial Reports: Electric Lighting Fixtures, MA36L, Oct. 1995, Table 1 for 1985.

5.9.7 Shipments of Fluorescent Lamp Ballasts

	Standard Magnetic Type (1)		Electronic Type		Total		
Year	Quantity (million)	Value ($million)	Quantity (million)	Value ($million)	Quantity (million)	Value ($million)	Electronic Type as a % of Total Units Shipped
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%
2001	46.9	297.1	52.5	580.3	99.4	877.4	53%
2002	40.7	263.3	53.8	573.1	94.5	836.4	57%
2003	35.2	231.8	54.4	557.2	89.7	789.0	61%
2004	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.

5.9.8 Typical Efficacies and Lifetimes of Lamps (1)

Current Technology	Efficacy (lumens/watt)	Typical Rated Lifetime (hours)	CRI (2)
Incandescent	10-19	750-2500	97
Halogen	14-20	2000-3500	99
Fluorescent - T5	25-55	6000-7500	52-75
Fluorescent - T8	35-87	7500-20000	52-90
Fluorescent - T12	35-92	7500-20000	50-92
Compact Fluorescent	40-70	10000	82
Mercury Vapor	25-50	29000	15-50
Metal Halide	50-115	3000-20000	65-70
High Pressure Sodium	50-124	29000	22
Low Pressure Sodium	18-180	18000	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 efficancy goal of 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, September 2002, Appendix A, p. 74; DOE/Navigant Consulting, Solid State Lighting Research and Development Portfolio, March 2006, p 55.

5.10.1 Refrigeration System Shipments, by Type (including exports)

Appliance Type	1990 (1000)	2000 (1000)	2004 (1000)	2004 Value of Shipments ($million)
Refrigerator/Freezers (1)	7,317	9,462	11,194	N.A.
Freezers (chest and upright)	1,328	2,007	2,561	N.A.
Refrigerated Display Cases	359	347	185	N.A.
Unit Coolers	178	207	215	145.0
Ice-Making Machines	171	385	346	585.7
Water Cooler	253	348	185	463.8
Beverage Vending Machine	229	353	350	N.A.

Note(s): 1) Does not include commercial products value.

Source(s): Appliance Magazine, 52nd Annual Statistical Review, May 2005, p. S1-S4 for refrigerator, freezer, refrigerated display cases, water cooler, and beverage vending machines shipments; The Air Conditioning, Heating and Refrigeration News, November 11, 1995, p. 19 for 1990 unit cooler and ice-making machine shipments; and DOC, Current Industrial Reports: Refrigeration, Air Conditioning, and Warm Air Heating Equipment, MA333M(05)-1, July 2006, for 2004 unit cooler and ice-making machine data and value of shipments.

5.10.2 Other Major Appliance Shipments, by Type (including exports)

Appliance Type	1990 (1000)	2000 (1000)	2004 (1000)	2004 Value of Shipments ($million)
Room Air Conditioners	**3,799**	**6,496**	**8,082**	**974**
Ranges (total)	**5,873**	**8,202**	**9,864**	**7,226**
Electric Ranges	3,350	5,026	6,145	5,621
Gas Ranges	2,354	3,176	3,719	1,606
Microwave Ovens/Ranges	**7,693**	**12,644**	**15,526**	**1,350**
Clothes Washers	**5,591**	**7,495**	**8,832**	**2,983**
Clothes Dryers (total)	**4,160**	**6,575**	**7,922**	**2,225**
Electric Dryers	3,190	5,095	6,262	N.A.
Gas Dryers	970	1,480	1,660	N.A.
Water Heaters (total)	**7,252**	**9,329**	**9,820**	**1,827**
Electric (1,2)	3,246	4,299	4,673	684
Gas and Oil (2)	4,005	5,006	5,147	1,143
Solar (3)	N.A.	24	N.A.	N.A.
Office Equipment				
Personal Computers (4)	N.A.	47,168	54,239	26,635
Copiers	N.A.	1,989	1,812	N.A.
Printers	N.A.	27,945	19,706	N.A.
Scanners	N.A.	9,400	10,815	N.A.

Note(s): 1) Heat pump water heaters sales 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 2000-2004 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; 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, August 2006, Table 2 for value of computer shipments; and Appliance, 52nd Annual Statistical Review, May 2005, p. S1-S4 for office equipment shipments.

5.10.3 Minimum Efficiency Standards for Appliances and Equipment

Refrigerator-Freezers (Auto Defrost) (1)	Adjusted Volume (2) (Cu. Ft.)	Rated Maximum Electricity Use (kWh) 1990	1993	2001
Top freezer w/o through-the-door ice service and all-refrigerators—auto defrost	20.6	955	685	478
Side freezer w/o through-the-door ice service	25.1	1183	797	631
Bottom freezer w/o through-the-door ice service	25.1	1183	781	574
Top freezer w/ through-the-door ice service	18.2	1015	711	542
Side freezer w/ through-the-door ice service	28.5	1428	992	694

Freezers (1)	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	1103	838	699
Chest Freezers and all other Freezers except Compact Freezers	24.8	590	433	389

Room Air-Conditioners (3)	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	1314
20,000 Btu/h or more	8.5	1765

Clothes Dryers (3)	Minimum EF (lbs./kWh)	Typical Maximum Energy Use
Electric, Standard	3.01	835 kWh
Gas	2.67	32 therms

Clothes Washers (3)	Minimum EF (cu. Ft./kWh per cycle) 1994	Minimum Modified EF (cu. Ft./kWh per cycle) 2004	2007	Typical Maximum Electricity Use (kWh) (5)
Top Loading, Standard	1.18	1.04	1.26	1265
Horizontal-Axis	N.A.	1.04	1.26	731

Dishwashers (3)	Minimum EF (cycles/kWh)	Typical Maximum Electricity Use (kWh)
Standard Dishwasher	0.46	498

Water Heaters (6)	Minimum EF (7) 1990	1991	2004	Typical Maximum Energy Use 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 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 Efficienct 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.

5.10.4 Refrigerator-Freezer Sizes and Energy Factors (shipment-weighted averages)

	Average Volume (cu. ft.)	Consumption/Unit (kWh/yr)	Best-Available (kWh/yr)
1972	18.2	1726	N.A.
1980	19.6	1278	N.A.
1985	19.5	1058	N.A.
1990	20.5	916	N.A.
1991	19.8	857	761
1992	19.8	821	N.A.
1993	20.1	660	631
1994	20.0	653	592
1995	20.0	649	555
1996	20.3	661	524
1997	20.4	669	524
1998	N.A.	N.A.	524
1999	20.6	690	559
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

Note(s): The average stock energy uses for refrigerator-freezers was 1220 kWh/yr in 1990, 1319 kWh/yr in 1997, and 1462 kWh/yr in 2001.

Source(s): 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; April 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 2001-2004 best available, http://www.energystar.gov/ia/products/prod_lists/appliances_prod_list.xls.

5.10.5 Room Air Conditioner Capacities and Energy Efficiencies (shipment-weighted averages)

	Average Capacity (Btu/hr)	EER	Best-Available (EER)
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.
1991	10,846	8.80	N.A.
1992	10,100	8.88	N.A.
1993	10,264	9.05	N.A.
1994	10,087	8.97	12.0
1995	10,099	9.03	12.0
1996	9,928	9.08	12.0
1997	10,015	9.09	12.0
1998	N.A.	N.A.	11.7
1999	9,596	9.07	11.7
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

Source(s): 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 2001-2004 best available, http://www.energystar.gov/ia/products/prod_lists/appliances_prod_list.xls.

