U.S. Department of Energy
Energy Efficiency and Renewable Energy

2004 Buildings Energy Databook

This version is dated: January 2005

D I S C L A I M E R

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DOE's Office of Energy Efficiency
and Renewable Energy

Buildings Energy Databook

The Department of Energy's Office of Energy Efficiency and Renewable Energy has developed this Buildings Energy Databook 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. The Databook is an evolving document and will be periodically updated. Additional data (e.g., more current, widely accepted, and/or better documented data) and suggested changes should be submitted to the contact below. Please provide full source references along with all data.

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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
BNL	Brookhaven National Laboratory
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 (continued)

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
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 (continued)

PY	Program Year
Quad	Quadrillion Btu (10^15 Btu)
R-value	Thermal resistance measured in (Btu/Hr-ft^2-^{o}F)$^{-1}$
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-^{o}F)
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**
1980	8.4	53%	4.9	31%	1.7	11%	0.0	0%	0.9	5%	**15.9**
1990	10.0	61%	4.5	27%	1.3	8%	0.0	0%	0.6	4%	**16.5**
2000	11.0	61%	5.1	28%	1.5	8%	0.0	0%	0.5	3%	**18.2**
2002	**13.9**	**67%**	**5.1**	**24%**	**1.5**	**7%**	**0.0**	**0%**	**0.4**	**2%**	**20.9**
2010	15.3	66%	5.7	25%	1.6	7%	0.0	0%	0.4	2%	**23.1**
2020	17.0	68%	6.1	24%	1.6	6%	0.0	0%	0.5	2%	**25.1**
2025	17.5	68%	6.3	24%	1.5	6%	0.0	0%	0.5	2%	**25.8**

Commercial Consumption

	Elec		NGas		Oil		Coal		Renew		**Total**
1980	6.5	62%	2.7	25%	1.3	12%	0.1	1%	0.02	0%	**10.6**
1990	9.1	71%	2.7	21%	0.9	7%	0.1	1%	0.04	0%	**12.9**
2000	10.7	72%	3.3	22%	0.8	5%	0.1	1%	0.06	0%	**14.9**
2002	**13.3**	**76%**	**3.2**	**18%**	**0.7**	**4%**	**0.1**	**1%**	**0.12**	**1%**	**17.4**
2010	15.9	77%	3.6	17%	0.9	4%	0.1	0%	0.13	1%	**20.6**
2020	19.0	79%	3.9	16%	1.0	4%	0.1	0%	0.13	1%	**24.1**
2025	20.5	79%	4.2	16%	1.0	4%	0.1	0%	0.13	1%	**25.9**

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

	Elec		NGas		Oil		Coal		Renew		**Total**
1980	15.0	56%	7.5	28%	3.0	11%	0.1	1%	0.9	3%	**26.5**
1990	19.1	65%	7.2	25%	2.2	7%	0.2	1%	0.7	2%	**29.4**
2000	21.8	66%	8.4	25%	2.3	7%	0.1	0%	0.6	2%	**33.1**
2002	**27.2**	**71%**	**8.3**	**22%**	**2.2**	**6%**	**0.1**	**0%**	**0.5**	**1%**	**38.3**
2010	31.3	72%	9.3	21%	2.5	6%	0.1	0%	0.6	1%	**43.7**
2020	36.0	73%	10.0	20%	2.5	5%	0.1	0%	0.6	1%	**49.2**
2025	38.4	74%	10.4	20%	2.5	5%	0.1	0%	0.6	1%	**52.1**

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

	Gas	Oil	Coal	Renew	Nuclear	Electric Import
1980	37%	17%	29%	11%	6%	N.A.
1990	31%	10%	36%	9%	13%	N.A.
2000	31%	8%	36%	8%	16%	N.A.
2002	**32%**	**7%**	**37%**	**8%**	**15%**	**0%**
2010	32%	7%	38%	9%	14%	0%
2020	33%	6%	39%	9%	12%	0%
2025	31%	6%	42%	8%	12%	0%

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

	Res	Com	**Bldgs**	Indtry	Trans
1980	20%	14%	**34%**	41%	25%
1990	20%	15%	**35%**	38%	27%
2000	19%	15%	**34%**	39%	27%
2002	**21%**	**18%**	**39%**	**33%**	**28%**
2010	21%	18%	**39%**	32%	29%
2020	20%	19%	**38%**	32%	30%
2025	19%	19%	**38%**	32%	30%

5. Buildings Share of U.S. Electricity Consumption

	Res	Com	**Bldgs**	Indtry	Trans
1980	34%	27%	**61%**	39%	0%
1990	34%	31%	**65%**	35%	0%
2000	35%	34%	**69%**	31%	0%
2002	**36%**	**35%**	**71%**	**28%**	**1%**
2010	35%	37%	**72%**	28%	1%
2020	34%	38%	**72%**	27%	1%
2025	34%	38%	**72%**	27%	1%

6. 1991 Industrial Buildings-Related *Delivered* & Primary Energy Consumption (quad)

	Space Vent	Space Heat	Space Cool	Light	Total
Delivered	0.087	0.774	0.085	0.170	1.116
Primary	0.270	0.890	0.280	0.520	1.960

7. U.S. Buildings Primary Energy and Expenditure End-Use Splits, 2002

Energy (quads and % of totals)

End Use	Residential		Commercial		**Buildings**	
Space Heating	6.6	32%	2.5	14%	9.1	24%
Lighting	2.5	12%	4.4	25%	6.8	18%
Space Cooling	2.6	12%	2.0	12%	4.6	12%
Water Heating	2.7	13%	1.1	7%	3.8	10%
Refrigeration	1.8	9%	1.1	6%	2.9	8%
Electronics	1.0	5%	1.0	6%	2.0	5%
Cooking	0.9	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%	0.6	2%
Other	0.8	4%	1.5	9%	2.4	6%
Adjust to SEDS	0.8	4%	2.0	11%	2.8	7%
Total	20.9	100%	17.4	100%	38.3	100%

Expenditures ($2002 and % of totals)

End Use	Residential		Commercial		**Buildings**	
Space Heating	49.7	31%	15.5	13%	65.2	23%
Lighting	19.0	12%	31.0	26%	50.0	18%
Space Cooling	19.9	12%	14.5	12%	34.3	12%
Water Heating	20.5	13%	7.4	6%	27.9	10%
Refrigeration	13.8	9%	7.7	6%	21.5	8%
Electronics	7.7	5%	7.1	6%	14.8	5%
Cooking	7.4	5%	2.4	2%	9.8	3%
Wet Clean	7.8	5%			7.8	3%
Ventilation			7.2	6%	7.2	3%
Computers	1.6	1%	3.1	3%	4.7	2%
Other	6.3	4%	10.7	9%	17.1	6%
Adjust to SEDS	6.8	4%	13.3	11%	20.1	7%
Total	160.5	100%	119.9	100%	280.4	100%

8. Buildings Energy Prices and Expenditures

Prices ($2002/10^6 Btu)

	Residential Buildings				Commercial Buildings				Bldgs
	Elec	NGas	Petro	Avg	Elec	NGas	Petro	Avg	Avg
1980	30.48	6.98	14.08	14.71	31.16	6.44	10.94	15.47	15.01
1990	29.37	7.20	11.28	15.60	27.11	6.01	7.57	15.56	15.58
2000	24.14	7.63	8.13	13.98	21.52	6.57	8.01	14.10	14.03
2002	**24.73**	**7.65**	**9.87**	**14.75**	**22.82**	**6.37**	**6.88**	**14.84**	**14.79**
2010	23.30	7.67	9.90	14.22	20.39	6.64	6.34	13.89	14.08
2020	23.73	8.24	10.86	15.10	21.21	7.31	6.83	15.05	15.07
2025	23.88	8.32	11.26	15.39	21.48	7.41	6.98	15.39	15.39

Petroleum includes distillate and residual fuel oils, LPG, kerosene, and motor gasoline
2002 average electricity cost: resid. $0.084/kWh, comm. $0.078/kWh, and Bldgs. $0.081/kWh.

Expenditures ($2002 billion)

	Residential Buildings				Commercial Buildings				Bldgs
	Elec	NGas	Petro	Total	Elec	NGas	Petro	Total	Total
1980	74.6	33.9	24.6	**133.2**	59.4	17.2	14.1	**90.7**	223.9
1990	92.6	32.5	14.3	**139.4**	77.5	16.2	6.9	**100.6**	240.1
2000	101.7	40.3	18.2	**160.2**	88.1	22.4	6.2	**116.8**	277.0
2002	**107.0**	**38.7**	**14.6**	**160.4**	**94.1**	**20.4**	**5.0**	**119.5**	**279.9**
2010	113.5	43.6	15.8	**173.0**	103.0	23.7	5.8	**132.6**	305.5
2020	132.9	50.1	17.0	**200.0**	132.3	28.8	6.7	**167.7**	367.7
2025	142.3	52.1	17.2	**211.7**	146.8	30.8	7.0	**184.6**	396.3

Expenditures exclude wood and coal costs. 2002 U.S. energy expenditures were $682.1 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	124.8	199.7
1990	94.2	N.A.	74.2	102.0	175.0
2000	105.7	N.A.	82.6	106.0	171.9
2002	**110.3**	**3%**	**N.A.**	**102.3**	**189.4**
2010	119.8	16%	N.A.	105.0	192.4
2020	132.0	29%	N.A.	103.5	190.1
2025	137.8	35%	N.A.	102.8	189.5

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	208.9
1990	64.3	N.A.	4.5	103.2	200.2
2000	68.5	N.A.	4.7	119.0	217.9
2002	**72.1**	**9%**	**N.A.**	**114.5**	**241.4**
2010	83.8	35%	N.A.	116.2	245.8
2020	95.9	60%	N.A.	118.3	251.0
2025	101.8	70%	N.A.	119.7	254.3

2000 number of buildings actually from 1999.
1999 floorspace: 18% office, 16% warehouse, 15% mercantile, 13% education and 4% health care. *1999 energy use:* 22% office, 15% mercantile, 10% education, 8% warehouse, and 8% health care.

10. Residential (2001) and Commercial (1999) Vintages

Residential	% of Hholds	Commercial	% of SF
1949 or Before	25%	Prior to 1919	6%
1950 to 1959	13%	1920 to 1959	23%
1960 to 1969	13%	1960 to 1979	34%
1970 to 1979	18%	1980 to 1989	21%
1980 to 1989	17%	1990 to 1999	16%
1990 to 2001	14%		

11. Stock Energy Expenditures ($2002)

	Residential ($/Household)	Commercial ($/SF)
1980	1,672	1.78
1990	1,480	1.57
2000	1,442	1.70
2002	**1,454**	**1.66**
2010	1,443	1.58
2020	1,514	1.75
2025	1,536	1.81

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
1980	255.2	172.0	427.1	33%	9%
1990	318.3	153.6	471.9	35%	8%
2000	425.4	167.9	593.3	37%	9%
2002	**434.9**	**163.9**	**598.8**	**38%**	**9%**
2010	502.8	184.4	687.2	38%	8%
2020	587.8	195.5	783.3	38%	9%
2025	648.0	201.0	849.0	38%	8%

Buildings emissions equal emissions of Japan and France combined.
2002 U.S. emissions = 1,563 MMTCE. 2001 Global emissions = 6,518 MMTCE.

13. EPA Emissions for U.S. Buildings, 2001
(10^6 short tons)

	Buildings			Bldgs % of
	Wood/*Site* Fossil	Elec	Total	U.S. Emiss
SO2	0.55	7.67	8.22	52%
NOx	1.07	3.47	4.53	20%
CO	2.92	0.35	3.27	3%
VOCs	0.95	0.04	1.00	6%
PM-2.5	0.49	0.40	0.90	12%
PM-10	0.51	0.47	0.98	4%

14. Value of New, Improvement & Repair Building Construction ($2002 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	138.9	133.8	272.7	5.0%	89.9	N.A.	N.A.	N.A.
1985	178.4	189.1	367.5	5.8%	123.3	117.2	240.5	3.8%
1990	173.9	189.6	363.5	4.9%	147.7	118.8	266.4	3.6%
1995	198.6	173.8	372.4	4.5%	141.0	112.8	253.8	3.0%
2000	279.5	269.5	549.0	5.4%	158.4	161.5	319.9	3.1%
2002	304.5	251.2	555.7	5.3%	173.3	155.9	329.2	3.2%

2002 U.S. GDP = $10.4 trillion.

15. 1998 Cost Breakdown of a 2,150-Square-Foot, New Single-Family Home ($2002)

	Cost	Percent
Finished Lot	57,385	24%
Construction Cost	133,386	55%
Financing	4,574	2%
Overhead & General Expenses	13,891	6%
Marketing	3,410	1%
Sales Commission	8,203	3%
Profit	22,343	9%
Total	243,193	100%

16. Residential New Single-Family Housing Completed

	# of Units	Average SF
1980	957,000	1,730
1990	966,000	2,080
2000	1,241,800	2,266
2002	**1,325,100**	**2,320**

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)

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 2002 Energy Burdens

	Mean Individual	Median Individual	Mean Group
All Hholds	5.9%	3.2%	2.4%
Fed Elgble Hhold	12.6%	7.5%	7.5%
Fed Ineligible Hhold	2.7%	2.4%	1.9%

Average income of a Federally eligible household was $15,533 in 2002.

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

5.1 million homes were weatherized under DOE through FY 2001.
DOE Weatherization saves an average of 13-34% on home energy bills with a cost-benefit ratio of 1.3.
DOE Weatherization program requires that states spend no more than an average of $2,568 per household in PY 2002. 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)	**1.9**
Heavy Construction	2.0
Special Trade Construction	0.2
U.S. Industry Average	**3.4**
Manufacturing Average	3.3
Service Industry Average	3.8
Building Technology	
Appliances	2.0
Lighting	1.2
HVAC	1.5
Fans, Blowers, & Air Cleaning Equip	1.6
Lumber & Wood Products	0.3

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

22. 2003 Five Largest Residential Homebuilders

Homebuilder	Home Closings	% of Closings
Centex Corporation	29,858	1.8%
D.R. Horton	37,662	2.2%
Pulte Homes	32,693	1.9%
Lennar Homes	32,180	1.9%
KB Home	23,407	1.4%
Total of Top Five	125,942	9.3%
Habitat for Humanity	4,532	0.27%

2003 total U.S. new home closings was 1.68 million. 2003 total share c
top 100 builders was 14.0%. 2003 total share of top 400 builders was 35%

The summary tables correspond to the following tables in the Buildings Energy Databook:

1.	1.2.1, 1.3.1	**5.**	1.1.6, 1.5.1	**8.**	4.1.1, 4.1.2, 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.**	1.3.11	**9.**	1.2.4, 1.2.6, 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.	1.1.5	**7.**	1.1.4, 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.	1.1.3		4.1.5, 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) (1)

	Natural Gas		Petroleum (2)		Coal		Renewable(3)		Electricity Sales	Electricity Losses	Electricity Total		TOTAL (3)		Growth Rate 2002-Year
1980	7.52	28%	3.04	11%	0.15	1%	0.88	3%	4.35	10.60	14.95	56%	26.54	100%	-
1990	7.22	25%	2.17	7%	0.16	1%	0.68	2%	6.01	13.12	19.13	65%	29.36	100%	-
2000	8.40	25%	2.27	7%	0.10	0%	0.56	2%	8.03	13.75	21.78	66%	33.10	100%	-
2002	**8.27**	**22%**	**2.21**	**6%**	**0.11**	**0%**	**0.54**	**1%**	**8.45**	**18.75** (4)	**27.20**	**71%**	**38.33**	**100%**	-
2005	8.62	21%	2.46	6%	0.11	0%	0.56	1%	8.92	19.61	28.54	71%	40.28	100%	1.7%
2010	9.26	21%	2.52	6%	0.11	0%	0.56	1%	9.92	21.34	31.26	72%	43.71	100%	1.7%
2020	10.02	20%	2.54	5%	0.11	0%	0.58	1%	11.84	24.16	35.99	73%	49.24	100%	1.4%
2025	10.42	20%	2.53	5%	0.11	0%	0.59	1%	12.79	25.65	38.44	74%	52.09	100%	1.3%

Note(s): 1) See Table 1.3.11 for buildings-related energy consumption in industrial buildings. 2) Petroleum includes distillate and residual fuels, liquefied petroleum gas, kerosene, and motor gasoline. 3) Includes *site* marketed and non-marketed renewable energy in Table 1.1.5. 4) 2002 *site*-to-source electricity conversion = 3.22.