5.10.6 Water Heater Efficiencies

Residential Type	Efficiency Parameter (1)	2003 Stock Efficiency	Minimum New Efficiency (2)	2005 Best-Available New Efficiency
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	0.55	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
Commercial Type				
Electric Storage	Thermal Efficiency	96%	98%	98%
Gas-Fired Storage	Thermal Efficiency	76%	80%	94%
Oil-Fired Storage	Thermal Efficiency	75%	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 40 gallon residential type tank. 3) Included in storage stock efficiency.

Source(s): EIA, Supplement to the AEO 2005, Feb. 2005, Table 21 and Table 22 for stock efficiencies; GAMA, Consumer's Directory of Certified Efficiency Ratings for the Residential and Water Heating Equipment, August 2005 for best available efficiencies and minimum efficiencies; and SRCC, Summary of SRCC Certified Solar Collector and Water Heating System Ratings, Apr. 2000, p. S-16 - S-20 for SEFs, Table 2.2, p. 4.

5.10.7 Other Major Appliance Efficiencies

Residential Appliance Type	Efficiency Parameter (1)	2003 Stock Efficiency	2004 U.S. Average New Efficiency	2005 Best Available New Efficiency
Dishwashers	EF	0.40	0.55	1.50
Clothes Washers (2)	MEF	0.92	1.35	2.66

Commercial Appliance Type	Efficiency Parameter (1)	2003 Stock Efficiency	U.S. Average New Efficiency	2001 Best Available New Efficiency	
Cooking Equipment:					
Electric Appliances	EF	0.72			
Gas Appliances	EF	0.51			
Laundry Equipment:					
Electric Drying	EF/COP			0.98	(3)
Gas Drying	EF			0.36	(3)
Motors	EF			0.65	(3)
Office Equipment:					
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, 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, August 2005 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.

5.10.8 2005 Room Air Conditioner Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
LG Electronics (Goldstar)	30%
Fedders	14%
Electrolux (Frigidaire)	14%
Whirlpool	14%
Haier	5%
Samsung	5%
Sharp	4%
Matsushita	2%
Friedrich	4%
Others	8%
	100%

Total Units Shipped: 8,032,000

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2006, p. P-2.

5.10.9 2005 Refrigerator Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
GE	29%
Electrolux (Frigidaire)	25%
Whirlpool	25%
Maytag (Admiral)	11%
Haier	2%
W.C. Wood	1%
Other	7%
	100%

Total Units Shipped: 11,134,000

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2006, p. P-3.

5.10.10 2005 Range Manufacturer Market Shares (by percentage of products produced)

Company	Electric Market Share (%)	Gas Market Share (%)
GE	49%	37%
Whirlpool	23%	11%
Maytag	10%	17%
Electrolux (Frigidaire)	10%	25%
Peerless Premier	4%	6%
Others	4%	4%
	100%	100%

Total Electric Units Shipped: 6,194,000

Total Gas Units Shipped: 3,756,000

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2006, p. P-2.

5.10.11 2005 Microwave Oven Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
LG Electronics (Goldstar)	35%
Sharp	20%
Samsung	12%
Daewoo	9%
Matsushita	8%
Whirlpool	4%
Galanz	3%
Midea	2%
Others	7%
	100%

Total Units Shipped: 14,081,000

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2006, p. P-3.

5.10.12 2005 Clothes Washer Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
Whirlpool	51%
Maytag	19%
GE	17%
Electrolux (Frigidaire)	9%
Others	4%
	100%

Total Units Shipped: 9,225,000

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2006, p. P-3.

5.10.13 Sales of ENERGY STAR Labeled Appliances, by year (thousands) and (% of Total Sales)

	Room Air Conditioners		Refrigerators		Clothes Washer		Dishwashers	
	ENERGY STAR	% of Total	ENERGY STAR	% of Total	ENERGY STAR	% of Total	ENERGY STAR	% of Total
1997	474	12%	2,008	25%	226	4%	265	6%
1998	589	13%	1,705	19%	392	6%	955	19%
1999	835	13%	2,218	24%	624	9%	664	12%
2000	1,230	19%	2,489	27%	697	9%	595	11%
2001	642 (1)	12%	1,610 (2)	17%	758	10%	1,119	20%
2002	2,195	36%	1,956	20%	1,262	16%	2,262	36%
2003	2,369	29%	2,570	26%	1,879	23%	1,290	20%
2004	2,632	35%	3,628	33%	2,405	27%	5,437	78%

Note(s): 1) On October 1, 2000, ENERGY STAR room air conditioner criteria changed to 10% more efficient than the 2000 federal standard.
2) On January 1, 2001, ENERGY STAR refrigerator criteria changed to 10% more efficient than the 2001 federal standard.

Source(s): D&R International, Resources for Appliance Manufacturers and Retailers, www.energystar.gov, March 2005.

5.10.14 2005 Clothes Dryer Manufacturer Market Shares (by percentage of products produced)

Company	Electric Market Share (%)	Gas Market Share (%)
Whirlpool	56%	55%
Maytag	18%	25%
GE	14%	11%
Electrolux (Frigidaire)	10%	7%
Others	2%	3%
	100%	100%

Total Electric Units Shipped: 6,451,000

Total Gas Units Shipped: 1,707,000

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2006, p. P-3.

5.10.15 2005 Water Heater Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
Rheem Manufacturing	39%
A.O. Smith/State Industries	26%
American Water Heater	19%
Bradford-White	15%
Others	1%
	100%

Total Units Shipped: 9,319,786

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2006, p. P-3.

5.10.16 2005 Facsimile and Copier Machine Manufacturer Market Shares (by percentage of products produced)

Company	Facsimile Machine Market Share (%)	Copier Market Share (%)
Hewlett-Packard	33%	10%
Brother	33%	-
Panasonic Panafax	17%	-
Sharp	11%	9%
Lexmark	8%	-
Canon	4%	26%
Xerox	1%	9%
Ricoh	-	8%
Others	4%	38%
	111%	100%

Total Facsimile Machine Units Shipped: 3,838,000

Total Copier Units Shipped: 2,013,000

Note(s): In 2004, 95% of facsimile machines sales were ENERGY STAR compliant and 90% are estimated to remain ENERGY STAR enabled.
In 2004, 90% of copier machine sales were ENERGY STAR compliant and 34% are estimated to remain ENERGY STAR enabled.

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2006, p. P-2; and EIA/Navigant Consulting, EIA - Technology Forecast Updates - Residential an Commercial Building Technologies - Reference Case, September 2004, p. 70 for note.

5.10.17 2005 Personal Computer Manufacturer Market Shares (by percentage of products produced)

Company	Desktop Computer Market Share (%)	Portable Computer Market Share (%)
Dell	35%	31%
Hewlett-Packard	20%	18%
Gateway	7%	-
Levono (IBM)	2%	5%
Apple	3%	6%
Toshiba	-	11%
Others	33%	29%
	100%	100%

Total Desktop Computer Units Shipped: 39,698,000

Total Portable Computer Units Shipped: 19,551,000

Note(s): In 2004, 80% of desktop computer sales were ENERGY STAR compliant and 25% are estimated to remain ENERGY STAR enabled.

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2006, p. P-2; and EIA/Navigant Consulting, EIA - Technology Forecast Updates - Residential an Commercial Building Technologies - Reference Case, September 2004, p. 70 for note.