Source(s): EIA, State Energy Data 2000, April 2003, Tables 8-12, p. 18-22 for 1980, 1990 and 2000; and EIA, Annual Energy Outlook (AEO) 2004, Jan. 2004, Table A2, p. 134-136 for 2002-2025 and Table A18, p. 157 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 2002-Year
1980	0.8810	0.0000	N.A.	0.0000	0.8810	-
1990	0.6210	0.0560	N.A.	0.0090	0.6860	-
2000	0.4860	0.0610	N.A.	0.0170	0.5640	-
2002	**0.4935**	**0.0464**	**0.0003**	**0.0015**	**0.5417**	-
2005	0.5037	0.0502	0.0007	0.0024	0.5570	0.9%
2010	0.5036	0.0534	0.0028	0.0041	0.5640	0.5%
2020	0.5057	0.0612	0.0043	0.0091	0.5804	0.4%
2025	0.5042	0.0642	0.0082	0.0109	0.5875	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 2000, April 2003, Table 8-12, p. 18-22 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A18, p. 157 for 2002-2025.

1.1.3 Buildings Share of U.S. Primary Energy Consumption (percent) (1)

	Residential	Commercial	**Total Buildings**	Industry	Transportation	TOTAL	Total Consumption (quads)
1980 (2)	20%	14%	34%	41%	25%	100%	78.5
1990	20%	15%	35%	38%	27%	100%	84.1
2000	19%	15%	34%	39%	27%	100%	98.2
2002	**21%**	**18%**	**39%**	**33%**	**28%**	**100%**	**97.8**
2005	21%	18%	39%	33%	28%	100%	102.8
2010	21%	18%	39%	32%	29%	100%	111.8
2020	20%	19%	38%	32%	30%	100%	128.0
2025	19%	19%	38%	32%	30%	100%	136.6

Note(s): 1) Buildings-related energy consumption in the industrial sector in 1991 was 1.96 of 31.76 quads; for comparison, 2002 industrial sector energy use was 32.47 quads. 2) Renewables are not included in the 1980 data.

Source(s): EIA, State Energy Data 2000, April 2003, Tables 8-12, p. 18-22 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for 2002-2025 data and Table A18, p. 157 for non-marketed renewable energy.

1.1.4 2002 U.S. Buildings Energy End-Use Splits, by Fuel Type (quads) (1)

	Natural Gas	Fuel Oil (2)	LPG	Other Fuel(3)	Renw. En.(4)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (5)	Primary Total	Primary Percent
Space Heating (6)	4.96	1.02	0.30	0.19	0.40	0.69	7.55	38.6%	2.21	9.08	23.7%
Lighting						2.12	2.12	10.9%	6.84	6.84	17.8%
Space Cooling	0.01					1.43	1.45	7.4%	4.62	4.63	12.1%
Water Heating	1.74	0.19	0.05		0.05	0.55	2.58	13.2%	1.77	3.79	9.9%
Refrigeration (7)						0.90	0.90	4.6%	2.89	2.89	7.5%
Electronics (8)						0.62	0.62	3.2%	2.00	2.00	5.2%
Cooking	0.47		0.03			0.25	0.75	3.8%	0.81	1.31	3.4%
Wet Clean (9)	0.07					0.29	0.36	1.8%	0.94	1.01	2.6%
Ventilation (10)						0.31	0.31	1.6%	1.01	1.01	2.6%
Computers						0.20	0.20	1.0%	0.65	0.65	1.7%
Other (11)	0.38	0.02	0.24	0.05	0.10	0.48	1.28	6.5%	1.56	2.35	6.1%
Adjust to SEDS (12)	0.64	0.22				0.59	1.45	7.4%	1.90	2.77	7.2%
Total	8.27	1.46	0.62	0.24	0.54	8.45	19.58	100%	27.20	38.33	100%

Note(s): 1) See Table 1.3.11 for buildings-related energy consumption in industrial buildings. 2) Includes (1.38 quad) distillate fuel oil and (0.08 quad) residual fuel oil. 3) Kerosene (0.08 quad) and coal (0.11 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 4) Comprised of (0.39 quad) wood space heating, (0.10 quad) biomass, (0.05 quad) solar water heating, (less than 0.01 quad) geothermal space heating, and (less than 0.01 quad) solar pv. 5) *Site* -to-source electricity conversion (due to generation and transmission losses) = 3.22. 6) Includes (0.25 quad) furnace fans. 7) Includes (1.37 quad) refrigerators and (0.43 quad) freezers. Includes commercial refrigeration. 8) Includes (0.40 quad) color television and (1.61 quad) other office equipment. 9) Includes (0.10 quad) clothes washers, (0.07 quad) natural gas clothes dryers, (0.76 quad) electric clothes dryers, and (0.08 quad) dishwashers. Does not include water heating energy. 10) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 11) 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. 12) 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 2004, Jan. 2004, Tables A2, p. 134-136, Table A4, p. 139-140, Table A5, p. 141-142, and Table A18, p. 157; EIA, National Energy Modeling System for AEO 2004, Jan. 2004; 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.

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

				Renewables				Net	
	Natural Gas	Petroleum	Coal	Hydro.	Other	Total	Nuclear	Electric Imports	Total
1980	37%	17%	29%	7%	4%	11%	6%	(2)	100%
1990	31%	10%	36%	6%	3%	9%	13%	(2)	100%
2000	31%	8%	36%	6%	2%	8%	16%	(2)	100%
2002	**32%**	**7%**	**37%**	**5%**	**3%**	**8%**	**15%**	**0%**	**100%**
2005	32%	7%	37%	6%	3%	9%	15%	0%	100%
2010	32%	7%	38%	5%	4%	9%	14%	0%	100%
2020	33%	6%	39%	5%	5%	9%	12%	0%	100%
2025	31%	6%	42%	4%	5%	8%	12%	0%	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. See Table 1.3.11 for buildings-related energy consumption in industrial buildings. 2) Electric imports included in renewables.

Source(s): EIA, State Energy Data 2000, April 2003, Tables 8-12, p. 18-22 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for 2002-2025 consumption and Table A18, p. 157 for non-marketed renewable energy.

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

	Residential	Commercial	**Total Buildings**	Industry	Transportation	TOTAL	U.S. Electricity *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
2002 (1)	**36%**	**35%**	**71%**	**28%**	**1%**	**100%**	**11.9**
2005	36%	35%	71%	28%	1%	100%	12.5
2010	35%	37%	72%	28%	1%	100%	13.8
2020	34%	38%	72%	27%	1%	100%	16.4
2025	34%	38%	72%	27%	1%	100%	17.8

Note(s): 1) Buildings accounted for 80% (or $201 billion) of total U.S. electricity expenditures.

Source(s): EIA, State Energy Data 2000, April 2003, Tables 8-12, p. 18-22 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for 2000-2025 consumption, Table A3, p. 137-138 for 2002 expenditures.

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

	Site Consumption				Primary Consumption			U.S. Natural Gas *Delivered* Total (quads)
	Buildings	Industry	Electricity Generators	Transportation	**Buildings**	Industry	Transportation	
1980	37%	41%	19%	3%	50%	47%	3%	20.4
1990	37%	44%	15%	4%	48%	48%	4%	19.3
2000	37%	47%	13%	3%	46%	51%	3%	22.9
2002	**35%**	**38%**	**24%**	**3%**	**53%**	**44%**	**3%**	**23.4**
2005	36%	37%	24%	3%	53%	44%	3%	24.1
2010	35%	37%	25%	3%	53%	44%	3%	26.8
2020	32%	37%	28%	3%	52%	44%	3%	31.2
2025	32%	38%	27%	3%	51%	45%	3%	32.2

Source(s): EIA, State Energy Data 2000, April 2003, Tables 8-12, p. 18-22 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for 2002-2025 consumption, Table A3, p. 137-138 for 2002 expenditures.

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

	Site Consumption				Primary Consumption			U.S. Petroleum *Delivered* Total (quads)
	Buildings	Industry	Electricity Generators	Transportation	**Buildings**	Industry	Transportation	
1980	9%	28%	8%	56%	14%	30%	56%	34.2
1990	6%	25%	4%	65%	9%	26%	65%	33.6
2000	6%	24%	3%	68%	7%	24%	68%	38.5
2002	**6%**	**24%**	**2%**	**68%**	**7%**	**24%**	**68%**	**38.1**
2005	6%	23%	2%	69%	7%	23%	69%	40.5
2010	6%	22%	2%	71%	7%	22%	71%	44.1
2020	5%	21%	2%	72%	6%	22%	72%	51.4
2025	5%	21%	1%	73%	6%	21%	73%	55.0

Source(s): EIA, State Energy Data 2000, April 2003, Tables 8-12, p. 18-22 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for 2002-2025 consumption, Table A3, p. 137-138 for 2002 expenditures.

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

	Site Consumption				Primary Consumption			
			Electricity					U.S. Petroleum
	Buildings	Industry	Generators	Transportation	**Buildings**	Industry	Transportation	Total
1980	1.52	4.84	1.15	9.55	2.34	5.17	9.55	17.06
1990	1.23	4.30	0.57	10.89	1.65	4.45	10.89	16.99
2000	1.28	4.90	0.51	13.01	1.66	5.03	13.01	19.70
2002	**1.25**	**4.93**	**0.40**	**13.08**	**1.53**	**5.04**	**13.08**	**19.66**
2005	1.16	4.38	0.31	13.29	1.38	4.47	13.29	19.14
2010	1.19	4.55	0.31	14.80	1.42	4.63	14.80	20.85
2020	1.20	5.17	0.40	17.48	1.49	5.28	17.48	24.26
2025	1.20	5.47	0.38	18.93	1.47	5.58	18.93	25.98

Source(s): EIA, Annual Energy Review 2002, October 2003, Table 5.12a for 1980 to 2002 buildings, Table 5.12b for 1980 to 2002 industry, Table 5.12c for 1980 to 2002 transportation and Table 5.12d for 1980 to 2002 electricity generators; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for 2005-2025 consumption.

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

	Energy Consumption (Quad)				Population (million)				Annual Growth Rate 1990-2000		Annual Growth Rate 2000-2010	
Region/Country	1990	2000		2010	1990	2000		2010	Energy	Pop.	Energy	Pop.
United States	84.6	99.3	24.9%	111.8	255	276	4.6%	309	1.6%	0.8%	1.2%	1.1%
Western Europe (1)	59.9	66.8	16.7%	71.2	377	390	6.4%	396	1.1%	0.3%	0.6%	0.2%
Former Soviet Union	60.7	40.8	10.2%	46.2	290	289	4.8%	283	-3.9%	0.0%	1.3%	-0.2%
China	27.0	37.0	9.3%	54.6	1155	1275	21.0%	1365	3.2%	1.0%	4.0%	0.7%
Other Asia	22.1	36.6	9.2%	46.2	808	977	16.1%	1145	5.2%	1.9%	2.4%	1.6%
Japan	17.9	21.8	5.5%	23.9	124	127	2.1%	128	2.0%	0.2%	0.9%	0.1%
Central & S. America	14.4	21.0	5.3%	25.4	358	421	6.9%	481	3.8%	1.6%	1.9%	1.3%
Middle East	13.1	20.3	5.1%	25.0	193	242	4.0%	294	4.5%	2.3%	2.1%	2.0%
Canada	11.0	13.2	3.3%	15.4	28	31	0.5%	33	1.8%	1.0%	1.6%	0.6%
India	7.8	12.7	3.2%	16.4	846	1017	16.8%	1174	5.0%	1.9%	2.6%	1.4%
Africa	9.3	11.9	3.0%	14.6	622	796	13.1%	984	2.5%	2.5%	2.1%	2.1%
Eastern Europe	15.6	11.3	2.8%	12.8	122	121	2.0%	119	-3.2%	-0.1%	1.3%	-0.2%
Mexico	5.0	6.2	1.6%	7.3	83	99	1.6%	113	2.2%	1.8%	1.6%	1.3%
World Total	348.4	398.9	100%	470.8	5263	6061	100%	6825	1.4%	1.4%	1.7%	1.2%

Note(s): 1) Germany consumed 14.2 quads, France 10.4 quads, United Kingdom 9.8 quads, and Italy 8.0 quads.
Source(s): EIA, International Energy Outlook 2004, April 2004, Table A1, p. 163 and Table A14, p. 177.

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 2002-Year
1980	4.86	31%	1.75	11%	0.03	0%	0.86	5%	2.45	5.96		8.41	53%	15.90	100%	-
1990	4.52	27%	1.27	8%	0.03	0%	0.64	4%	3.15	6.88		10.03	61%	16.48	100%	-
2000	5.10	28%	1.52	8%	0.01	0%	0.49	3%	4.07	6.97		11.04	61%	18.17	100%	-
2002	**5.06**	**24%**	**1.48**	**7%**	**0.01**	**0%**	**0.42**	**2%**	**4.33**	**9.60**	(3)	**13.93**	**67%**	**20.91**	**100%**	-
2005	5.35	25%	1.59	7%	0.01	0%	0.43	2%	4.50	9.89		14.39	66%	21.78	100%	1.4%
2010	5.69	25%	1.60	7%	0.01	0%	0.44	2%	4.87	10.48		15.35	66%	23.09	100%	1.2%
2020	6.08	24%	1.56	6%	0.01	0%	0.45	2%	5.60	11.43		17.03	68%	25.14	100%	1.0%
2025	6.26	24%	1.53	6%	0.01	0%	0.45	2%	5.60	11.95		17.55	68%	25.81	100%	0.9%

Note(s): 1) Petroleum includes distillate and residual fuels, petroleum gas, kerosene, and motor gasoline. 2) Includes *site* marketed and non-marketed renewable energy. 3) 2002 *site* -to-source electricity conversion = 3.22.

Source(s): EIA, State Energy Data 2000, April 2003, Tables 8-12, p. 18-22 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A2, p.134-136 for 2002-2025 consumption and Table A18, p. 157 for non-marketed renewable energy.

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

	Wood	Solar Thermal (2)	Solar PV(2)	GHP (3)	Total
1980	0.8600	0.0000	N.A.	0.0000	0.8600
1990	0.5820	0.0560	N.A.	0.0060	0.6440
2000	0.4330	0.0610	N.A.	0.0090	0.5030
2002	**0.3943**	**0.0225**	**0.0001**	**0.0015**	**0.4184**
2005	0.4045	0.0245	0.0001	0.0024	0.4315
2010	0.4045	0.0276	0.0009	0.0041	0.4372
2020	0.4066	0.0342	0.0011	0.0091	0.4509
2025	0.4050	0.0371	0.0013	0.0109	0.4543

Note(s): 1) Does not include renewable energy consumed by electric utilities (including hydroelectric). 2) Includes only solar energy. Commercial sector cannot be separated out for 1980-2000. 3) GHP = Ground-Coupled Heat Pumps.

Source(s): EIA, State Energy Data 2000, April 2003, Table 8, p. 18 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A18, p. 157 for 2002-2025.

1.2.3 2002 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)	3.54	0.77	0.30	0.08	0.40	0.48	5.56	49.2%	1.54	6.62	31.7%
Water Heating	1.15	0.12	0.05		0.02	0.41	1.75	15.5%	1.32	2.66	12.7%
Space Cooling	0.00					0.80	0.80	7.1%	2.59	2.59	12.4%
Lighting						0.77	0.77	6.8%	2.47	2.47	11.8%
Refrigeration (5)						0.56	0.56	4.9%	1.80	1.80	8.6%
Wet Clean (6)	0.07					0.29	0.36	3.2%	0.94	1.01	4.8%
Electronics (7)						0.31	0.31	2.8%	1.00	1.00	4.8%
Cooking	0.21		0.03			0.22	0.46	4.0%	0.71	0.94	4.5%
Computers						0.06	0.06	0.6%	0.21	0.21	1.0%
Other (8)	0.10	0.00	0.15		0.00	0.18	0.42	3.7%	0.58	0.82	3.9%
Adjust to SEDS (9)						0.24	0.24	2.2%	0.79	0.79	3.8%
Total	5.06	0.89	0.53	0.08	0.42	4.33	11.30	100%	13.93	20.91	100%

Note(s): 1) Kerosene (0.07 quad) and coal (0.01 quad) are assumed attributable to space heating. 2) Comprised of (0.39 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) = 3.22. 4) Includes (0.25 quad) furnace fans. 5) Includes (1.37 quad) refrigerators and (0.43 quad) freezers. 6) Includes (0.10 quad) clothes washers, (0.07 quad) natural gas clothes dryers, (0.76 quad) electric clothes dryers, and (0.08 quad) dishwashers. Does not include water heating energy. 7) Includes (0.40 quad) color television and (1.61 quad) other office equipment. 8) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills and natural gas outdoor lighting. 10) 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 2004, Jan. 2004, Tables A2, p. 134-136, Table A4, p. 139-140 and Table A18, p. 157; 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	124.8	15.9	199.7
1990	94.2	N.A.	9.6	102.0	16.5	175.0
2000	105.7	N.A.	11.2	106.0	18.2	171.9
2002	**110.3**	**3%**	**11.3**	**102.3**	**20.9**	**189.4**
2005	113.7	8%	11.9	104.3	21.8	191.4
2010	119.8	16%	12.6	105.0	23.1	192.4
2020	132.0	29%	13.7	103.5	25.1	190.1
2025	137.8	35%	14.2	102.8	26.1	189.5

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

Source(s): EIA, State Energy Data 2000, April 2003, Table 8, p. 18 for 1980-2000 energy consumption; EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 and Table A4, p. 134-136 for 2002-2025, and Table A20, p. 159 for households; and DOC, Statistical Abstract of the United States 2003, Feb. 2004, Table No. 953, p. 615 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 (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) (1)

	Natural Gas		Petroleum (2)		Coal		Renewable(3)		Electricity Sales	Electricity Losses		Electricity Total		TOTAL (3)		Growth Rate 2002-Year
1980	2.67	25%	1.29	12%	0.12	1%	0.02	**0%**	1.91	4.64		6.54	62%	10.64	100%	-
1990	2.70	21%	0.91	7%	0.13	1%	0.04	**0%**	2.86	6.24		9.10	71%	12.88	100%	-
2000	3.29	22%	0.75	5%	0.09	1%	0.06	**0%**	3.96	6.78		10.74	72%	14.93	100%	-
2002	**3.21**	**18%**	**0.72**	**4%**	**0.10**	**1%**	**0.12**	**1%**	**4.12**	**9.15**	(4)	**13.27**	**76%**	**17.43**	**100%**	-
2005	3.26	18%	0.87	5%	0.10	1%	0.13	1%	4.42	9.72		14.14	76%	18.50	100%	2.0%
2010	3.57	17%	0.92	4%	0.10	0%	0.13	1%	5.05	10.86		15.91	77%	20.63	100%	2.1%
2020	3.94	16%	0.97	4%	0.10	0%	0.13	1%	6.24	12.73		18.96	79%	24.10	100%	1.8%
2025	4.16	16%	1.00	4%	0.10	0%	0.13	1%	6.83	13.70		20.53	79%	25.92	100%	1.7%

Note(s): 1) See Table 1.3.11 for buildings-related energy consumption in the industrial sector. 2) Petroleum includes distillate and residual fuels, liquefied petroleum gas, kerosene, and motor gasoline. 3) Includes *site* marketed and non-marketed renewable energy. 4) 2002 *site* -to-source electricity conversion = 3.22.

Source(s): EIA, State Energy Data 2000, April 2003, Table 9, p. 19 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for 2002-2025 and Table A18, p. 157 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
1980	0.0210	N.A.	N.A.	N.A.	0.0210
1990	0.0390	N.A.	N.A.	0.0030	0.0030
2000	0.0530	N.A.	N.A.	0.0080	0.0080
2002	**0.0992**	**0.0238**	**0.0003**	**N.A.**	**0.1233**
2005	0.0992	0.0257	0.0006	N.A.	0.1255
2010	0.0992	0.0258	0.0019	N.A.	0.1269
2020	0.0992	0.0271	0.0032	N.A.	0.1294
2025	0.0992	0.0271	0.0070	N.A.	0.1333

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 2000, April 2003, Table 8-9, p. 18-19 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A18, p. 157 for 2002-2025.

1.3.3 2002 Commercial Energy End-Use Splits, by Fuel Type (quads) (1)

	Natural Gas	Fuel Oil (2)	LPG	Other Fuel(3)	Renw. En.(4)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (5)	Primary Total	Primary Percent
Lighting						1.36	1.36	16.4%	4.37	4.37	25.1%
Space Heating	1.42	0.25		0.11		0.21	1.99	24.1%	0.68	2.46	14.1%
Space Cooling	0.01					0.63	0.64	7.8%	2.03	2.04	11.7%
Water Heating	0.59	0.07			0.02	0.14	0.82	10.0%	0.45	1.13	6.5%
Refrigeration						0.34	0.34	4.1%	1.09	1.09	6.3%
Ventilation						0.31	0.31	3.8%	1.01	1.01	5.8%
Electronics						0.31	0.31	3.7%	1.00	1.00	5.7%
Computers						0.14	0.14	1.6%	0.44	0.44	2.5%
Cooking	0.26					0.03	0.29	3.5%	0.10	0.36	2.1%
Other (6)	0.28	0.02	0.09	0.05	0.10	0.31	0.85	10.3%	0.98	1.53	8.8%
Adjust to SEDS (7)	0.64	0.22				0.35	1.21	14.6%	1.12	1.98	11.4%
Total	3.21	0.57	0.09	0.16	0.12	4.12	8.28	100%	13.27	17.43	100%

Note(s): 1) See Table 1.3.11 for buildings-related energy consumption in industrial buildings. 2) Includes (0.49 quad) distillate fuel oil and (0.08 quad) residual fuel oil. 3) Kerosene (0.02 quad) and coal (0.10 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 4) Comprised of (0.10 quad) biomass, (0.02 quad) solar water heating, and (less than 0.01 quad) solar pv. 5) *Site* -to-source electricity conversion (due to generation and transmission losses) = 3.22. 6) 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. 7) 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 2004, Jan. 2004, Tables A2, p. 134-136, Table A5, p. 141-142, and Table A18, p. 157 for 2002; EIA, AEO 1999, Dec. 1998, Table A5, p. 120 for 1996 refrigeration; EIA, National Energy Modeling System for AEO 2004, Jan. 2004; 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.

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1.3.4 Commercial *Delivered* and Primary Energy Consumption Intensities, by Year (1)

		Floorspace (10^9 SF)	Percent Post-2000 Floorspace (2)	*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	208.9
1990		64.3	N.A.	6.6	103.2	12.9	200.2
2000	(3)	68.5	N.A.	8.2	119.0	14.9	217.9
2002	**(3)**	**72.1**	**9%**	**8.3**	**114.5**	**17.4**	**241.4**
2005	(3)	77.6	21%	8.8	112.8	18.5	238.2
2010	(3)	83.8	35%	9.7	116.2	20.6	245.8
2020	(3)	95.9	60%	11.3	118.3	24.1	251.0
2025	(3)	101.8	70%	12.2	119.7	25.9	254.3

Note(s): 1) See Tables 1.3.11 and 2.2.9 for buildings-related energy consumption and floorspace of the industrial sector. 2) Percent built after December 31, 2000. 3) Excludes parking garages and commercial buildings on multibuilding manufacturing facilities.

Source(s): EIA, State Energy Data 2000, April 2003, Table 9, p. 19 for 1980-2000 energy consumption; 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 2004, Jan. 2004, Table A5, p. 141-142 for 2002-2025.

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 1980	81.0	59.8%
1980 to 1989	87.2	21.2%
1990 to 1999	98.3	19.0%
		100%
Average	85.2	

Note(s): 1) Parking garages and commercial buildings on multibuilding manufacturing facilities are excluded from CBECS 1999.
Source(s): EIA, Commercial Building Energy Consumption and Expenditures 1999, August 2002, Table C3.

1.3.6 1999 Commercial *Delivered* Energy Consumption Intensities, by Principal Building Type and Vintage (1)

	Consumption (10^3 Btu/SF)	
Building Type	Pre-1990	1990-1999
Education	75.1	74.1
Food Sales	136.2	224.3
Food Service	146.8	N.A.
Health Care	186.9	122.7
Inpatient	179.4	N.A.
Outpatient	79.0	N.A.
Lodging	101.2	90.3
Mercantile	66.4	83.1
Enclosed & Strip Malls	66.0	76.0
Other	67.0	88.7
Service	129.5	N.A.
Office	92.7	78.0
Public Assembly	78.8	97.2
Public Order and Safety	40.3	N.A.
Warehouse and Storage	35.0	N.A.
Vacant (2)	24.1	N.A.

Note(s): 1) See Table 1.3.4 for primary versus *delivered* energy consumption. 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, August 2002, Table C8.

1.3.7 1999 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
Office	**218.9**	**22%**	**Service**	**199.8**	**6%**
Mercantile	**170.9**	**15%**	**Lodging**	**185.8**	**7%**
Enclosed & Strip Malls	174.6		**Public Assembly**	**166.6**	**6%**
Other	162.8		**Food Service**	**469.5**	**7%**
Education	**135.1**	**10%**	**Food Sales**	**532.2**	**4%**
Warehouse and Storag	**86.1**	**8%**	**Public Order/Safety**	**138.7**	**1%**
Health Care	**336.9**	**8%**	**Vacant (2)**	**44.8**	**2%**
Inpatient	393.0		**Other (3)**	**287.2**	**3%**
Outpatient	192.8				**100%**

Note(s): 1) Parking garages and commercial buildings on multibuilding manufacturing facilities are excluded from CBECS 1999.
2) Includes vacant and religious worship. 3) Includes mixed uses, hangars, crematoriums, laboratories, and other.
Source(s): EIA, Commercial Building Energy Consumption and Expenditures 1999, August 2002, Table C1.

1.3.8 1999 Commercial *Delivered* Energy Consumption Intensities, by Ownership of Unit (1)

Ownership	Consumption (10^3 Btu/SF)	Percent of Total Consumption
Nongovernment Owned	**83.0**	**79.6%**
Owner-Occupied	88.4	58.3%
Nonowner-Occupied	77.4	21.1%
Government Owned	**94.7**	**20.4%**
		100%

Note(s): 1) Parking garages and commercial buildings on multibuilding manufacturing facilities are excluded from CBECS 1999.
Source(s): EIA, Commercial Buildings Energy Consumption and Expenditures 1999, August 2002, Table C3.

1.3.9 Aggregate Commercial Building Component Loads (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.

1.3.11 1991 Buildings-Related *Delivered* and Primary Energy Consumption in Industrial Sector (10^12 Btu)

SIC Group	Manufacturing Industry	Ventilation	Space Heating	Space Cooling	Lighting	Total
20	Food	10.9	110.8	11.4	12.5	145.6
21	Tobacco	0.5	5.9	0.6	N.A.	7.0
22	Textiles	3.4	37.3	3.7	9.2	53.6
23	Apparel	1.7	13.5	1.6	3.6	20.4
24	Lumber	1.1	7.8	1.0	3.3	13.2
25	Furniture	1.5	12.8	1.4	2.1	17.8
26	Paper	5.1	53.9	5.4	9.2	73.6
27	Printing	5.4	27.9	4.2	8.2	45.7
28	Chemicals	7.9	76.9	8.1	15.4	108.3
29	Refining	1.5	15.5	1.6	4.0	22.6
30	Rubber	3.2	28.3	3.1	9.4	44.0
31	Leather	0.5	5.4	0.5	N.A.	6.4
32	Stone, Clay, Glass	2.1	19.7	2.1	5.1	29.0
33	Primary Metals	4.9	51.0	5.2	16.3	77.4
34	Fabricated Metals	6.6	61.3	6.6	11.8	86.3
35	Industrial Machinery	7.4	54.0	6.6	16.3	84.3
36	Electronic Equipment	6.0	44.6	5.4	13.7	69.7
37	Transportation Equipment	10.8	101.0	10.8	19.1	141.7
38	Instruments	5.2	39.6	4.8	8.4	58.0
39	Miscellaneous Manufacturing	1.0	7.2	0.9	2.2	11.3
	Delivered Total	86.9	774.3	85.1	169.9	1,116.2
	Primary Total	270.0	890.0	280.0	520.0	1,960.0

Note(s): Total buildings-related (i.e., non-process) primary energy consumption in the industrial sector in 1991 was 1.96 of 31.80 quads; for comparison, 2002 industrial primary energy consumption was 32.67 quads.

Source(s): PNNL, An Analysis of Buildings-Related Energy Use in Manufacturing, PNNL-11499, April 1997, Table 4.1, p. 4.2; EIA, State Energy Data 2000, April 2003, Table 10, p. 20 for industrial sector note; EIA, AEO 2002, Table A2, p. 126-128; and DOE/BTS Memorandum, AEO98 Data Clarification for Building Energy Analysts, May 13, 1998.

1.4.1 FY 2001 Federal Primary Energy Consumption

Buildings and Facilities	**0.62 quads**	
Vehicles/Equipment/Energy-Intensive Operations	0.77 quads	(mostly jet fuel and diesel)
Total Federal Government Consumption	1.40 quads	

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, February 2004, Table 1-A, p. 13 for total consumption and Table 5-A, p. 57 for buildings consumption.