5.10.18 2005 Printer Manufacturer Market Shares (by percentage of products produced)

Company	Ink Jet Printer Market Share (%)	Laser Printer Market Share (%)	Dot Matrix Market Share (%)
Hewlett-Packard	39%	56%	-
Lexmark	18%	7%	10%
Epson	12%	-	23%
Canon	14%	-	-
Dell	18%	12%	
Samsung	-	4%	-
Brother	-	6%	-
Konica-Minolta	-	5%	-
Okidata	-	-	49%
Panasonic	-	-	6%
Genicom (Tally)	-	-	6%
Others	-	10%	6%
	100%	100%	100%

Total Ink Jet Units Shipped: 14,463,000

Total Laser Units Shipped: 4,477,000

Total Dot Matrix Units Shipped: 292,000

Note(s): In 2004, 99% of laser printer sales were ENERGY STAR compliant and 47% are estimated to remain ENERGY STAR enabled.

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2006, p. P-2; and EIA/Navigant Consulting, EIA - Technology Forecast Updates - Residential an Commercial Building Technologies - Reference Case, September 2004, p. 70 for note.

5.10.19 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 2006
Refrigerators (1)	10 - 18	14	8	7,760,800
Freezers	8 - 16	12	12	1,692,200
Room Air Conditioners	7 - 13	10	8	4,817,200
Microwave Ovens	7 - 10	9	N.A.	9,248,600
Ranges (2)				
Electric	12 - 19	16	N.A.	3,529,200
Gas	14 - 22	18	N.A.	2,457,000
Clothes Washers	7 - 14	11	N.A.	7,101,100
Clothes Dryers				
Electric	8 - 15	12	N.A.	4,035,800
Gas	8 - 15	12	N.A.	1,303,100
Water Heaters				
Electric	4 - 20	12	9	3,896,839
Gas	3 - 15	9	9	4,618,338
Facsimile Machines	3 - 6	4	N.A.	6,014,125
Portable Computers	2 - 4	3	N.A.	12,415,744

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. 2006, p. P-5 - P-6 for service and average lifetimes and units to be replaced; EIA, A Look at Residential Energy Consumption in 2001, April 2004, Table HC4-1a and Table HC5-1a for average stock ages.

5.10.20 Major Appliance Ownership (number of households in millions and percent of U.S. households)

	1982		1990		1996		2001		2005	
Appliance Type	Hholds	%	Hholds	%	Hholds	%	Hholds	%	Hholds	%
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.
Total U.S. Households	83.6		94.0		98.9		107.0		108.8	

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.

6.1.1 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.

6.1.2 Consumption Comparisons in 2004

One quad equals:

- 49 million short tons of coal
  - = enough coal to fill a train of railroad cars 4,450 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
  - = 19.8 million passenger cars each driven 12,200 miles
  - = 17.9 million light-duty vehicles each driven 11,500 miles
  - = all new passenger cars and light-duty trucks sold each driven 11,500 miles
  - = 14.5 million stock passenger cars each driven 11,500 miles = 11% 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 = 15 days of U.S. imports = 177 days of oil flow in the Alaska pipeline at full capacity
  - = the amount of crude oil transported by 483 supertankers
- 21 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 2.9 million people in the U.S.
- the approximate annual primary consumption of any one of the following states: Arkansas, Connecticut, Iowa, Kansas, Mississippi, or Oregon (2002)

Source(s): EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136, Table A7, p. 145-146, Table A8, p. 147-148, Table A9, p. 149-150, Table A11, p. 152-153 for consumption, Table G1, p. 221 for heat rates; EIA, State Energy Data 2002: Consumption, June 2006, Table S3, p. 5 and Table R2, p. 14; EIA, Electric Power Annual 2004, November 2005,Table 2.2, p. 17; EIA, International Energy Outlook 2006, June 2006, Table A1, p. 83; DOC, Statistical Abstract of the United States 2006, Jan. 2006, No. 1027, p. 679, No. 1078 p. 711, No. 1084, p. 715; and Newport News Shipbuilding Website.

6.1.3 Carbon Emission Comparisons

One million metric ton of carbon equivalent emissions equals:

- the combustion of 1.91 million short tons of coal
- the coal input to 3 coal plant (200-MW) in one year
- the combustion of 67 billion cubic feet of natural gas
- the combustion of 431 million gallons of gasoline = the combustion of gasoline for 26 hours in the U.S.
  - = 1.0 million new cars each driven 12,200 miles
  - = 932 thousand new light-duty vehicles each driven 11,500 miles
  - = 805 thousand new light trucks each driven 11,500 miles
  - = 0.5 million new passenger cars each making 5 round trips of New York to Los Angeles
- the combustion of 694 million gallons of LPG
- the combustion of 388 million gallons of kerosene
- the combustion of 375 million gallons of distillate fuel
- the combustion of 321 million gallons of residual fuel
- 77 minutes of world energy emissions
- 6 hours of U.S energy emissions
- 14 hours of U.S. Buildings energy emissions
- 27 hours of U.S. Residential energy emissions
- 31 hours of U.S. Commercial energy emissions
- 3 days of U.S. Buildings lighting energy emissions
- average annual per capita emissions of 183,000 people in the U.S.

Source(s): EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136, Table A7, p. 145-146 for consumption, Table A18, p. 160 for emissions, and Table G1, p. 221 for heat rates; EIA, Electric Power Annual 2004, November 2004, Table 2.2, page 17; EIA, International Energy Outlook 2006, June 2006, Table A10, p. 93; EIA, Assumptions to the AEO 2006, Mar. 2006, Table 2, p. 9 for carbon coefficients; and DOC, Statistical Abstract of the United States 2006, Jan. 2006, No. 2, p. 8 and No. 1084, p. 715.

6.1.4 Average Annual Carbon Dioxide Emissions for Various Functions

	Annual Unit Energy Consumption		Carbon Emissions (MTCE)	Carbon Emissions (lb CO2)
Stock Refrigerator	1249	kWh - Electricity	0.2	1,800
Stock Electric Water Heater	2549	kWh - Electricity	0.4	3,600
Stock Gas Water Heater	19.8	million Btu - Natural Gas	0.3	2,300
Stock Oil Water Heater	28.3	million Btu - Fuel Oil	0.6	4,500
Single-Family Home	107.3	million Btu	3.1	25,000
Mobile Home	75.9	million Btu	2.2	17,700
Multi-Family Unit in Large Building	41.0	million Btu	1.2	9,500
Multi-Family Unit in Small Building	78.1	million Btu	2.2	18,200
School Building	2125	million Btu	71.5	578,400
Office Building	1376	million Btu	46.3	374,500
Hospital, In-Patient	60152	million Btu	2025.0	16,372,500
Stock Vehicles				
Passengar Car	550	gallons - Gasoline	1.3	10,600
Van, Pickup Truck, or SUV	647	gallons - Gasoline	1.5	12,400
Heavy Truck	1886	gallons - Diesel Fuel	4.6	37,400
Tractor Trailer Truck	11980	gallons - Diesel Fuel	29.4	237,700

Source(s): EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 for consumption and Table A18, p. 160 for emissions, and Table G1, p. 221 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 25, 2006, 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 Annual Energy Outlook 2006, Mar. 2006, Table 2, p. 9 for carbon coefficients.

6.2.1 2004 Impacts of Saving an Electric Quad (1)

Plant Tuel Type	Utility Fuel Input Shares (%)	Average-Sized Utility Unit (MW) in 2004	Aggregate Number of Units to Provide the Fuel's Share of the Electric Quad (2)
Natural Gas	14.1%	67	121
Petroleum	2.9%	26	121
Coal	52.5%	205	40
Nuclear	21.3%	958	3
Renewable (3)	9.2%	20	150
Total	100%		434

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 2004. Use this table to estimate the avoided capacity implied by saving one electric quad. 2) Based on the fact that typical U.S. power plants operate less than fully loaded throughout the year. 3) Includes pumped storage.

Source(s): EIA, Electric Power Annual 2004, Nov. 2005, Table 2.2, p. 17; and EIA, Annual Energy Outlook 2006, Feb. 2006, Table A2, p. 134-136 for consumption and Table A8, p. 147-148 for electricity supply.

6.2.2 Cost of an Electric Quad Used in the Buildings Sector ($2004 billion)

	2004	2010	2015	2020	2025	2030
Residential	8.24	7.86	7.84	8.00	8.23	8.49
Commercial	7.40	7.07	7.00	7.20	7.49	7.77
Buildings Sector	7.83	7.47	7.42	7.59	7.85	8.11

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 2006, Feb. 2006, Table A2, p. 134-136 and Table A3, p. 137-138.

6.2.3 Characteristics of New and Stock Generating Capacities, by Plant Type

	2005 Heat Rate	2010 Heat Rate	2005 Installed Capital Costs of a Typical Power Plant		
			Price	Size	Cost
New Plant Type	(Btu/kWh)	(Btu/kWh)	($2004 thousand per MW)	(MW)	($2004 million)
Pulverized Coal	8,844	8,763	1,249	600	749
Coal-Gasification Comb. Cycle	8,309	7,939	1,443	550	794
Combined Cycle	7,196	7,031	584	250	146
Advanced Combined-Cycle	6,752	6,577	575	400	230
Combustion Turbine	10,842	10,664	407	160	65
Advanced Combustion Turbine	9,227	8,920	385	230	89
Fuel Cell	7,930	6,960	4,374	10	44
Wind	10,280	10,280	1,167	50	58
Advanced Nuclear	10,400	10,400	1,980	1000	1980

Stock Plant Type	2004	2010	2015	2020	2025	2030
Fossil Fuel Steam Heat Rate (Btu/kWh)	10,681	10,597	10,403	10,162	9,947	9,664
Nuclear Energy Heat Rate (Btu/kWh)	10,439	10,439	10,439	10,439	10,439	10,439

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, Assumptions to the AEO 2006, March 2006, Table 48, p. 85 for fossil fuel heat rates, Table 38, p. 73 for other generator data; EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136, and Table A8, p. 147-148.

6.2.4 Electric Conversion Factors and Transmission and Distribution (T&D) Losses

	2004	2010	2015	2020	2025	2030
Average Utility Delivery Efficiency (1, 2)	31.5%	31.7%	32.3%	32.7%	33.3%	33.9%
Average Utility Delivery Ratio (Btu/kWh) (2, 3)	10,840	10,764	10,555	10,422	10,262	10,055

Transmission and Distribution (T&D) Losses as a:

Percent of Electric Generator Fuel Input	3.1%
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 2006, Feb. 2006, Table A2, p. 134-136 for generator consumption and Table A8, p. 147-148 for electricity sales; and EIA, Annual Energy Review 2004, August 2005, Diagram 5, p. 223 for T&D losses.

6.2.5 Characteristics of New Commercial Distributed Generating Technologies, by Plant Type

	Efficiency (HHV)		2005 Installed Capital Costs of a Typical DG Technologies			Service Life
			Price	Size	Cost	
New Plant Type	Electrical	Electrical + Thermal	($2004 per kW)	(kW)	($2004 thousand)	(years)
Solar Photovoltaic	0.16	N/A	6,145	25	154	30
Fuel Cell	0.36	0.72	5,326	200	1065	20
Natural Gas Engine	0.32	0.77	1,157	200	231	20
Oil-Fired Engine	0.31	0.82	1,270	200	254	20
Natural Gas Turbine	0.23	0.66	1,853	1000	1853	20
Natural Gas Microturbine	0.30	0.63	1,659	200	332	20

Source(s): Discovery Insights, Final Report: Commercial and Industrial CHP Technology Cost and Performance Data Analysis for EIA's NEMS, January 2006, Table 7, p. 12.

6.3.1 Cost of a Generic Quad Used in the Buildings Sector ($2004 billion) (1)

	2004	2010	2015	2020	2025	2030
Residential	9.32	8.95	8.77	9.01	9.35	9.68
Commercial	7.82	7.46	7.29	7.50	7.82	8.12
Buildings Sector	8.60	8.25	8.06	8.27	8.58	8.88

Note(s): 1) See Table 6.1.1 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, AEO 2006, Feb. 2006, Table A2, p. 134-136 and Table A17, p. 159 for energy consumption and Table A3, p. 137-138 for energy prices.

6.3.2 Shares of U.S. Buildings Generic Quad (percent) (1)

					Renewables				
		Natural Gas	Petroleum	Coal	Hydro.	Other	Total	Nuclear	Total
2004	(2)	**31%**	**8%**	**37%**	**5%**	**3%**	**8%**	**15%**	**100%**
2010		30%	7%	39%	5%	4%	10%	14%	100%
2015		32%	7%	38%	5%	5%	9%	14%	100%
2020		31%	6%	39%	5%	5%	10%	14%	100%
2025		30%	6%	41%	4%	5%	10%	13%	100%
2030		28%	6%	44%	4%	6%	10%	13%	100%

Note(s): 1) See Table 6.1.1 for generic quad definition. 2) The total 2004 Buildings sector primary energy consumption was 38.46 quads.
Source(s): EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 and Table A17, p. 159 for energy consumption.

6.3.3 Shares of U.S. Residential Buildings Generic Quad (percent) (1)

					Renewables				
		Natural Gas	Petroleum	Coal	Hydro.	Other	Total	Nuclear	Total
2004	(2)	**33%**	**9%**	**35%**	**5%**	**4%**	**8%**	**14%**	**100%**
2010		32%	8%	37%	5%	5%	10%	13%	100%
2015		34%	8%	36%	5%	5%	10%	13%	100%
2020		34%	7%	36%	4%	5%	10%	13%	100%
2025		32%	7%	38%	4%	6%	10%	13%	100%
2030		31%	6%	41%	4%	6%	10%	12%	100%

Note(s): 1) See Table 6.1.1 for generic quad definition. 2) The total 2004 Residential buildings sector primary energy consumption was 21.07 quads.
Source(s): EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 and Table A17, p. 159 for energy consumption.

6.3.4 Shares of U.S. Commercial Buildings Generic Quad (percent) (1)

					Renewables				
		Natural Gas	Petroleum	Coal	Hydro.	Other	Total	Nuclear	Total
2004	(2)	**29%**	**7%**	**41%**	**5%**	**2%**	**8%**	**16%**	**100%**
2010		27%	6%	43%	5%	4%	9%	16%	100%
2015		29%	5%	41%	5%	4%	9%	15%	100%
2020		29%	5%	42%	5%	5%	10%	15%	100%
2025		27%	5%	44%	5%	5%	10%	14%	100%
2030		25%	5%	47%	5%	5%	10%	14%	100%

Note(s): 1) See Table 6.1.1 for generic quad definition. 2) The total 2004 Commercial buildings sector primary energy consumption was 17.40 quads.
Source(s): EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136 and Table A17, p. 159 for energy consumption.