1.4.2 FY 2001 Federal Building Energy Use Shares, by Fuel Type, and by Agency

Fuel Type	*Site* Percent	Primary Percent	Agency	Primary Percent		FY 2001 Quads
Electricity	43.8%	71.2%	Defense	62.2%	Total *Delivered*	
Natural Gas	33.5%	17.2%	Postal	8.9%	Energy Consumption =	0.33
Fuel Oil	12.7%	6.5%	DOE	5.7%	Total Primary	
Coal	4.5%	2.3%	VA	7.6%	Energy Consumption =	0.62
Other	5.5%	2.8%	GSA	4.5%		
	100%	100%	Other	11.0%		
				100%		

Note(s): See Table 2.3.1 for floorspace.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, February 2004, Table 7-B, p. 63 for fuel types, and Table 5-A, p. 57 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 1995 (2)	117.4
FY 1986	132.3	FY 1996	115.1
FY 1987	137.4	FY 1997	113.0
FY 1988	137.2	FY 1998	108.8
FY 1989	133.1	FY 1999	107.8
FY 1990	125.9	FY 2000	105.9
FY 1991	123.9	FY 2001	106.8
FY 1992	125.7	FY 2005 (3)	97.6
FY 1993	122.5	FY 2010 (3)	90.6
FY 1994	120.4		

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, February 2004, Table 5-B, p. 58 for 1990-2001 energy consumption and Table 8-A, p. 66 for 2001 floorspace; 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	U.S. Electricity *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
2002 (1)	**36%**	**35%**	**71%**	**28%**	**1%**	**100%**	**11.9**
2005	36%	35%	71%	28%	1%	100%	12.5
2010	35%	37%	72%	28%	1%	100%	13.8
2020	34%	38%	72%	27%	1%	100%	16.4
2025	34%	38%	72%	27%	1%	100%	17.8

Note(s): 1) Buildings accounted for 80% (or $199 billion) of total U.S. electricity expenditures.

Source(s): EIA, State Energy Data, April 2003, Tables 8 -12, p. 18-22 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for 2002-2025 consumption, and Table A3, p. 139-140 for 2002 expenditures.

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

				Renewables				Net	
	Natural Gas	Petroleum	Coal	Hydro.	Oth(2)	Total	Nuclear	Electric Imports	Total
1980	16%	11%	50%	13%	0%	13%	11%	(1)	100%
1990	10%	4%	54%	10%	1%	11%	21%	(1)	100%
2000	10%	2%	55%	9%	0%	9%	24%	(1)	100%
2002	**15%**	**2%**	**52%**	**7%**	**2%**	**10%**	**21%**	**0%**	**100%**
2005	15%	2%	52%	8%	3%	11%	21%	0%	100%
2010	16%	2%	53%	7%	4%	11%	19%	0%	100%
2020	18%	2%	53%	6%	5%	11%	17%	0%	100%
2025	16%	2%	56%	6%	5%	11%	16%	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 2000, April 2003, Table 12, p. 22 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for 2002-2025 consumption and Table A18, p. 157 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	2002-Year
1980	3.80	2.63	12.16	3.09	0.11	3.20	2.74	(1)	24.53	-
1990	2.86	1.25	16.09	2.80	0.21	3.01	6.10	(1)	29.53	-
2000	3.10	0.78	17.54	2.80	0.02	2.82	7.86	(1)	32.10	-
2002	**5.65**	**0.85**	**19.96**	**2.75**	**0.94**	**3.69**	**8.15**	**0.07**	**38.36**	-
2005	5.81	0.66	20.96	3.12	1.12	4.25	8.26	0.11	40.04	1.4%
2010	6.79	0.66	23.05	3.13	1.54	4.68	8.29	0.11	43.58	1.6%
2020	8.78	0.85	26.22	3.13	2.33	5.47	8.53	0.07	49.92	1.5%
2025	8.55	0.81	29.67	3.13	2.66	5.79	8.53	0.03	53.37	1.4%

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 2000, April 2003, Table 12, p. 22 for 1980, 1990 and 2000; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for 2002-2025 consumption and Table A18, p. 157 for renewables.

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

Electric Generator	1990	2000	2002	2005	2010	2020	2025
Coal Steam	300	305	306	304	305	348	407
Other Fossil Steam	144	135	133	128	105	100	95
Combined Cycle	7	29	81	121	127	184	202
Combustion Turbine/Diesel	46	79	123	134	131	164	175
Nuclear Power	100	98	99	100	101	103	103
Pumped Storage	18	20	20	20	20	20	20
Fuel Cells	0	0	0	0	0	0	0
Conv. Hydropower	75	78	78	79	79	79	79
Geothermal	3	3	3	3	4	6	7
Municipal Solid Waste	2	3	3	4	4	4	4
Biomass	7	2	2	2	2	3	4
Solar Thermal	0	0	0	0	0	0	1
Solar Photovoltaic	0	0	0	0	0	0	0
Wind	2	2	5	7	8	13	16
Total	703	754	853	901	887	1033	1125
Distributed Generation	N.A.	0	0	0	0	8	12

Source(s): EIA, AEO 1994, Table A9, p. 66 and Table A16, p. 73 for 1990; and EIA, AEO 2004, Jan. 2004, Table A9, Table 147-148 and Table A17, p. 156 for 2000-2025.

1.5.5 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
Coal Steam	550	1	12	94	203
Combined Cycle	400	109	125	269	313
Combustion Turbine/Diesel	160	76	116	338	420
Nuclear Power (2)	1000	0	0	0	0
Pumped Storage (2)	133 (3)	0	0	0	0
Fuel Cells	10	0	5	5	5
Conventional Hydropower	29 (3)	10	14	14	14
Geothermal	50	0	23	63	79
Municipal Solid Waste	30	6	14	15	15
Wood and Other Biomass	80	1	5	15	24
Solar Thermal	100	1	1	2	2
Solar Photovoltaic	5	9	26	60	78
Wind	50	37	64	171	223
Total		248	404	1046	1376
Distributed Generation	2	0	3	47	77

Note(s): 1) Cumulative additions after December 31, 2002. 2) EIA projects no new power plants will be constructed through 2025. However, it is expected that the capacity of existing units will increase. 3) Based on current stock averaged capacity.

Source(s): EIA, AEO 2004, Jan. 2004, Table A9, p. 147-148 and Table A17, p. 156; EIA, Assumption to the AEO 2004, Jan. 2004, Table 38, p. 71; 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
2002	**110.3**	**3%**	**N.A.**	**N.A.**	**288**	**2.6**
2005	113.7	8%	N.A.	N.A.	296	2.6
2010	119.8	16%	N.A.	N.A.	322	2.7
2020	132.0	29%	N.A.	N.A.	336	2.5
2025	137.8	35%	N.A.	N.A.	349	2.5

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. 2003, Feb. 2004, No. 931, p. 615 1980-2000 households, No. 2-3, p. 8-9 for population; EIA, AEO 2004, Jan. 2004, Table A4, p. 139-140 for 2002-2025 households and Table A20, p. 159 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 by 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
1980	957	N.A.	545	N.A.	234	1735
1981	819	1720	447	980	229	1495
1985	1073	N.A.	631	N.A.	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	363	1776
1997	1116	2150	284	1095	354	1754
1998	1160	2190	315	1065	373	1847
1999	1270	2225	335	1105	348	1953
2000	1242	2266	332	1092	250	1824
2001	1256	2324	315	1122	193	1764
2002	1325	2320	323	1132	169	1817
2003	1386	N.A.	292	N.A.	131	1809

Source(s): U.S. Census Bureau, Manufacturing, Mining and Construction Statistics, New Residential Construction: New Privately Owned Housing Units Completed for 1999-2003 single and multi-family unit values; 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 data; DOC, Manufactured Housing Statistics: Manufactured Homes Placements by Region, March 2003 for 1995-2002 data; NAHB, Housing Economics, March 1995 for 1981-1993 average floorspace; DOC, Current Construction Reports: Characteristics of New Housing, 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; and DOC Characteristics of New One-Family Houses Completed, May 2004 for 2000-2002 square footage.

2.1.7 Materials Used in the Construction of a 2,272-Sq.-Ft. Single-Family Home, 2000

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

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

2.1.8 2003 New Homes Completed/Placed, by Census Region (thousand units and percent of total units by housing type)

	Single-Family		Multi-Family		Mobile Homes		
Region	Units	% of Total	Units	% of Total	Units	% of Total	Total
Northeast	114	8%	41	14%	11	8%	165
Midwest	274	20%	58	20%	24	18%	356
South	636	46%	120	41%	75	55%	830
West	363	26%	73	25%	25	19%	461
Total	1,387	100%	292	100%	135	100%	1,813

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 2004 for mobile home placements.

2.1.9 2002 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	97	8%	12	26%	5	15%	113
Midwest	249	20%	15	33%	8	24%	272
South	580	47%	16	35%	20	61%	615
West	321	26%	3	7%	1	3%	325
Total	1,246	100%	46	100%	33	100%	1,325

Source(s): DOC, Manufacturing, Mining and Construction Statistics, New Residential Construction: Type of Construction Method of New One-Family Houses Completed, March 2004.

2.2.1 Total Commercial Floorspace and Number of Buildings, by Year (1)

	Commercial Sector Floorspace (10^9 square feet)	Percent Post-2000 Floorspace (3)	Buildings (10^6)
1980	50.9 (2)	N.A.	3.1 (4)
1990	64.3	N.A.	4.5 (4)
2000 (5)	68.5	N.A.	4.7 (6)
2002 (5)	**72.1**	**9%**	N.A.
2005 (5)	77.6	21%	N.A.
2010 (5)	83.8	35%	N.A.
2020 (5)	95.9	60%	N.A.
2025 (5)	101.8	70%	N.A.

Note(s): 1) Excludes industrial buildings floorspace (see Table 2.2.8). 2) Based on PNNL calculations. 3) Percent built after December 31, 2000. 4) Actually for previous year. 5) EIA now excludes parking garages and commercial buildings on multibuilding manufacturing facilities from the commercial building sector. 6) 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 2004, Jan. 2004, Table A5, p. 141-142 for 2002-2025 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 1999 (percent of total floor space) (1)

	Total Floorspace	Total Buildings	Primary Energy Consumption
Office	18%	16%	22%
Warehouse/Storage	16%	13%	8%
Mercantile (2)	15%	14%	15%
Education	13%	7%	10%
Public Assembly	7%	7%	6%
Lodging	7%	3%	7%
Service	5%	10%	6%
Health Care (3)	4%	3%	8%
Food Service	3%	7%	7%
Public Order/Safety	2%	2%	1%
Food Sales	1%	4%	4%
Vacant (4)	8%	12%	2%
Other (5)	2%	2%	3%
	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 67.4 billion square feet. 2) Mercantile consists of Enclosed and Strip Malls (8%) and Retail Centers (7%). 3) Health Care includes Inpatient (3%) and Outpatient Health Care (2%). 4) Includes vacant (3%) and religious worship (5%). 5) Includes mixed uses, hangars, crematoriums, laboratories, and other.

Source(s): EIA, Commercial Building Characteristics 1999, August 2002, Table B2.

2.2.3 Number of Floors and Type of Ownership as of 1999 (percent of total floorspace) (1)

Floors		Ownership	
One	40%	**Nongovernment Owned**	**82%**
Two	25%	Owner-Occupied	56%
Three	13%	Nonowner-Occupied	23%
Four to Nine	15%	Unoccupied	2%
Ten or More	7%	**Government Owned**	**18%**
	100%	Federal	3%
		State	4%
		Local	11%
			100%

Note(s): 1) Excludes floorspace of industrial buildings.

Source(s): EIA, Commercial Building Characteristics 1999, August 2002, Table B2 for floors and Table B13 for ownership.

2.2.4 Share of Commercial Floorspace, by Census Region and Vintage as of 1999 (percent) (1)

Region	Prior to 1980	1980 to 1989	1990 to 1999	Total
Northeast	13%	3%	2%	18%
Midwest	16%	4%	4%	25%
South	19%	9%	7%	35%
West	14%	4%	4%	22%
				100%

Note(s): 1) Excludes floorspace of industrial buildings.
Source(s): EIA, Commercial Building Characteristics 1999, August 2002, Table B3.

2.2.5 Commercial Building Size as of 1999 (percent of total floorspace) (1)

Square Foot Range	Percent	Total Number of Buildings (1000s)
1,001 to 5,000	10.1%	2348
5,001 to 10,000	12.2%	1110
10,001 to 25,000	16.6%	708
25,001 to 50,000	13.8%	257
50,001 to 100,000	15.0%	145
100,001 to 200,000	12.3%	59
200,001 to 500,000	10.2%	23
Over 500,000	9.8%	7
	100%	4657

Note(s): 1) Excludes floorspace of industrial buildings.
Source(s): EIA, Commercial Building Characteristics 1999, August 2002, Table B2.

2.2.6 Commercial Building Vintage (as of 1999) and Lifetimes (1)

	Percent of Total Floorspace
Prior to 1919	6%
1920 to 1959	23%
1960 to 1979	34%
1980 to 1989	21%
1990 to 1999	16%
	100%

Note(s): 1) Excludes floorspace of industrial buildings.
Source(s): EIA, Commercial Building Characteristics 1999, August 2002, Table B3 for vintages.

2.2.7 Commercial Building Median Lifetimes (1)

Building Type	Years (2)	Building Type	Years (2)
Assembly	48	Large Office	36
Education	48	Small Office	36
Food Sales	36	Mercantile & Service	36
Food Service	36	Warehouse	36
Health Care	48	Other	42
Lodging	36		

Note(s): 1) One-half of buildings of a given vintage are retired (demolished) by the median lifetime. 2) PNNL estimates the median lifetime of commercial buildings is 70-75 years.
Source(s): EIA, Assumptions for the Annual Energy Outlook 2004, Jan. 2004, Table 12, p. 30; and PNNL, Memorandum: New Construction in the Annual Energy Outlook 2003, April 24, 2003 for note 2.

2.2.8 1999 Average Commercial Building Floorspace, by Principal Building Type and Vintage (1)

Building Type	Average Floorspace/Building (1000 SF) Pre-1990	1990-1999	All
Mercantile and Service	26.5	24.6	12.0
Education	26.5	26.4	26.5
Warehouse/Storage	18.5	14.0	17.4
Office	16.9	13.6	16.3
Public Assembly	N.A.	N.A.	14.4
Lodging	N.A.	N.A.	29.5
Health Care	N.A.	N.A.	23.0
Food Service	N.A.	N.A.	5.3
Food Sales	N.A.	N.A.	5.7
Public Order and Safety	N.A.	N.A.	16.2
Vacant (2)	N.A.	N.A.	17.5

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.

2.2.9 1991 Industrial Building Floorspace (10^6 square feet)

SIC	Manufacturing Industry	Office Floorspace	Non-Office Floorspace	Total Floorspace
20	Food	203	1,207	1,410
21	Tobacco	6	51	56
22	Textiles	42	581	623
23	Apparel	73	451	523
24	Lumber	53	1,135	1,187
25	Furniture	49	521	569
26	Paper	72	827	899
27	Printing	351	477	827
28	Chemical	185	714	899
29	Refining	20	105	125
30	Rubber	97	768	865
31	Leather	9	44	53
32	Stone, Clay	57	808	864
33	Primary Metals	81	1,121	1,202
34	Fabricated Metals	182	1,175	1,357
35	Industrial Machinery	337	1,149	1,485
36	Electronic Equipment	266	629	894
37	Transportation	289	776	1,065
38	Instruments	225	170	395
39	Misc. Manufacturing	52	190	242
	Total	2,641	12,898	15,539

Source(s): PNNL, An Analysis of Buildings-Related Energy Use in Manufacturing, PNNL-11499, April 1997, Table 4.3, p. 4.4.

2.3.1 Federal Building Gross Floorspace, by Year and by 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

Agency	2001 Percent of Total Floorspace
Defense	66%
Postal	11%
GSA	6%
VA	5%
DOE	2%
Other	10%
	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 (draft), June 6, 2002, Table 8-A, p. 83 for FY 1985 and FY 2000 data; and DOE/FEMP, Annual Report to Congress on FEMP, February 2004, Table 8-A, p. 66 for 2001 data.