6.4.1 Electric Quad Average Carbon Emissions with Average Stock Utility Fuel Mix and Projected New Marginal Capacity Fuel Mix (million metric tons) (1)

	Stock	Projected New Marginal Capacity				
	2004	2010	2015	2020	2025	2030
Petroleum	0.69	0.00	0.00	0.00	0.00	0.00
Natural Gas	2.09	0.10	3.59	3.01	1.88	0.88
Coal	13.38	16.28	11.77	12.64	15.21	17.78
Nuclear	0.00	0.00	0.00	0.00	0.00	0.13
Renewable Energy (2)	0.08	0.10	0.54	0.40	0.33	0.28
Total	16.24	16.48	15.45	15.73	17.18	18.86

Note(s): 1) This table provides estimates of the carbon emissions resulting from consumption of a primary quad at electric utilities. Projected (2010-2030) new marginal capacity emissions will result from natural gas- and coal-fired power plants and renewable energy technologies. Nuclear electric generation will increase in the near-term and new capacity added 2013-2019. 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 includes emissions released from geothermal power and non biogenic emissions from municipal solid waste.

Source(s): EIA, Annual Energy Outlook 2006, Feb. 2006, Table A2, p. 134-136 and Table A18, p. 160.

6.4.2 Average Carbon 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								
	2004			2010			2020			2030		
	Resid.	Comm.	Bldgs.	Resid.	Comm.	Bldgs.	Resid.	Comm.	Bldgs.	Resid.	Comm.	Bldgs.
Electricity (2)	10.80	12.43	11.54	13.96	15.91	14.96	13.17	14.14	13.72	16.01	15.88	15.93
Petroleum	1.41	0.89	1.17	0.17	0.03	0.10	0.29	0.04	0.15	0.30	0.06	0.16
Natural Gas	3.44	2.56	3.05	2.09	0.57	1.32	2.13	1.51	1.78	1.90	1.57	1.70
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	0.01	0.13	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.67	16.01	15.82	16.22	16.51	16.37	15.59	15.69	15.64	18.20	17.51	17.78

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, natural gas, and petroleum. 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 2005, Feb. 2006, Table A2, p. 134-136 and Table A17, p. 163 for energy consumption and Table A18, p. 160 for carbon emissions; and EIA, Assumptions to the AEO 2006, March 2006, Table 2, p. 9.

7.1.1 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 2004 was $16,804 , 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 5.6 million households have received Weatherization services.
- In FY 2004, the energy burden on Federally eligible households was four times the burden on Federally ineligible households (13.7% versus 3.0%).
- DOE Weatherization saves an average of 13-34% on home energy bills (depending on main heating fuel). This equates to $1.538 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 2004, June 2006, Table A-2a, p. 56 for Federally eligible average income and Table A-2b, p 57 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.

7.1.2 Weatherization Program Facts

- In FY 2004, DOE contributed 38% to all Federal weatherization funding, LIHEAP 37%, and others 24%.
- 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 for 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.

Source(s): EERE/OWIP, Weatherization Assistance Program Briefing Book, May 2006 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, March 2006 for HUD spending.

7.1.3 Weatherization Costs and Savings

- DOE Weatherization program requires that states spend no more than an average of $2,826 per household in PY 2006. All states are using energy audits to determine the most cost-effective weatherization measures. (1)
- In spite of funding reductions which 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, reduces household's annual gas heating consumption 32% with a benefit-cost ratio of 1.53.

Note(s): 1) Program year is April 1 - March 31.

Source(s): EERE/OWIP, Weatherization Program Notice 06-1, Nov. 21, 2005 for average expenditures; ORNL, Weatherization Plus Progress Report: Poised to Move Forward, June 2001; and EERE/OWIP, Weatherization Assistance Program Briefing Book, May 2006 for savings.

7.1.4 Residential Energy Burdens, by Weatherization Eligibility and Year

	1987	1990		FY 2000 (1)			FY 2004 (2)		
	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%	3.4%	2.4%	6.4%	3.4%	2.6%
Federally Eligible	**13.0%**	**14.4%**	**10.1%**	**12.1%**	**7.9%**	**8.3%**	**13.7%**	**8.0%**	**8.3%**
Federally Ineligible	4.0%	3.5%	N.A.	3.0%	2.6%	2.0%	3.0%	2.6%	2.1%
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, April 2000, Tables A-2a, A-2b, and A-2c, p. 48-50 for FY 2000; and HHS, LIHEAP Home Energy Notebook for FY 2004, June 2006, Tables A-2a, A-2b, and A-2c, p. 56-58.

7.1.5 FY 2004 Residential Energy Burdens, by Region (1)

	Northeast			South			Midwest			West		
	Mean Indvdl	Mdn Indvdl	Mean Group	Mean Indvdl	Mdn Indvdl	Mean Group	Mean Indvdl	Mdn Indvdl	Mean Group	Mean Indvdl	Mdn Indvdl	Mean Group
Total U.S. Households	8.1%	4.0%	2.9%	6.8%	3.7%	2.9%	6.2%	3.5%	2.8%	4.4%	2.6%	1.9%
Federally Eligible	**17.3%**	**9.1%**	**9.2%**	**15.0%**	**9.1%**	**9.2%**	**13.3%**	**8.2%**	**8.9%**	**8.8%**	**5.3%**	**5.7%**
Federally Ineligible	3.4%	3.0%	2.3%	3.1%	2.8%	2.3%	3.0%	2.7%	2.2%	2.3%	2.1%	1.6%

Note(s): 1) Data are derived from RECS 2001, adjusted to reflect FY 2004 HDD, CDD, and fuel prices. See Table 7.1.4 for totals and Table 7.1.10 for definitions.

Source(s): HHS, LIHEAP Home Energy Notebook for FY 2004, June 2006, Tables A-2a, A-2b, and A-2c, p. 56-58.

7.1.6 Households, by Weatherization Eligibility and Year (million)

	Weatherization Recipient			Federally	Federally	Below 125%	Total
	DOE	Other	Total	Eligible (2)	Ineligible	Poverty Line	Households
1977	0.03	0.00	0.03	N.A.	N.A.	N.A.	74.8
1980	0.18	0.00	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
1977-2004	2.91	2.93	5.84	N/A	N/A	N/A	N/A

Note(s): 1) Recipients are reported according to DOE Weatherization Program Year of April 1-March 31 and includes households weatherized with other funds. 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, 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, April 2004, Table HC2-3a for 2001 eligible households; EIA, RECS 2001 for eligible households; and DOC, Income, Poverty, and Valuation of Noncash Benefits: 1994,April 1996, Table B-1, for 1991 households.

7.1.7 2001 Housing Unit Ownership, by Income Level and Weatherization Eligibility (million)

	Single-Family		Multi-Family Unit		Mobile Home	
2001 Household Income	Own	Rent	Own	Rent	Own	Rent
Less than $15,000	5.7	2.9	0.3	8.0	1.2	0.4
$15,000 to $30,000	10.9	2.5	1.0	5.7	2.3	0.4
$30,000 to $49,999	16.4	2.8	1.2	5.2	1.3	0.2
All Households	63.2	10.5	3.9	22.6	5.7	1.1
Federally Eligible	**12.8**	**5.0**	**0.9**	**11.8**	**2.6**	**0.7**
Federally Ineligible	50.4	5.5	3	10.8	3.1	0.4
Below 100% Poverty Line	3.8	2.8	0.3	6.5	1.1	0.5

Source(s): EIA, 2001 Residential Energy Consumption Survey: Housing Characteristics Tables, April 2004, Table HC1-3a.

7.1.8 2001 Average Energy Expenditures per Household Member and per Square Foot, by Weatherization Eligibility ($2004)

	Per Household Member	Members/ Hhold	Per Square Foot	Square Feet/ Hhold
Total U.S. Households	616	2.6	0.80	1975
Federally Eligible	**506**	**2.7**	**0.94**	**1435**
Federally Ineligible	669	2.5	0.76	2225
Below 100% Poverty Line	469	2.6	0.98	1227

Source(s): EIA, 2001 Residential Energy Consumption Survey: Household Energy Consumption and Expenditures Tables, April 2004, Table CE1-5.1u and Table CE1-5.2u; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for implicit price deflators.

7.1.9 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 includes 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% 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 60% 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.

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; and HHS, LIHEAP Report to Congress FY 2001, February 2003, Table E-1, p. 105 and Figure 1, p. iii for LIHEAP recipient household.

7.1.10 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 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.

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, April 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, November 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.

7.2.1 Operating Characteristics of Electric Appliances in the Residential Sector

		Power Draw (W) (1)			Annual Usage (hours/year)			Annual Consumption	Annual Cost
		Active	Idle	Off	Active	Idle	Off	(kWh/year)	($) (2)
Kitchen									
	Coffee Maker	1000	70	0	38	229	8493	58	5
	Dishwasher	(3) 0.332	0		(4) 365	0		120	11
	Microwave Oven	1500	0	3	70	0	8690	131	12
	Refrigerator-Freezer							730	65
	Freezer							540	48
Lighting									
	18-W Compact Fluorescent	18	0	0	1189	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	6
	Torchiere Lamp-Halogen	300	0	0	1460	0	0	440	39
Bedroom and Bathroom									
	Hair Dryer	710	0	0	50	0	0	40	4
	Waterbed Heater	350	0	0	3051	0	0	1070	95
Laundry Room									
	Clothes Dryer				(4) 359			1000	89
	Clothes Washer	(3) 0.276	0	0	(4) 392	0	0	(3) 110	10
Home Electronics									
	CPU & Monitor	182/30	0		1337/632	0		260	23
	Stereo Systems	33	30	3	1510	1810	5440	119	11
	Television	113		4	1460		7300	193	17
	Analog, <40"	86			(5) 1095			184	16
	Analog, >40"	156			(5) 1825			312	28
	Digital, ED/HD TV, <40"	150			(5) 1095			301	27
	Digital, ED/HD TV, >40"	234			(5) 1825			455	40
	Set-top box	20	0	20	6450	0	2310	178	16
	DVD/VCR	17	13	3	170	5150	3430	78	7
Heating and Cooling									
	Dehumidifier	600	0		1620	0		970	86
	Furnace Fan	295	0		1350	0		400	36
	Ceiling Fan (only fan motor)	35			2310			81	7
Water Heating									
	Water Heater-Family of 4	4500			(6) 64	N.A.	0	4770	425
	Water Heater-Family of 2	4500			(6) 32	N.A.	0	2340	208
	Portable Spa	4350	275	0	25	8735	0	2525	225
Miscellaneous									
	Pool Pump	1000	0		792	0		790	70
	Well Pump	725	0		115	0		80	7
Total Standby		0	57		0	8760		500	45

Note(s): 1) Power draw will vary due to appliance components and modes of operation. 2) $0.089/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, August 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, September 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, April 1998, Appendix D for hair dryer; EIA, Supplement to AEO 2006, Feb. 2006, Table 21 for refrigerator and freezer; GAMA, Consumer's Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment, April 2000 for water heater power draw; EIA/TIAX, Commercial and Residential Sector Miscellaneous Electricity Consumption: Y2005 and Projections to 2030, September 2006, p. 41-60 for coffee maker, microwave oven, stereo systems, televisions, set-top box, DVD/VCR, ceiling fan, and portable spa; and LBNL for total standby.

7.2.2 Operating Characteristics of Natural Gas Appliances in the Residential Sector

	Average Capacity (10^3 Btu/hr)	Appliance Usage		Annual Consumption (10^6 Btu/year)	Annual Cost ($) (1)
Range	10			4.2	39
Clothes Dryer		(2)	359	4.3	40
Water Heating					
Water Heater-Family of 4	40	(3)	64	25.8	238
Water Heater-Family of 2	40	(3)	32	12.3	113

Note(s): 1) $1.04/therm. 2) Cycles/yr. 3) Gallons/day.

Source(s): A.D. Little, EIA-Technology Forecast Updates - Residential and Commercial Building Technologies - Reference Case, September 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, Consumer's Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment, April 2002, for water heater capacity; and AGA, Gas Facts 1998, Dec. 1999, www.aga.org for range and clothes dryer consumption.

7.2.3 Operating Characteristics of Electric Equipment in the Commercial Sector

	Power Draw (kW) (1)			Annual Usage (hours/year)			Annual Consumption	
	Active	Standby	Off	Active	Standby	Off	(kWh/year)	($) (2)
Medical Imaging Equipment								
MRI	25.0	11.0	7.0	340	3310	5110	81000	6480
CT	21.0	N/A	1.7	3000	N/A	5760	73000	5840
X-ray	4.0	N/A	1.6	4380	N/A	4380	24800	1984
Vertical Transport								
Elevator	10.0	0.5	0.3	300	8460	0	7400	592
Escalator	4.7	N/A	0.0	4380	N/A	4380	20500	1640
Distribution Transformer (3)								
Dry	10.3 W/kVA			8760				
Liquid	4.2 W/KVA			8760				
Water Systems								
Distribution				17700 billion gallons per year			2230 kWh/10^6 gal	178
Purification				16500 billion gallons per year			65 kWh/10^6 gal	5.2
Treatment				14280 billion gallons per year			1649 kWh/10^6 gal	132

Note(s): 1) Power draw will vary due to modes of operation. 2) $0.080/kWh. 3) Losses from stepping down power distributed at higher voltages to lower voltages.

Source(s): EIA/TIAX, Commercial and Residential Sector Miscellaneous Electricity Consumption: Y2005 and Projections to 2030, September 2006, p. 16-37; and EIA, AEO 2006, Feb. 2006, Table A3, p. 137-138 for electricity price.

7.3.1 2001 *Delivered* Energy End-Uses for an Average Household, by Region (10^6 Btu/Hhold)

	Northeast	Midwest	South	West	National
Space Heating	63.1	66.8	27.7	29.7	43.9
Space Cooling	3.3	5.1	11.5	5.4	7.7
Water Heating	18.0	17.4	13.9	15.1	15.8
Refrigerator	4.2	4.9	6.0	4.0	5.0
Other Appliances & Lighting	20.1	23.7	24.3	20.2	22.5
Total (1)	106.6	116.7	82.5	70.1	92.2

Note(s): 1) Total does not sum correctly due to rounding errors.
Source(s): EIA, A Look at Residential Energy Consumption in 2001, 2004, Table CE1-9c, Table CE1-10c, Table CE1-11c, and Table CE1-12c.