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 2002-Year	Total	Growth Rate 2002-Year	Buildings % of Total U.S.	Buildings % of Total Global
1980	172.0	255.2	427.1	-	1281.7	-	33%	9%
1990	153.6	318.3	471.9	-	1360.5	-	35%	8%
2000	167.9	425.4	593.3	-	1581.5	-	37%	9%
2002	**163.9** (2)	**434.9** (2)	**598.8**	-	**1562.5**	-	**38%**	**9%**
2005	174.0	451.3	625.3	1.5%	1632.5	1.5%	38%	8%
2010	184.4	502.8	687.2	1.7%	1788.8	1.7%	38%	8%
2020	195.5	587.8	783.3	1.5%	2055.2	1.5%	38%	9%
2025	201.0	648.0	849.0	1.5%	2220.6	1.5%	38%	8%

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 2004, Jan. 2004, Table A19, p. 158 by less than 1%. U.S. buildings approximately equal the carbon emissions of Japan and France combined.

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. 2002, Oct. 2003, Tables 6-10, p. 28-30 for 1990 and 2000; EIA, Assumptions to the AEO 2004, Jan. 2004, Table 2, p.8 for carbon coefficients; EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for 2002-2025 energy consumption and Table A19, p. 158 for 2002-2025 emissions; EIA, International Energy Outlook 2004, April 2004, Table A9, p. 172 for 1990-2025 global emissions; and ORNL, Global CO2 Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring: 1751-1995, Jan. 1998 for 1980 global emissions.

3.1.2 2002 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)	71.4	18.6	1.7	5.1	1.6	27.1	2.8	35.4	136.6	22.8%
Lighting								109.4	109.4	18.3%
Space Cooling	0.2							73.8	74.0	12.4%
Water Heating	25.0	3.8		0.8		4.7		28.3	58.0	9.7%
Refrigeration (5)								46.2	46.2	7.7%
Electronics (6)								32.0	32.0	5.3%
Cooking	6.8			0.5		0.5		12.9	20.2	3.4%
Ventilation (8)								16.2	16.2	2.7%
Wet Clean (7)	1.0							15.1	16.1	2.7%
Computers								10.4	10.4	1.7%
Other (9)	5.5	0.4		4.1	0.9	5.4		24.9	35.8	6.0%
Adjust to SEDS (10)	9.3	4.4				4.4		30.4	44.1	7.4%
Total	119.1	27.2	1.7	10.6	2.5	42.0	2.8	434.9	598.8	100%

Note(s): 1) Excludes emissions of buildings-related energy consumption in the industrial sector. 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 2004 and differ by as much as 0.1% from EIA, AEO 2004, Table A19. Buildings sector total varies by 0.1% from EIA, AEO 2004. 2) Includes kerosene space (1.6 MMTCE) heating and motor gasoline other uses (0.9 MMTCE). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (3.9 MMTCE). 5) Includes refrigerators (28.7 MMTCE) and freezers (10.4 MMTCE). 6) Includes color television (6.3) MMTCE) and other office equipment. 7) Includes clothes washers (1.6 MMTCE), natural gas clothes dryers (1.0 MMTCE), electric clothes dryers (12.2 MMTCE), and dishwashers (1.2 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 2004, Jan. 2004, Table A2, p. 134-136, Table A4, p. 139-140 and Table A5, p. 141-142 for energy consumption, and Table A19, p. 158 for emissions; EIA, National Energy Modeling System for AEO 2004, Jan. 2004; EIA, Assumptions to the AEO 2004, Jan. 2004 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; and EIA, AEO 1999, Dec. 1998, p. 120 for 1996 commercial refrigeration.

3.1.3 2002 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)	50.9	15.2	5.1	1.3	21.6	0.3	24.6	97.4	30.1%
Space Cooling	0.0						41.4	41.4	12.8%
Water Heating	16.5	2.4	0.8		3.3		21.1	40.8	12.6%
Lighting							39.5	39.5	12.2%
Refrigeration (4)							28.7	28.7	8.9%
Electronics (5)							16.0	16.0	5.0%
Wet Clean (6)	1.0						15.1	16.1	5.0%
Cooking	3.0		0.5		0.5		11.3	14.8	4.6%
Computers							3.3	3.3	1.0%
Other (7)	1.4	0.0	2.5		2.5		9.2	13.1	4.1%
Adjust to SEDS (8)							12.6	12.6	3.9%
Total	72.9	17.6	9.0	1.3	27.9	0.3	222.7	323.8	100%

Note(s): 1) Excludes emissions of buildings-related energy consumption in the industrial sector. 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 2004 and differ by as much as 2% from EIA, AEO 2004, Table A19. Sector total varies by 0.1% from EIA, AEO 2004. 2) Excludes electric imports by utilities. 3) Includes furnace fans (3.9 MMTCE). 4) Includes refrigerators (21.8 MMTCE) and freezers (6.9 MMTCE) 5) Includes color television (6.3 MMTCE) and other office equipment (9.7 MMTCE). 6) Includes clothes washers (1.6 MMTCE), natural gas clothes dryers (1.0 MMTCE), electric clothes dryers (12.2 MMTCE), and dishwashers (1.2 MMTCE). Does not include water heating energy. 7) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, and outdoor grills. 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 2004, Jan. 2004, Table A2, p. 134-136 and Table A4, p. 139-140 for energy consumption, and Table A19, p. 158 for emissions; EIA Assumptions to the AEO 2004, Jan. 2004, p. 9 for emission coefficients; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for small electric end-uses.

3.1.4 2002 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								69.9	69.9	25.4%
Space Heating	20.4	3.4	1.7		0.3	5.4	2.5	10.8	39.2	14.2%
Space Cooling	0.2							32.4	32.6	11.9%
Refrigeration								17.4	17.4	6.3%
Water Heating	8.5	1.4				1.4		7.2	17.1	6.2%
Ventilation								16.2	16.2	5.9%
Electronics								16.0	16.0	5.8%
Computers								7.0	7.0	2.6%
Cooking	3.8							1.6	5.4	2.0%
Other (4)	4.1	0.4		1.6	0.9	2.9		15.7	22.7	8.3%
Adjust to SEDS (5)	9.3	4.4				4.4		17.9	31.5	11.5%
Total	46.2	9.6	1.7	1.6	1.2	14.1	2.5	212.2	275.0	100%

Note(s): 1) Excludes emissions of buildings-related energy consumption in the industrial sector. 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 2004 and differ by as much as 2% from EIA, AEO 2004, Table A19. Sector total varies by 0.1% from EIA, AEO 2004. 2) Includes kerosene space (0.3 MMTCE) heating and motor gasoline other uses (0.9 MMTCE). 3) Excludes electric imports by utilities. 4) Includes service station equipment, automated teller machines, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, and manufacturing in commercial buildings. 5) Emissions related to a discrepancy between data sources. Energy attributable to the commercial sector, but not directly to specific end-uses.

Source(s): EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 and Table A5, p. 141-142 for energy consumption, and Table A19, p. 158 for emissions; EIA, National Energy Modeling System for AEO 2004, Jan. 2004; EIA, Assumptions to the AEO 2004, Jan. 2004, p. 9 for emissions coefficients; A.D. Little/BTS, 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; and EIA, AEO 1999, Dec. 1998,p. 120 for 1996 refrigeration.

3.1.5 World Carbon Dioxide Emissions (1)

	Emissions (10^6 metric tons of carbon)				Annual Growth Rate	
Nation/Region	1990	2000		2010	1990-2000	2000-2010
United States	1,361	1,578	24.6%	1,789	1.5%	1.3%
Western Europe	931	939	14.6%	973	0.1%	0.4%
China	617	780	12.2%	1,108	2.4%	3.6%
Former Soviet Union	1,036	638	9.9%	709	-4.7%	1.1%
Other Asia	400	633	9.9%	791	4.7%	2.2%
Middle East	231	344	5.4%	427	4.1%	2.2%
Japan	269	310	4.8%	338	1.4%	0.9%
Central & S. America	192	262	4.1%	326	3.2%	2.2%
India	153	249	3.9%	311	5.0%	2.2%
Africa	179	221	3.4%	265	2.1%	1.8%
Eastern Europe	301	206	3.2%	217	-3.7%	0.5%
Canada	129	158	2.5%	187	2.1%	1.7%
Mexico	84	99	1.5%	118	1.7%	1.8%
World Total	5,881	6,419	100%	7,559	0.9%	1.6%

Source(s): EIA, International Energy Outlook 2004, April 2004, Table A9, p. 172.

3.1.6 2002 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	8.5	5.4	14.0
Coal	0.0	0.1	0.1
Wood	1.8	0.0	1.8
Electricity (2)	8.9	8.5	17.3
Total	19.5	14.1	33.5

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. 2002, October 2003, Table 13, p. 41 for energy production emissions, and Table 17, p. 44 for stationary combustion emissions; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for energy consumption.

3.1.7 2002 Carbon Dioxide Emission Coefficients for Buildings (10^6 metric tons of carbon per quad) (1)

	All Buildings	Residential Buildings	Commercial Buildings
Coal			
Average (2)	25.74	25.74	25.74
Natural Gas			
Average (2)	14.40	14.40	14.40
Petroleum Products			
Distillate Fuel Oil/Diesel	19.75	-	-
Kerosene	19.52	-	-
Motor Gasoline	19.15	-	-
Liquefied Petroleum Gas	17.09	-	-
Residual Fuel Oil	21.28	-	-
Average (2)	19.04	18.80	19.53
Electricity Consumption (3)			
Average - Primary (4)	16.02	16.02	16.02
Average - Site (5)	51.58	51.58	51.58
New Generation			
Gas Combined Cycle - Site (6)	32.64	32.64	32.64
Gas Combustion Turbine - Site (6)	47.61	47.61	47.61
Stock Gas Generator - Site (7)	43.80	43.80	43.80
All Fuels (3)			
Average - Primary	15.64	15.51	15.81
Average - Site	30.69	28.67	33.27

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 2004 and were adjusted using Assumptions to the AEO 2004. 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 (2003) 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 2004, Jan. 2004, Table A2, p. 134-136, Table A8, p. 145-146, Table A18, p. 157 for consumption and Table A19, p. 158 for emissions; EIA, Assumptions to the AEO 2004, Jan. 2004, Table 2, p. 8 for coefficients and Table 48, p. 84 for generator efficiencies; EIA, Annual Energy Review 2002, Oct. 2003, Diagram 5, p. 219 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)	120	0.00	Aerosol Propellant
HFC-227ea	3500	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.

3.2.2 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 (2)	165	2,883	3,048	59%
2005 (2)	145	3,084	3,229	63%
2006 (2)	125	3,064	3,189	67%
Total	9,518	46,064	55,582	

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, 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.

3.2.3 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 1999 and 2000 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 2001 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	549	7,670 (2)	8,219	15,790	52%
NOx	1,068	3,467	4,535	22,349	20%
CO	2,919	349	3,268	120,759	3%
VOCs	953	45	998	17,963	6%
PM-2.5	493	403	896	7,380	12%
PM-10	511	470	981	24,101	4%

Note(s): 1) Excludes emissions of buildings-related energy consumption in the industrial sector. 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 26% lower for 2001 than 1994 estimates since Phase II of the 1990 Clean Air Act Amendments began in 2000. Buildings Energy Consumption related to SO2 emissions dropped 18% from 1994 to 2001.

Source(s): EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136; and EPA, 2001 Average Annual Emissions, All Criteria Pollutants, February 2003 Tables A-2 to A-8.

3.3.2 2001 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	0.937	(2)	0.087	(2)	0.287
NOx	0.423	0.072	0.113	(2)	0.130
CO	0.043	(2)	(2)	(2)	0.013

Commercial

	Electricity (1)	Gas	Oil(3)	Coal	Electricity (per primary quad) (1)
SO2	0.937	(2)	0.328	(2)	0.287
NOx	0.423	0.075	0.107	(2)	0.130
CO	0.043	(2)	(2)	(2)	0.013

All Buildings

	Electricity (1)	Gas	Oil(3)	Coal	Electricity (per primary quad) (1)
SO2	0.937	(2)	0.166	(2)	0.287
NOx	0.423	0.073	0.111	(2)	0.130
CO	0.043	(2)	(2)	(2)	0.013

Note(s): 1) Emissions of SO2 are 26% lower for 2001 than 1994 estimates since Phase II of the 1990 Clean Air Act Amendments began in 2000. Buildings energy consumption related SO2 emissions dropped 18% from 1994 to 2001. 2) Data not available, significant enough, or reliable. 3) Oil includes distillate and residual fuel oils, LPG, motor gasoline, and kerosene.

Source(s): EPA, 2001 Average Annual Emissions, All Criteria Pollutants, February 2003 Tables A-2 to A-8 for emissions; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 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 ($2002/10^6 Btu) (1)

	Residential Buildings				Commercial Buildings				Buildings
	Electricity	Natural Gas	Petroleum (2)	Avg	Electricity	Natural Gas	Petroleum (2)	Avg	Average (3)
1980	30.48	6.98	14.08	14.71	31.16	6.44	10.94	15.47	15.01
1990	29.37	7.20	11.28	15.60	27.11	6.01	7.57	15.56	15.58
2000	24.14	7.63	8.13	13.98	21.52	6.57	8.01	14.10	14.03
2002	**24.73**	**7.65**	**9.87**	**14.75**	**22.82**	**6.37**	**6.88**	**14.84**	**14.79**
2005	24.13	8.39	9.81	14.78	21.07	7.17	6.45	14.28	14.56
2010	23.30	7.67	9.90	14.22	20.39	6.64	6.34	13.89	14.08
2020	23.73	8.24	10.86	15.10	21.21	7.31	6.83	15.05	15.07
2025	23.88	8.32	11.26	15.39	21.48	7.41	6.98	15.39	15.39

Note(s): 1) Excludes expenditures from buildings-related energy consumption in the industrial sector. 2) Petroleum products include distillate fuel, oil, residual fuel oil, LPG, kerosene, and motor gasoline. 3) In 2002, Buildings average electricity price was $23.80/10^6 Btu or ($0.081/kWh), average natural gas price was $7.15/10^6 Btu ($7.40/1000 CF), and petroleum was $8.89/10^6 Btu ($1.02/gal.). Averages do not include wood or coal prices.

Source(s): EIA, State Energy Data 2000, April 2003, p. Tables 2-3, p. 24-25 for 1980,1990 and 2000 and prices for note, Tables 8-9, p. 18-19 for 1980, 1990 and 2000 consumption; EIA, AEO 2004, Jan. 2004, Table A2, p. 135-136, Table A3, p. 137-138, Table A12, p. 151, and Table A14, p. 153 for 2002-2025 consumption; and prices; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price deflators.

4.1.2 Building Energy Prices, by Year and Fuel Type ($2002)

	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	10.4	69.8	1.89	1.32	10.6	64.4	1.74	1.20
1990	10.0	72.0	1.42	1.20	9.2	60.1	1.05	0.65
2000	8.5	79.0	1.43	1.29	7.6	68.0	1.07	0.70
2002	**8.4**	**76.5**	**1.14**	**1.11**	**7.8**	**63.7**	**0.84**	**0.63**
2005	8.2	83.9	1.11	1.17	7.2	71.7	0.78	0.60
2010	7.9	76.7	1.08	1.19	7.0	66.4	0.76	0.62
2020	8.1	82.4	1.16	1.27	7.2	73.1	0.83	0.66
2025	8.1	83.2	1.18	1.30	7.3	74.1	0.85	0.68

Source(s): EIA, State Energy Data 2000, April 2003, p. Tables 2-3, p. 24-25 for 1980-2000; EIA, AEO 2004, Jan. 2004, Table A3, p. 137-138 for 2002-2025 prices and Table H1, p. 262 for fuels' heat content; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price deflators.