7.3.2 2001 End-Use Carbon Dioxide Emissions Splits for an Average Household, by Region (pounds of CO2)

	Northeast	Midwest	South	West	National
Space Heating	9,083	8,690	4,890	4,467	6,475
Space Cooling	1,467	2,063	4,742	2,170	3,197
Water Heating	2,936	2,625	3,135	2,530	2,914
Refrigerator	1,444	2,041	2,463	1,796	2,068
Other Appliances & Lighting	6,957	8,694	9,224	7,125	8,177
Total	21,888	24,113	24,455	18,089	22,830

Source(s): EIA, A Look at Residential Energy Consumption in 2001, April 2004, Tables CE(2-5)-(9-12)c; EIA, AEO 2006, Feb. 2006, Table A2, p. 134-136, Table A17, p. 159 for consumption data, and Table A18, p. 160 for emissions data; and EIA, Assumptions to the AEO 2006, Feb. 2006, Table 2, p. 9 for coefficients.

7.3.3 2001 Energy End-Use Expenditures for an Average Household, by Region ($2004)

	Northeast	Midwest	South	West	National
Space Heating	714	625	369	329	485
Space Cooling	112	124	285	159	199
Water Heating	227	186	217	185	205
Refrigerator	152	123	146	120	136
Other Appliances & Lighting	600	524	547	497	541
Total (1)	1760	1558	1546	1181	1509

Note(s): 1) Total does not sum correctly due to rounding errors.
Source(s): EIA, A Look at Residential Energy Consumption in 2001, April 2004, Table CE1-9e, Table CE1-10e, Table CE1-11e, and Table CE1-12e; EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price deflators.

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

13,837 board-feet of lumber
13,118 square feet of sheathing
19 tons of concrete
3,206 square feet of exterior siding material
3,103 square feet of roofing material
3,061 square feet of insulation
6,050 square feet of interior wall material
2,335 square feet of interior ceiling material
226 linear feet of ducting
19 windows
4 exterior doors (3 hinged, 1 sliding)
2,269 square feet of flooring material

12 interior doors
6 closet doors
2 garage doors
1 fireplace
3 toilets; 2 bathtubs; 1 shower stall
3 bathroom sinks
15 kitchen cabinets; 5 other cabinets
1 kitchen sink
1 range; 1 refrigerator; 1 dishwasher; 1 garbage disposer; 1 range hood
1 washer; 1 dryer
1 heating and cooling system

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

7.3.5 Characteristics of a Typical Single-Family Home (1)

Year Built			late 1960s	Building Equipment	Type	Fuel	Age (5)
Occupants			3	Space Heating	Central Warm-Air Furnace	Natural Gas	12
Floorspace				Water Heating	50 Gallons	Natural Gas	9
	Heated Floorspace		2047	Space Cooling	Central Air Conditioner		9
	Cooled Floorspace		2061				
	Garage		2-Car				
Stories			1	Appliances	Type / Fuel / Number	Size	Age (5)
Foundation			Basement	Refrigerator	2-Door	19 Cubic Feet	8
Total Rooms (2)			6	Clothes Dryer	Electric		
	Bedrooms		3	Clothes Washer	Top Loading		
	Other Rooms		3	Range/Oven	Electric		
Full Bathroom			2	Microwave Oven			
Half Bathroom			0	Dishwasher			
Windows				Color Televisions	3		
	Area	(3)	235	Ceiling Fans	3		
	Number	(4)	16	Computer			
	Type		Single-Pane	Printer			
	Frame		Nonmetal				
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, A Look at Residential Energy Consumption in 2001, April 2004, Table HC1-4a, HC2-4a, Table HC3-4a, Table HC4-4a, Table HC5-4a, Table HC6-4a, Table HC7-4a, Table CE2-4c, and Table CE3-4c; and EIA, Housing Characteristics 1993, June 1995, Table 3.29a, p. 168-173 for windows area.

7.4.1 1995 Commercial Buildings *Delivered* Energy End-Use Intensities, by Building Activity (10^3 Btu/sq. ft.)

	Education	Food Sales	Food Service	Health Care	Lodging	Mercantile & Service	Office
Space Heating	32.8	27.5	30.9	55.2	22.7	30.6	24.3
Space Cooling	4.8	13.4	19.5	9.9	8.1	5.8	9.1
Ventilation	1.6	4.4	5.3	7.2	1.7	2.5	5.2
Water Heating	17.4	9.1	27.5	63.0	51.4	5.1	8.7
Lighting	15.8	33.9	37.0	39.3	23.2	23.4	28.1
Cooking	1.4	5.6	77.5	11.2	6.6	1.5	1.1
Refrigeration	1.0	110.9	31.6	4.7	2.3	0.9	0.4
Office Equipment	1.5	1.3	2.6	15.5	3.8	2.9	15.1
Other	2.9	7.4	13.7	34.4	7.5	3.7	5.2
Total	79.3	213.5	245.5	240.4	127.3	76.4	97.2

	Public Assembly	Public Order & Safety	Religious Worship	Warehouse & Storage	Other	Vacant	All Buildings
Space Heating	53.6	27.8	23.7	15.7	59.6	11.9	29.0
Space Cooling	6.3	6.1	1.9	0.9	9.3	0.6	6.0
Ventilation	3.5	2.3	0.9	0.3	8.3	0.3	2.8
Water Heating	17.5	23.4	3.2	2.0	15.3	2.4	13.8
Lighting	21.9	16.4	5.0	9.8	26.7	3.6	20.4
Cooking	2.8	NA	0.5	0.0	NA	NA	3.7
Refrigeration	1.8	0.2	0.6	1.7	0.7	0.2	3.1
Office Equipment	2.4	5.8	0.4	4.4	15.2	0.5	5.7
Other	3.8	12.7	1.1	3.4	35.9	1.9	6.1
Total	113.7	97.2	37.4	38.3	172.2	21.5	90.5

Source(s): EIA, A Look at Commercial Buildings in 1995: Characteristics, Energy Consumption, and Energy Expenditures, Oct. 1998, Table EU-2, p. 311.

7.4.2 Typical Office Building (1)

	Large (>= 25,000 ft2)	Small (<25,000 ft2)
Stock Floor Area (billion ft2)	8.22	4.29
Floor-Area Weighted Averages		
Building Area (thousand ft2)	90-137	5.5-6.6
Floors	6-7	1-2
SHELL		
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
OCCUPANCY		
Average Occupancy (ft2/person)	390-460	420-470
Weekday Hours (hrs/day)	12	11
Weekend Hours (hrs/day)	5	4
EQUIPMENT		
Average Power Density (W/ft2)	1	1
Full Lighting Hours (hrs/year)	3580	3360
LIGHTING		
Average Power Density (W/ft2)	1.3-1.8	1.7-2.2
Full Lighting Hours (hrs/year)	4190	3340
SYSTEM AND PLANT		
System and Distribution Type	Constant Volume w/ reheat	Packaged single-zone
	VAV w/ economizer	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 10, p. 31.

7.4.3 Typical School Building (1) (2)

	Pre-1980	Post-1980
Stock Floor Area (billion ft2)	7.48	0.60
Floor-Area Weighted Averages		
Building Area (thousand ft2)	22-47	16-26
Floors	2	2
SHELL		
Percent Glass	27	18
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
OCCUPANCY		
Average Occupancy (ft2/person)	105	105
Weekday Hours (hrs/day)	8	8
Weekend Hours (hrs/day)	2	2
EQUIPMENT		
Average Power Density (W/ft2)	0.80	0.80
Full Equipment Hours (hrs/year)	1136	1136
LIGHTING		
Average Power Density (W/ft2)	1.8	1.7
Full Lighting Hours (hrs/year)	2436	2436
SYSTEM AND PLANT		
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. (2) For additional data on Educational Facilities, see Section 7.5.