4.1.3 Buildings Aggregate Energy Expenditures, by Year and Major Fuel Type ($2002 billion) (1)

	Residential Buildings				Commercial Buildings				Total Building
	Electricity	Natural Gas	Petroleum (2)	Total	Electricity	Natural Gas	Petroleum (2)	Total	Expenditures
1980	74.6	33.9	24.6	133.2	59.4	17.2	14.1	90.7	223.9
1990	92.6	32.5	14.3	139.4	77.5	16.2	6.9	100.6	240.1
2000	101.7	40.3	18.2	160.2	88.1	22.4	6.2	116.8	277.0
2002	**107.0**	**38.7**	**14.6**	**160.4**	**94.1**	**20.4**	**5.0**	**119.5**	**279.9**
2005	108.6	44.9	15.6	169.1	93.2	23.4	5.6	122.2	291.3
2010	113.5	43.6	15.8	173.0	103.0	23.7	5.8	132.6	305.5
2020	132.9	50.1	17.0	200.0	132.3	28.8	6.7	167.7	367.7
2025	142.3	52.1	17.2	211.7	146.8	30.8	7.0	184.6	396.3

Note(s): 1) Excludes expenditures from buildings-related energy consumption in the industrial sector. Expenditures exclude wood and coal. 2002 U.S. energy expenditures were $682.1 billion. 2) Petroleum products include distillate fuel oil, residual fuel oil, LPG, kerosene and motor gasoline

Source(s): EIA, State Energy Data 2000, April 2003, p. 24-25 for 1980, 1990 and 2000; EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 and Table A3, p. 139-140 for 2002-2025; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price deflators.

4.1.4 FY 2001 Federal Buildings Energy Prices and Expenditures, by Fuel Type ($2002)

Fuel Type	Average Fuel Prices ($/million Btu)	Total Expenditures ($million) (2)
Electricity	18.55 (1)	2,660.5
Natural Gas	7.35	805.4
Fuel Oil	6.38	265.9
Coal	2.10	31.1
Purchased Steam	12.94	170.2
LPG/Propane	10.85	30.4
Other	8.40	17.1
Average	12.16	Total 3,980.7

Note(s): 1) $0.063/kWh. 2) Energy used in buildings FY 2001 accounted for 40.6% of the total Federal energy bill.

Source(s): DOE, Annual Report to Congress on FEMP, February 2004, p. 63 for buildings expenditures, and p. 13 for Federal energy expenditures.
EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price deflators.

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4.1.5 2002 Buildings Energy End-Use Expenditure Splits, by Fuel Type ($2002 billion) (1)

	Natural Gas	Petroleum					Coal	Electricity	Total	Percent
		Distil.	Resid.	LPG	Oth(2)	Total				
Space Heating (3)	36.1	7.4	0.3	3.9	0.8	12.4	0.2	16.6	65.2	23.3%
Lighting								50.0	50.0	17.8%
Space Cooling	0.1							34.3	34.3	12.2%
Water Heating (4)	12.5	1.4		0.6		2.1		13.3	27.9	10.0%
Refrigeration (5)								21.5	21.5	7.7%
Electronics (6)								14.8	14.8	5.3%
Cooking	3.3			0.4		0.4		6.1	9.8	3.5%
Wet Clean (7)	0.5							7.2	7.8	2.8%
Ventilation (8)								7.2	7.2	2.6%
Computers								4.7	4.7	1.7%
Other (9)	1.8	0.1		3.1	0.6	3.9		11.4	17.1	6.1%
Adjust to SEDS (10)	4.8	1.3				1.3		14.0	20.1	7.2%
Total	59.1	10.3	0.3	8.0	1.4	20.0	0.18	201.1	280.4	100%

Note(s): 1) Excludes expenditures from buildings-related energy consumption in the industrial sector. Expenditures include coal and exclude wood (unlike Table 4.1.2). 2) Includes kerosene space heating ($0.8 billion) and motor gasoline other uses ($0.6 billion). 3) Includes furnace fans ($1.9 billion). 4) Includes residential recreation water heating ($1.0 billion). 5) Includes refrigerators ($13.8 billion) and freezers ($4.6 billion). 6) Includes color televisions ($3.0 billion) and other electronics ($4.7 billion). 7) Includes clothes washers ($0.8 billion), natural gas clothes dryers ($0.5 billion), electric clothes dryers ($5.9 billion) and dishwashers ($.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 2004, Jan. 2004, 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 2003, March 2003; EIA, State Energy Data 2000, April 2003, p. 24-25 for coal and minor petroleum prices; EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 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 (1996 = 1.00)

Year	Implicit Price Deflator	Year	Implicit Price Deflator	Year	Implicit Price Deflator
1980	0.57	1990	0.87	2000	1.07
1981	0.62	1991	0.90	2001	1.09
1982	0.66	1992	0.92	2002	1.11
1983	0.69	1993	0.94		
1984	0.71	1994	0.96		
1985	0.74	1995	0.98		
1986	0.75	1996	1.00		
1987	0.78	1997	1.02		
1988	0.80	1998	1.03		
1989	0.83	1999	1.05		

Source(s): EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353.

4.2.1 2002 Residential Energy End-Use Expenditure Splits, by Fuel Type ($2002 billion) (1)

	Natural	Petroleum							
	Gas	Distil.	LPG	Kerosene	Total	Coal	Electricity	Total	Percent
Space Heating (2)	27.1	6.3	3.9	0.6	10.8	0.0	11.8	49.7	31.0%
Water Heating (3)	8.8	1.0	0.6		1.6		10.1	20.5	12.8%
Space Cooling (4)	0.0						19.9	19.9	12.4%
Lighting							19.0	19.0	11.8%
Refrigeration (5)							13.8	13.8	8.6%
Wet Clean (6)	0.5						7.2	7.8	4.8%
Electronics (7)							7.7	7.7	4.8%
Cooking	1.6		0.4		0.4		5.4	7.4	4.6%
Computers							1.6	1.6	1.0%
Other (8)	0.0	0.0	1.9		1.9		4.4	6.3	4.0%
Adjust to SEDS (9)	0.7						6.0	6.8	4.2%
Total	38.7	7.3	6.8	0.6	14.8	0.03	107.0	160.5	100%

Note(s): 1) Expenditures include coal and exclude wood (unlike Table 4.1.2). 2) Includes furnace fans ($1.9 billion). 3) Includes residential recreation water heating ($1.0 billion). 4) Fan energy use included. 5) Includes refrigerators ($10.5 billion) and freezers ($3.3 billion). 6) Includes clothes washers ($0.8 billion), natural gas clothes dryers ($0.5 billion), electric clothes dryers ($5.9 billion), and dishwashers ($0.6 billion). 7) Includes color televisions ($3.0 billion) and other electronics ($4.7 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 2004, Jan. 2004, Table A2, p. 134-136, Table A3, p. 137-138 for prices, and Table A4, p. 139-140 for residential energy; EIA, State Energy Data 2000, November 2001, p. 24-25 for coal and minor petroleum prices; EIA, Annual Energy Review 2002, October 2003, Appendix D, p. 353 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 ($2002)

1980	1,672
1990	1,480
2000	1,442
2002	**1,454**
2005	1,488
2010	1,443
2020	1,514
2025	1,536

Source(s): EIA, State Energy Data 2000, April 2003, p. 24 for 1980, 1990 and 2000; EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136, Table A4, p. 139-140 for consumption, Table A3, p. 137-138 for prices 2002-2025; EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 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 ($2002)

	Per Household	Per Square Foot
Single Family	**1,710**	**0.78**
-Detached	1,738	0.72
-Attached	1,545	0.70
Multi-Family	**924**	**0.96**
-2 to 4 units	1,270	0.91
-5 or more units	801	0.94
Mobile Home	**1,350**	**1.28**

Source(s): EIA, A Look at Residential Energy Consumption in 2001, Oct. 2003, Table CE1-6.2u; and EIA, Annual Energy Review 2002, October 2003, Appendix D, p. 353 for price inflators.

4.2.4 2001 Energy Expenditures per Household, by Census Region ($2002)

Northeast	1,753
Midwest	1,556
South	1,538
West	1,178

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 2001, Nov. 2002, Appendix E, p. 353 for price inflators.

4.2.5 2001 Household Energy Expenditures, by Vintage ($2002)

Year	Per Household	Per Square Foot	Per Household Member	Percent of Residential Sector Expenditures
Prior to 1970	1,529	0.78	599	52%
1970 to 1979	1,395	0.80	557	16%
1980 to 1989	1,445	0.75	578	16%
1990 to 1999	1,598	0.68	546	14%
2000 to 2001	1,871	0.62	554	1%
				100%
Average	1,504	0.76	581	

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 2002, Oct. 2003, Appendix D, p. 353 for price inflators.

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

	Households		Energy Expenditures by		Percent of Income for
Family Income/Year	Number(10^6)	Percent	Household	Household Member	Energy Expenditures (1)
Less than $9,999	11.0	10%	1,042	555	16%
$10,000 to $14,999	7.7	7%	1,118	525	9%
$15,000 to $19,999	8.9	8%	1,278	560	7%
$20,000 to $29,999	14.0	13%	1,315	560	5%
$30,000 to $39,999	13.9	13%	1,379	540	4%
$40,000 to $49,999	13.2	12%	1,515	561	3%
$50,000 to $74,999	21.7	20%	1,671	573	3%
$75,000 to $99,999	8.1	8%	1,830	626	2%
$100,000 or more	8.6	8%	2,242	736	2%
Total	107.1	100%			3%

Note(s): 1) See Tables 4.2.7 and 7.1.10 for more on energy burdens.
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 2002 (2)		
	Mean Group	Mean Indvdl	Mean Indvdl	Mean Group	Mean Indvdl	Mdn Indvdl	Mean Group
Total US Households	4.0%	6.8%	N.A.	3.2%	5.9%	3.2%	2.4%
Federally Eligible	13.0%	14.4%	N.A.	10.1%	12.6%	7.5%	7.5%
Federally Ineligible	4.0%	3.5%	N.A.	N.A.	2.7%	2.4%	1.9%
Below 125% Poverty Line	13.0%	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 2001, adjusted to reflect FY 2002, HDD, CDD, and fuel prices.

Source(s): HHS, LIHEAP Home Energy Notebook FY 2002, April 2004, Tables A-2a to A-2c, p. 50-52 for FY2002 burdens; 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 ($2002) (1)

	Cost	Percent
Finished Lot	57,385	**24%**
Construction Cost		
Inspection/Fees	3,750	2%
Shell/Frame		
Framing	27,461	11%
Windows/Doors	9,121	4%
Exterior Finish	10,038	4%
Foundation	14,324	6%
Wall/Finish Trim	25,051	10%
Flooring	6,403	3%
Equipment		
Plumbing	7,847	3%
Electrical Wiring	5,007	2%
Lighting Fixtures	1,385	1%
HVAC	5,479	2%
Appliances	1,923	1%
Property Features	15,599	6%
Financing	**4,574**	**2%**
Overhead & General Expenses	**13,891**	**6%**
Marketing	**3,410**	**1%**
Sales Commission	**8,203**	**3%**
Profit	**22,343**	**9%**
Total	243,193	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 2002, Oct. 2003, Appendix D, p. 353 for price inflators.

4.3.1 2002 Commercial Energy End-Use Expenditure Splits, by Fuel Type ($2002 billion) (1)

	Natural Gas	Petroleum					Coal	Electricity	Total	Percent
		Distil.	Resid.	LPG	Oth(2)	Total				
Lighting								31.0	31.0	25.9%
Space Heating	9.0	1.1	0.3		0.1	1.5	0.2	4.8	15.5	12.9%
Space Cooling	0.1							14.4	14.5	12.1%
Water Heating	3.8	0.4				0.4		3.2	7.4	6.2%
Refrigeration								7.7	7.7	6.4%
Ventilation								7.2	7.2	6.0%
Electronics								7.1	7.1	5.9%
Computers								3.1	3.1	2.6%
Cooking	1.7					0.0		0.7	2.4	2.0%
Other (3)	1.8	0.1		1.2	0.6	1.9		7.0	10.7	9.0%
Adjust to SEDS (4)	4.1	1.3				1.3		7.9	13.3	11.1%
Total	20.4	3.0	0.3	1.2	0.7	5.2	0.15	94.1	119.9	100%

Note(s): 1) Excludes expenditures from buildings-related energy consumption in the industrial sector. Expenditures include coal and exclude wood (unlike Table 4.1.2). 2) Includes kerosene space heating ($0.1 billion) and motor gasoline other uses ($0.6 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 2004, Jan. 2004, Table A2, p. 134-136, Table A3, p. 137-138 for prices, and Table A5, p. 141-142 for commercial energy consumption; EIA, National Energy Modeling System for AEO 2004, March 2004; EIA, State Energy Data Report 2000, April 2003, p. 24-25 for coal and minor petroleum prices; EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 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.

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4.3.2 Average Annual Energy Expenditures per Square Foot of Commercial Floorspace, by Year ($2002)

1980	1.78
1990	1.57
2000	1.70
2002	**1.66**
2005	1.57
2010	1.58
2020	1.75
2025	1.81

Source(s): EIA, State Energy Data 2000, April 2003, p. 15 for 1980, 1990 and 2000; EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 and Table A5, p. 141-142 for consumption, Table A3, p. 137-138 for prices for 2002-2025; EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price deflators; EIA, AEO 1994, Jan. 1994, Table A5, p. 62 for 1990 floorspace; and PNNL for 1980 floorspace.

4.3.3 1999 Energy Expenditures per Square Foot of Commercial Floorspace and per Building, by Building Type ($2002)

	per Square Foot	per Building (10^3)		per Square Foot	per Building (10^3)
Food Sales	3.82	21.8	Public Order and Safety	1.11	17.9
Food Service	3.65	19.3	Mercantile	1.33	20.7
Health Care	2.05	47.0	Service	1.45	10.3
Office	1.56	25.5	Education	0.98	25.9
Lodging	1.33	39.4	Warehouse and Storage	0.61	10.6
Public Assembly	1.23	17.7	Vacant (1)	0.37	3.5

Note(s): 1) Includes vacant and religious worship.

Source(s): EIA, Commercial Buildings Energy Consumption and Expenditures 1999, July 2002, Table 4; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price deflators.

4.3.4 1999 Energy Expenditures per Square Foot of Commercial Floorspace, by Vintage ($2002)

Prior to 1980	1.18
1980 to 1989	1.40
1990 to 1999	1.51
Average	1.28

Source(s): EIA, Commercial Buildings Energy Consumption and Expenditures 1999, July 2002, Table C4; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price inflators.

4.4.1 Annual Energy Expenditures per Gross Square Foot of Federal Floorspace Stock, by Year ($2002)

FY 1985	1.78
FY 2000	1.14
FY 2001	1.30

Note(s): Total Federal buildings and facilities energy expenditures in FY 2001 were $3.98 billion (in $2002).

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, February 2004, Table 7-B, p. 63 for energy costs and Table 8-A, p. 66 for floorspace; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price deflators.

4.4.2 Direct Appropriations on Federal Buildings Energy Conservation Retrofits and Capital Equipment ($2002 million)

FY 1985	388.0	FY 1991	140.6	FY 1997	217.5
FY 1986	285.0	FY 1992	174.7	FY 1998	279.9
FY 1987	82.2	FY 1993	142.1	FY 1999	216.8
FY 1988	90.5	FY 1994	265.2	FY 2000	125.1
FY 1989	69.4	FY 1995	325.1	FY 2001	132.8
FY 1990	75.9	FY 1996	198.3		

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, February 2004, Table 4-B, p. 38; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price deflators.

4.5.1 Estimated Value of All U.S. Construction Relative to the GDP ($2002)

- 2002 estimated value of all U.S. construction is $1.33 trillion (including renovation; heavy construction; public works; residential, commercial, and industrial new construction; and non-contract work).
- Compared to the $10.4 trillion U.S. gross domestic product (GDP), all construction holds a 12.7% share.
- In 2002, residential and commercial building renovation (valued at $329 billion) and new building construction (valued at $556 billion) is estimated to account for just over 70% (or around $937 billion, including an additional $52 billion for non-contract work) of the $1.33 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 Public Construction Put in Place, April 2004; DOC, Annual Value of Private Construction Put in Place, April 2004; DOC, Expenditures for Residential Improvements and Repairs by Property Type, Quarterly, March 2004; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price deflators.

4.5.2 Value of New Building Construction Relative to GDP, by Year ($2002 billion)

	Value of New Construction Put in Place				Bldgs. Percent of
	Residential	Commercial (1)	All Bldgs. (1)	GDP	Total U.S. GDP
1980	138.9	133.8	272.7	5,423	5.0%
1985	178.4	189.1	367.5	6,327	5.8%
1990	173.9	189.6	363.5	7,423	4.9%
1995	198.6	173.8	372.4	8,348	4.5%
2000	279.5	269.5	549.0	10,171	5.4%
2002	304.5	251.2	555.7	10,446	5.3%

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 1980-2000; DOC, Annual Value of Private Construction Put in Place, April 2004; DOC, Annual Value of Public Construction Put in Place, April 2004 for 2002; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for GDP and price deflators.

4.5.3 Value of Building Improvements and Repairs Relative to GDP, by Year ($2002 billion) (1)

	Value of Improvements and Repairs				Bldgs. Percent of
	Residential	Commercial	All Bldgs.	GDP	Total U.S. GDP
1980	89.9	N.A.	N.A.	5,423	N.A.
1985	123.3	117.2 (2)	240.5	6,327	3.8%
1990	147.7	118.8 (3)	266.4	7,423	3.6%
1995	141.0	112.8	253.8	8,348	3.0%
2000	158.4	161.5	319.9	10,171	3.1%
2002	173.3	155.9	329.2	10,446	3.2%

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, March 2004 for 1980-2002; 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 Census of Construction Industries: Industry Summary, Jan. 2000, Table 7, p. 15; DOC, Current Construction Reports: Value of Construction Put in Place, C30, Aug. 2003, Table 1, p. 3 for 1995-2000; DOC, Annual Value of Private Construction Put in Place, Apr. 2004 for 2002; DOC, Annual Value of Public Construction Put in Place, Apr. 2004 for 2002; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 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)	**1.9**	(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)	**3.4**	(2)	Fans, Blowers, & Air Cleaning Equipment	1.6
Manufacturing Average	3.3	(2)	Lumber and Wood Products	0.3
Service Industry Average	3.8	(2)	Commercial Building Operations	2.2

Note(s): 1) Includes all construction (e.g., bridges, roads, dams, buildings, etc.). 2) Actually 2000.

Source(s): National Science Foundation, Research and Development in Industry: 2000, May 2003, Table A-20, p. 74-76; and Schonfeld & Associates, R&D Ratios & Budgets, June 2003, p. 219-222.

4.5.5 2000 International Investment into Construction and Energy R&D

	Percent of Private R&D to Total Private R&D			R&D Expenditures (millions of PPP dollars) (1)			
	Construction	Electricity, Gas, & Water	Agriculture & Mining (2)	Construction	Electricity, Gas, & Water	Agriculture & Mining	Total
U.S.	0.1	0.1	0.1	200	200	200	199,500
Canada	0.2	1.6	2.9	18	144	261	9,000
Germany	0.2	0.3	0.5	75	112	187	37,400
France (3)	0.9	2.5	1.8	173	480	346	19,200
Italy	0.2	0.2	0.0	15	15	-	7,400
Japan	1.7	0.9	0.0	1,185	627	-	69,700
United Kingdom	0.3	1.4	1.4	53	249	249	17,800
Russian Fed. (4)	0.9	0.5	3.3	51	29	188	5,700
South Korea	3.7	1.8	0.0	522	254	-	14,100
Sweden (3)	0.4	0.6	1.1	24	35	65	5,900
Finland	1.0	1.2	0.7	31	37	22	3,100

Note(s): 1) Purchasing power parity is the equivalent buying power of different currencies. Currency units show the same cost of goods and services in another country as one currency unit would buy at home. 2) Percentages are from 1997 and 1998. 3) 1998. 4) 1997.

Source(s): National Science Foundation, Science & Engineering Indicators -- 2004, Volume 1, May 2004 , Table 4-20, p. 4-56.

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
				1997	46.6	33.6	52.1	134.1

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 architect employment, Table 609, p. 393; 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; 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	2002
Air Conditioning and Refrigeration Equipment (incl. warm-air furnaces): SIC 3585						
- Total Employment	118.4	122.8	126.9	136.3	150.2	128.5
- Production Workers	81.6	87.2	92.4	102.4	111.6	92.7
Plumbing, Heating, and Air-Conditioning Contractors: SIC 171						
- Total Employment	532.8	605.1	649.2	736.5	928.5	917.0
- Construction Workers	400.4	447.3	476.7	542.4	687.2	670.0
Wholesalers of Hardware, Plumbing and Heating Equipment: SIC 507						
- Total Employment	242.7	254.1	283.8	288.2	318.3	312.9

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, April 2003, Table 3, p. 9, Table 4, p. 10, Table 5, p. 12, Table 6, p. 13 and Table 8, p. 15 for 1995 to 2002 data.

5.1.1 2003 Five Largest Residential Homebuilders

Homebuilder	Number of Home Closings (1)	Gross Revenue ($million)	Market Share of Total New Home Closings (%) (2)
Centex Corporation	29,858	10,810	1.8%
D.R. Horton	37,662	9,188	2.2%
Pulte Homes	32,693	9,000	1.9%
Lennar Homes	32,180	8,908	1.9%
KB Home	23,407	5,850	1.4%
Total of Top Five	125,942	32,946	9.3%
Habitat for Humanity (3)	4,532	N.A.	0.3%

Note(s): 1) 2003 total U.S. new home closings were 1.68 million (includes single-family and multi-family). 2) Total share of closings of top 100 builders was 14%. The top 400 builders accounted for 35% of 2003 home sales. According to NAHB, its builder members construct about 80% of all housing built in the U.S. in a typical year. 3) Habitat for Humanity International plans to build 100,000 homes internationally between 2000 and 2005. Habitat for Humanity's 1,900 worldwide affiliates completed 13,873 homes in FY 2003.

Source(s): Builder Magazine, May 2004, Builder 100; Builder Magazine, 2004 Giant 400, www.housingzone.com, for top 400 portion of Note 2; and NAHB, 1997 Housing Facts, Figures and Trends, 1997, p. 35 for NAHB portion of Note 2; and DOC, Manufacturing, Mining and Construction Statistics, New Residential Construction: New Privately Owned Housing Units Completed for 2003 total new home closings.

5.1.2 Value of New Building Construction, by Year ($2002 billion)

	Residential	Commercial	All Bldgs.
1980	138.9	133.8	272.7
1985	178.4	189.1	367.5
1990	173.9	189.6	363.5
1995	198.6	173.8	372.4
2000	279.5	269.5	549.0
2002 (1)	304.5	251.2	555.7

Note(s): 1) In 2002, new Buildings construction accounted for 5.3% of the $10.4 trillion U.S. GDP. Refer to Chapter 2 for more new building statistics.

Source(s): DOC, Current Construction Reports: Value of Construction Put in Place, C30, Aug. 2003 for 1980-2000; DOC, Annual Value of Private Construction Put in Place, April 2004 for 2002; DOC, Annual Value of Public Construction Put in Place, April 2004 for 2002 and Note 1; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price deflators.

5.2.1 2003 Top Five Manufacturers of Panelized Homes (including pre-cut homes) (1)

Company	Units Produced: Homes	Units Produced: Commercial	Gross Sales Volume ($million)	Market Share of Top 19 Company Sales (2)	Number of Employees
Oldcastle Precast	270	100	700	66%	N.A.
Wausau Homes	4,000	0	200	19%	N.A.
Barden Homes	500	40	40	4%	N.A.
Worldwide Structures Group	1,500	3	23	2%	N.A.
Bob Schmitt Homes	NA	NA	18	2%	N.A.

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 panelized homes included in the list of the top 19 IH producers responding to the survey. In 2003, surveyed panelized home sales were estimated at $1.06 billion and 9,671 housing units and 544 commercial buildings produced.

Source(s): Automated Builder Magazine, July 2004, p. 40-41.

5.2.2 2003 Top Five Manufacturers of Modular Homes (1)

Company	Units Produced	Gross Sales Volume ($million)	Market Share of Top 32 Company Sales (2)	Number of Employees
New Era Building Systems	4,546	126.1	16%	775
Ritz-Craft Corp.	3,754	92.1	12%	805
Liberty Homes	839	94.4	12%	832
R-Anell Housing Group	1,584	45.4	6%	400
Penn Lyon Homes	1,579	36.0	5%	250

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 home producers included in the list of the top 32 IH producers responding to the survey. In 2003, surveyed modular home sales were estimated at $796 million and 26,226 units produced. The top 32 companies responding to the survey employ roughly 10,189 people.

Source(s): Automated Builder Magazine, May 2004, p. 38-40.

5.2.3 2002 Top Five Manufacturers of HUD-Code (Mobile) Homes (1)

Company	Units Produced	Gross Sales Volume ($million)	Market Share of Top 24 Company Sales (2)	Number of Employees
Champion Enterprises, Inc.	54,213	1,033	24%	6,500
Fleetwood Enterprises, Inc	48,421	859	20%	13,000
Clayton Homes	29,292	531	12%	3,446
Palm Harbor Homes	15,287	523	12%	4,600
Skyline Corp.	8,711	318	7%	2,500

Note(s): 1) Data based on mail-in surveys from manufacturers which may not be entirely complete. 2) Gross sales volumes may include sales from units other than HUD-Code homes for companies active in multiple housing markets. Market shares based on total gross sales volume of the HUD-Code home producers included in the list of the top 24 IH producers responding to the survey. In 2002, surveyed HUD-Code home sales were estimated at $4.3 billion and 211,646 units. The top 24 IH producers responding to the survey employ over 38,000 people.

Source(s): Automated Builder Magazine, October 2003, p. 40.

5.2.4 2002 Top Five Manufacturers of Factory-Fabricated Components (trusses, wall panels, doors) (1)

Company	Gross Sales Volume ($million)	Market Share of Top 53 Company Sales (2)	Number of Employees (3)
Raymond Building Supply	50.0	5%	280
Automated Building Company	46.8	5%	350
Littfin Lumber	38.0	4%	340
Adams Building Materials	27.6	3%	252
Younger Bors. Company	26.0	3%	250

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 53 IH producers responding to the survey. In 2002, surveyed component sales was estimated at $636.7 million. 3) The top 53 companies employ over 5,800 people at their plants.

Source(s): Automated Builder Magazine, September 2003, p. 36-38.

5.2.5 2003 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, Jan. 2004, p. 16.

5.2.6 2003 HUD-Code (Mobile) Home Shipments, by Census Region and Top Five States (percent of national total)

Region		Top Five States	
Northeast	8%	Texas	8.5%
Midwest	18%	California	5.9%
South	55%	Florida	7.9%
West	19%	West Virginia	5.9%
	100%	Tennessee	4.2%

Source(s): DOC, Manufactured Housing Statistics, 2003 New Manufactured Homes Placed by Size of Home, by State, May 2004.

5.3.1 Value of Building Improvements and Repairs, by Sector ($2002 billion) (1)

	Value of Improvements and Repairs		
	Residential	Commercial	All Bldgs.
1980	89.9	N.A.	N.A.
1985	123.3	117.2 (2)	240.5
1990	147.7	118.8 (3)	266.4
1995	141.0	112.8	253.8
2000	158.4	161.5	319.9
2002	173.3 (4)	155.9 (5)	329.2

Note(s): 1) Improvements includes additions, alterations, reconstruction, and major replacements. Repairs include maintenance. 2) 1986. 3) 1989. 4) Includes 73% improvements and 27% maintenance & repairs. 5) Includes 76% improvements and 24% maintenance and repairs.

Source(s): DOC, Current Construction Reports: Expenditures for Residential Improvements and Repairs by Property Type, Quarterly, Mar. 2004 for residential DOC, Current Construction Reports: Expenditures for Nonresidential Improvements and Repairs: 1992, CSS/92, Sept. 1994, Table A, p. 2 for 1986-1990 expenditures; DOC, 1992 Census of Construction Industries: Unites States Summary, June 1996, Table 11, p. 16; DOC, 1997 Census of Construction Industries: Industry Summary, Jan. 2000, Table 7, p. 15; 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, Current Construction Reports: Value of Construction Put in Place, C30, Aug. 2003, Table 1, p. 3 for 1995-2000; DOC, Annual Value of Public Construction Put in Place, April 2004; DOC, Annual Value of Private Construction Put in Place, April 2004 for 2002; and EIA, Annual Energy Review 2002, Oct. 2002, Appendix D, p. 353 for GDP and price deflators.

5.3.2 2000-2001 Professional and Do-It-Yourself Improvements by Homeowners, by Project ($2002)

	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	1.00	10.5	10,482	0.27	1.5	5,731
Kitchen Remodeled	1.93	19.8	10,289	1.82	9.4	5,170
Additions Built	3.61	36.8	10,187	4.16	13.5	3,250
Bathroom Remodeled or Added	2.51	15.3	6,112	2.73	6.5	2,395
Exterior Improvements	7.29	39.3	5,392	6.73	10.8	1,609
Siding Replaced or Added	1.73	9.1	5,268	0.73	1.2	1,611
Roof Replacement	5.11	19.9	3,908	1.71	3.1	1,840
HVAC Replacement	5.05	15.1	2,999	1.02	1.8	1,751
Windows/Doors Installed	5.19	12.7	2,443	3.78	3.2	844
Flooring/Paneling/Ceiling Replacement	10.05	20.9	2,081	6.10	4.8	782
Electric System Replacement	2.77	2.9	1,035	1.79	0.6	353
Plumbing Replacement	5.01	4.2	832	5.36	2.0	364
Insulation Added	1.27	1.0	806	1.64	1.0	615
Appliance/Major Equipment Replacement	7.47	4.0	537	4.89	1.5	314

Note(s): Expenditures are $38.2 billion higher than 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 2003, Table A-2 and A-3 , p. 28-29; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 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 1996 Top Manufacturers of Mineral Fiber (Glass/Wool) Insulation

Company	Gross Sales Volume ($million)	Market Share (percent) (1)
Owens-Corning Fiberglass Corp.	3,612	67%
Johns Manville	1,278	24%
Knauf Fiber Glass	140	3%
Dryvit Systems Inc.	75	1%
CTA Insulation	71	1%
BP Chemicals Hitco	62	1%
Other	153	3%
	5,391	100%

Note(s): 1) Percent of sales value of top 29 companies.
Source(s): Ward's Business Directory of U.S. Private and Public Companies 1997.