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

7.4.4 Typical Mercantile & Service (Retail) Building (1)

		Retail (>= 25,000 ft2)	Retail (<25,000 ft2)
Stock Floor Area (billion ft2)		5.88	6.53
Floor-Area Weighted Averages			
	Building Area (thousand ft2)	80	5.3-6.4
	Floors	2	1
SHELL			
	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
OCCUPANCY			
	Average Occupancy (ft2/person)	390-460	1635-2085
	Weekday Hours (hrs/day)	12	12
	Weekend Hours (hrs/day)	5	4
EQUIPMENT			
	Average Power Density (W/ft2)	0.40	0.50
	Full Equipment Hours (hrs/year)	4750-5850	3480
LIGHTING			
	Average Power Density (W/ft2)	1.6-2.1	1.7-2.2
	Full Lighting Hours (hrs/year)	4500-5245	3786-4412
SYSTEM AND PLANT			
	System and Distribution Type	Constant Volume w/ reheat	Packaged single-zone
		VAV w/ economizer	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.

7.4.5 Typical Hospital Building (1)

		Pre-1980	Post-1980
Stock Floor Area (billion ft2)		1.43	0.21
Floor-Area Weighted Averages			
	Building Area (thousand ft2)	66.2	156
	Floors	6	12
SHELL			
	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
OCCUPANCY			
	Average Occupancy (ft2/person)	190	190
	Weekday Hours (hrs/day)	24	24
	Weekend Hours (hrs/day)	24	24
EQUIPMENT			
	Average Power Density (W/ft2)	2.20	2.20
	Full Equipment Hours (hrs/year)	6962	6962
LIGHTING			
	Average Power Density (W/ft2)	2.1	2.1
	Full Lighting Hours (hrs/year)	6752	6752
SYSTEM AND PLANT			
	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.

7.5.1 Energy End-Use Intensities and Consumption of Educational Facilities, by Building Activity (1)

	(1000 Btu/SF)		(10^12 Btu)	
Space Heating	32.8	41%	254	41%
Space Cooling	4.8	6%	37	6%
Ventilation	1.6	2%	13	2%
Water Heating	17.4	22%	134	22%
Lighting	15.8	20%	122	20%
Cooking	1.4	2%	11	2%
Refrigeration	1.0	1%	8	1%
Office Equipment	1.5	2%	11	2%
Other	2.9	4%	22	4%
Total	79.3	100%	614	100%

Note(s): 1) Educational Facilities include K-12 as well as higher education facilities.

Source(s): EIA, Commercial Building Energy Consumption and Expenditures 1995, April 1998, Table 1 for total energy consumption, Table 2 for energy intensities, and Table 4 for expenditures.

7.5.2 2003-2004 Number of Public K-12 Schools in the United States and Students per School

Number of Schools	
Regular (1)	85,910
Special	1,771
Vocational	347
Alternative	4,788
Total (2)	92,816

Average Number of Students per School (3)	
Elementary	438
Middle	616
High	758
Other	266

Note(s): 1) Regular schools are those responsible for providing free public education for school age children residing whin 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.

7.5.3 National Enrollment and Expenditures for Public K-12 Facilities ($2004)

	Enrollment (millions)	Expenditures ($ billion)	Expenditures per Pupil
1986	39.42	236.0	5,987
1990	40.54	280.8	6,925
1995	44.11	307.1	6,961
2000	46.86	362.3	7,731
2002	47.67	391.6	8,216
2005	48.27	422.3	8,747
2010	48.74	472.3	9,690
2014	49.58	517.8	10,443

Source(s): National Center for Educational Statistics (NCES), Projections of Educational Statistics to 2014, Sept. 2005, Table 33, p. 82 for 1990-2014; National Center for Educational Statistics (NCES), Projections of Educational Statistics to 2011, Oct. 2001, Table 33, p. 88 for 1986; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price inflators.

7.5.4 Total Expenditures for K-12 Plant Operations and Maintenance, by Function ($2004 billion)

	1990		1995		2000		2002	
Salaries and Benefits	15.2	54%	16.0	53%	18.7	51%	19.8	52%
Purchased Services	7.6	27%	9.0	30%	10.4	28%	10.3	27%
Supplies	5.0	18%	5.0	16%	7.4	20%	7.8	20%
Other	0.4	2%	0.3	1%	0.3	1%	0.4	1%
Total	28.2	100%	30.2	100%	36.8	100%	38.3	100%

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): U.S. Department of Education/National Center for Educational Statistics (NCES), Digest of Educational Statistics 2005, July 2006, Table 160, p. 263-264; EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373 for price inflators.

7.5.5 New Construction and Renovations Expenditures for Public K-12 Schools ($2004 billion)

	New Schools	Additions	Modernizations	Total
1996	5.67	3.84	3.13	12.64
1997	6.93	4.05	3.07	14.05
1998	8.85	5.77	4.55	19.17
1999	6.60	5.61	5.53	17.74
2000	12.46	4.41	6.47	23.34
2001	11.83	4.47	12.00	28.31
2002	12.14	5.92	7.29	25.35
2003	17.87	5.41	6.05	29.33
2004	13.23	5.58	10.28	29.09
2005	12.29	6.15	4.52	22.96

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; and EIA, Annual Energy Review 2004, Aug. 2005, Appendix D, p. 373.

7.5.6 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.

Thermal Conversion Factors

Fuel	Units	Approximate Heat Content
Coal		
Production	million Btu per short ton	20.411
Consumption	million Btu per short ton	20.276
Coke Plants	million Btu per short ton	27.426
Industrial	million Btu per short ton	22.473
Residential and Commercial	million Btu per short ton	22.948
Electric Power Sector	million Btu per short ton	19.966
Imports	million Btu per short ton	25.000
Exports	million Btu per short ton	26.108
Coal Coke	million Btu per short ton	24.800
Crude Oil		
Production	million Btu per barrel	5.800
Imports	million Btu per barrel	5.980
Petroleum Products		
Consumption	million Btu per barrel	5.357
Motor Gasoline	million Btu per barrel	5.215
Jet Fuel	million Btu per barrel	5.670
Distillate Fuel Oil	million Btu per barrel	5.799
Residual Fuel Oil	million Btu per barrel	6.287
Liquefied Petroleum Gas	million Btu per barrel	3.618
Kerosene	million Btu per barrel	5.670
Petrochemical Feedstocks	million Btu per barrel	5.527
Unfinished Oils	million Btu per barrel	5.825
Imports	million Btu per barrel	5.473
Exports	million Btu per barrel	5.753
Natural Gas Plant Liquids		
Production	million Btu per barrel	3.724
Natural Gas		
Production, Dry	Btu per cubic foot	1,027
Consumption	Btu per cubic foot	1,030
End-Use Sectors	Btu per cubic foot	1,031
Electric Power Sector	Btu per cubic foot	1,025
Imports	Btu per cubic foot	1,023
Exports	Btu per cubic foot	1,009
Electricity Consumption	Btu per kilowatt-hour	3,412

Note(s) Conversion factors vary from year to year

Source(s) DOE, EIA, Annual Energy Outlook 2006, February 2006, Table G1, p. 221.

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