5.4.2 1997 Builder Insulation Demand, by Type

Insulation Type	Market Share
Fiberglass-Batts	72%
Fiberglass-Blown	15%
Cellulose-Blown	7%
Plastic Foam	4%
Rockwool	1%
Other	1%
	100%

Source(s): Builder Magazine, April 1999, p. 257.

5.4.3 2001 Industry Use Shares of Mineral Fiber (Glass/Wool) Insulation (1)

Insulating Buildings (2)	71.7%
Industrial, Equipment, and Appliance Insulation	24.9%
Unknown	3.5%
	100%

Note(s): 1) Based on value of shipments. 2) Including industrial.
Source(s): DOC, 2001 Annual Survey of Manufacturers: Value of Product Shipments, Dec. 2002, p. 65.

5.4.4 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	2003	1990	1995	2000	2003	1990	1995	2000	2003
Aluminum (2)	5.9	4.7	3.7	2.9	3.6	3.9	4.0	3.1	9.5	8.6	7.7	6.0
Wood (3)	9.4	11.6	12.8	13.6	7.6	9.4	10.2	11.0	17.0	21.0	23.0	24.6
Vinyl	1.2	4.8	9.0	12.2	7.1	9.6	14.8	18.5	8.3	14.4	23.8	30.7
Other	0.1	0.3	0.4	0.8	0.1	0.2	0.2	0.7	0.2	0.5	0.6	1.5
Total	16.6	16.6	25.8	29.5	18.4	23.1	29.2	31.4	35.0	44.5	55.0	62.8

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.

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

	Windows				Doors				Total			
Type	1990	1995	2000	2003	1990	1995	2000	2003	1990	1995	2000	2003
Aluminum	9.9	9.2	8.0	7.4	1.9	3.8	4.3	4.4	11.8	13.0	12.3	11.8
Wood	0.5	1.8	2.3	2.2	0.4	1.3	1.4	1.7	1.1	0.9	3.1	3.9
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	9.8	2.4	5.2	5.8	6.2	12.9	16.5	19.1	16.0

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.

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	2003	1995	2003	1995	2003	1995	2003	1995	2003
New Construction										
Commercial Windows (2)	4	35	16	28	21	46	13	27	54	132
Curtain Wall	7	13	6	11	16	21	8	14	33	59
Store Front	14	18	11	17	14	37	11	21	43	93
Total	14	62	33	56	51	103	32	62	130	283
Remodeling/Replacement										
Commercial Windows (2)	18	24	25	21	46	27	27	14	116	86
Curtain Wall	4	3	6	2	8	4	10	3	28	12
Store Front	12	8	18	8	24	16	22	9	76	41
Total	34	35	49	31	78	47	59	26	220	138
Total										
Commercial Windows (2)	22	56	41	48	67	72	40	41	170	218
Curtain Wall	7	16	12	13	24	25	18	17	61	70
Store Front	19	26	29	25	38	53	33	30	119	133
Total	48	97	82	86	129	150	91	88	350	421

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 American Architectural Manufacturers Association/ Window & Door Manufacturers Association 2003 Industry Statistical Review and Forecast, June 2004, p. 17 for 2003.

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

Sector	1985	1990	1995	1998	2000	2002	2003
Residential	73%	86%	89%	91%	92%	93%	93%
Nonresidential	63%	80%	84%	84%	86%	87%	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 1998-2003.

5.5.5 Residential Prime Window Stock and Sales, by Type

	Existing U.S. Stock	Sales (million units) (1)				
Type	(% of households)	1980	1985	1990	1991	1996
Single-Pane	63.6%	8.6	9.7	4.9	4.3	3.9
Double-Pane	33.7%	15.0	25.0	19.9	19.0	27.2
Double-Pane, Low-e	1.8%	0.0	0.4	8.3	7.2	16.6
Triple Pane	0.8%	1.6	1.2	1.5	1.7	(2)
Triple-Pane, Low-e	0.1%	0.0	0.0	1.0	1.6	(2)
Total (3)	100%	25.2	36.3	35.6	33.8	47.7

Note(s): 1) Residential windows available in 1999 had an average U-Value of 0.47 and a SHGC of 0.45. Low-e window sales accounted for 26% of the market in 1991, 35% in 1993, and 35% in 1996. 2) Included in double-pane and double-pane, low-e. 3) LBNL 1985 and 1990 totals differ slightly (by ~1%) from Ducker Research values in other tables.

Source(s): PNNL, Electronic Residential Energy Consumption Survey-1993 (data taken originally from EIA, RECS 1993) for existing stock data; LBNL, Savings from Energy Efficient Windows, Apr. 1993, p. 42 for sales data; LBNL, From the Lab to the Marketplace, Mar. 1995, p. 10 for 1993 data in Note 1; Ducker Research Company, Study to Quantify and Profile the U.S. Market for Residential and Light Commercial Windows and the Technology for High-Performance Windows, Dec. 1997, p. 27 for 1996 sales; and NFRC, Directory of Certified Products, Dec. 1999, U-Factor Chart from www.nfrc.org for Note 1.

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

	Existing U.S. Stock	Glass Area Usage (million square feet)		
Type	(% of buildings)	1992	1995	2003
Single-Pane	54%	42	56	45
Insulating Glass (2)	46%	188	294	375
Total	100%	230	350	420
Clear	**72%**	9%	36%	44%
Tinted	**28%**	54%	40%	20%
Reflective	**(3)**	20%	7%	6%
Low-e	**(3)**	17%	17%	30%
Total	**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, Commercial Buildings Characteristics 1999, July 2002, 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 2003 usage values.

5.5.7 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)	2002 (1000s)	2002 Value of Shipments ($million) (6)
Air Conditioners (1)	**2,920.0**	**5,346.0**	**5,262.7**	**4,256**
Heat Pumps	**808.7**	**1,539.2**	**1,679.5**	**1,305**
Air-to-Air Heat Pumps	808.7	1,339.4	1,483.6	1,065
Water-Source Heat Pumps (2)	N.A.	199.8	195.9	240
Chillers	**N.A.**	**38.1**	**41.9**	**1,068**
Reciprocating	N.A.	24.8	30.3	479
Centrifugal/Screw	5.0	8.5	6.6	532
Absorption	N.A.	4.8	5.0	57
Furnaces	**2,368.9**	**3,680.7**	**3,318.6**	**1,484**
Gas-Fired (3)	1,950.5	3,104.2	3,201.6	1,414
Electric	280.0	455.0	N.A.	N.A.
Oil-Fired (4)	138.5	121.5	117.0	70
Boilers (5)	**316.1**	**368.4**	**361.9**	**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 37,100 units shipped in 2002. 3) Gas-fired furnace value of shipments are based on Census unit shipment data, which is about 43,000 units higher than the industry data shown. 4) Oil-fired furnace value of shipments are based on Census unit shipment data, which is approximately 24,200 units lower than the industry data shown. 5) 59% of boiler shipments were gas-fired and 41% were oil-fired. 6) Total 2002 value of shipments for refrigeration, air-conditioning, and heating equipment was $18.7 billion, including industrial and excluding boilers and electric furnaces.

Source(s): ARI, Statistical Profile, April 25, 2003, 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; GAMA, GAMA Statistical Highlights: Ten Year Summary, 1987-1996; GAMA, GAMA Statistical Highlights: Ten Year Summary, 1994-2003 for furnace and boiler shipments; Appliance Manufacturer, Feb. 1998 for electric furnace; and DOC, Current Industrial Reports: Refrigeration, Air Conditioning and Warm Air Heating Equipment, MA333M(02)-1, July 2003, Table 2 for water-source heat pumps, chillers, and value of shipments.

5.6.2 Minimum Efficiency Standards for Residential Heating and Cooling Equipment

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

			Typical Maximum Electricity Use for Space Cooling a 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	2003	AFUE Range	1985	AFUE Range	2003
Below 65%	15%	75% to 88%	69%	Below 75%	10%	75% to 88%	100%
65% to 71%	44%	88% and Over	31%	75% to 80 %	56%	88% and Over	0%
71% to 80%	10%		100%	Over 80%	35%		100%
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 2004:	97% AFUE	Best Available in 2003:	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 2003 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 2004:	99% AFUE	Best Available in 2004:	90% 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, May 2004, 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	2000 U.S. Average New Efficiency	2004 Best-Available New Efficiency
Air Conditioners	SEER	10.95	19.5
Heat Pump - Cooling			
Air-Source	SEER	11.21	18.6
Ground-Source	EER	13.50	31.5
Heat Pump - Heating			
Air-Source	HSPF	7.50	10.6
Ground-Source	COP	3.40	6.3

Note(s): 1) Federal appliance standards effective January 1, 1992 require a minimum SEER of 10.

Source(s): ARI ratings for best-available in 2004; ARI, Statistical Profile of the Air-Conditioning, Refrigeration, and Heating Industry, Apr. 2001, p. 28 for shipment-weighted SEERs; and EIA, Technology Forecast Updates, October 2001 for heat pump data.

5.6.6 Commercial Equipment Efficiencies

Equipment Type	Efficiency Parameter	1999 Stock Efficiency	2000 U.S. Average New Efficiency	2000 Best-Available New Efficiency
Chiller				
Reciprocating	COP	2.5	2.9	3.5
Centrifugal	COP	5.2	5.2	7.5
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	2.6	2.6	4.3
Rooftop Heat Pump	EER	8.9	10.3	11.5
Boilers				
Gas-Fired	Thermal Efficiency	75	80	87
Oil-Fired	Thermal Efficiency	78	83	88
Electric	Thermal Efficiency	98	98	98
Gas-Fired Furnace	AFUE	75	80	92
Water Heater				
Gas-Fired	Thermal Efficiency	76	80	94
Electric Resistance	Thermal Efficiency	96	98	98
Gas-Fired Instantaneous	Thermal Efficiency	75	80	90

Source(s): EIA/Arthur D. Little, Inc., Technology Forecast Updates, Final Report, October 2001, p. 36-60.

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5.6.7 2003 Air-Conditioner/Heat Pump Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
UTC/Carrier	29%
Goodman (Amana)	17%
American Standard (Trane)	15%
Lennox	11%
Rheem	11%
York	9%
Nordyne	7%
Others	1%
	100%

Total Units Shipped: 6,807,262 (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. 2004, p. P-2.

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5.6.8 2003 Gas Furnace Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
UTC/Carrier	31%
Goodman (Amana)	16%
Lennox	14%
American Standard (Trane)	13%
Rheem	11%
York	7%
Nordyne	6%
Others	2%
	98%

Total Units Shipped: 3,265,550

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sep. 2004 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 2005
Central Air Conditioners	**10 - 17**	**14**	**9**	**3,006,296**
Heat Pumps	**10 - 15**	**13**	**8**	**798,930**
Furnaces				**2,613,953**
Electric	11 - 16	14	11	245,161
Gas-Fired	12 - 20	16	12	2,162,347
Oil-Fired	15 - 20	18	N.A.	206,445
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. 2004, 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.

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5.6.10 Major Commercial HVAC Equipment Lifetimes and Ages

Equipment Type	Median Lifetime	1989 Average Stock Age
Air Conditioners		11
Through-the-Wall	15	N.A.
Water-Cooled Package	15	N.A.
Roof-Top	15	N.A.
Chillers		15
Reciprocating	20	N.A.
Centrifugal	23	N.A.
Absorption	23	N.A.
Heat Pumps		N.A.
Air-to-Air	15	N.A.
Water-to-Air	19	N.A.
Furnaces (gas or oil)	18	N.A.
Boilers (gas or oil)		N.A.
Hot-Water	24-35	N.A.
Steam	25-30	N.A.
Unit Heaters		N.A.
Gas-Fired or Electric	13	N.A.
Hot-Water or Steam	20	N.A.
Cooling Towers (metal or wood)	20	N.A.

Source(s): ASHRAE, 2003 ASHRAE Handbook: HVAC Applications, Table 3, p. 36.3 for median service lifetimes; and EIA, Commercial Building Characteristics 1989, June 1991, Tables 90-91, p. 176-177 for average stock age.

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, 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
Packaged Heating Units	29%	38%
Boilers	29%	29%
Individual Space Heaters	29%	26%
Furnaces	25%	21%
Heat Pumps	10%	13%
District Heat	10%	8%
Other	11%	6%

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

Note(s): 1) Heating and cooling equipment percentages of floorspace add to over 100% since equipment shares floorspace.

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.

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	
Packaged Air Conditioning Units	54%
Room Air Conditioning	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 1990 Existing Housing Stock, by Distribution System Type and Census Region (million units) (1)

Single-Family	Northeast/ North Central	South/West
Forced-Air	**22.2**	**18.1**
- Unconditioned space (2)	6.6	14.9
- Partially conditioned space (2)	7.6	2.7
- Conditioned space	8.0	0.5
Hydronic	**7.2**	**1.8**
Built-In Electric	**1.0**	**1.8**
Other or None	**4.6**	**14.4**
Multi-Family		
Forced-Air	**5.9**	**10.5**
Hydronic	**5.8**	**(3)**
Built-In Electric	**0.6**	**1.1**
Other or None	**(3)**	**(3)**
Mobile Home		
Forced-Air	**1.1**	**1.8**
Other or None	**0.8**	**1.4**

Note(s): 1) Housing stock in 1990 totaled 94 million units. 2) 34% of single-family houses have ducts in either fully or partially unconditioned spaces. 3) Less than 0.2 million units.

Source(s): BNL/LBNL, Energy Savings Potential for Advanced Thermal Distribution Technology in Residential and Small Commercial Buildings, July 1991, draft report, 1987 data revised to 1990 using RECS data.

5.7.2 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.

5.7.3 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.

5.7.4 Thermal Distribution Equipment Design Load and Electricity Intensities by System Type

	Design Load Intensity (W/SF)			End Use Intensity (kWh/SF)		
	Central VAV	Central CAV	Packaged CAV	Central VAV	Central CAV	Packaged CAV
Condenser Fan			0.3			0.2
Cooling Tower Fan	0.2	0.2		0.1	0.2	
Condenser Water Pump	0.2	0.2		0.3	0.3	
Chilled Water Pump	0.2	0.2		0.1	0.2	
Supply & Return Fans	0.7	0.5	0.6	1.2	1.9	1.9
Chiller/Compressor	1.9	1.8	3.3	1.7	2.3	4.0

Source(s): BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, Table 5-11 p. 5-22.

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

Distribution System Fans	
Central System Supply Fans	0.3 - 1.0
Central System Return Fans	0.1 - 0.4
Terminal Box Fans	0.5
Fan-Coil Unit Fans (1)	0.1 - 0.3
Packaged or Split System Indoor Blower	0.6
Pumps	
Chilled Water Pump	0.1 - 0.3
Condenser Water Pump	0.1 - 0.2
Heating Water Pump	0.1 - 0.2
Other	
Cooling Tower Fan	0.1 - 0.3
Air-Cooled Chiller Condenser Fan	0.6
Exhaust Fans (2)	0.05 - 0.3
Condenser Fans	0.6

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.

5.7.6 Market Share of Major HVAC Equipment Manufacturers ($2002 million)

	Total Market Size
Air Handling Units	858
Cooling Towers	443
Pumps	277
Central System Terminal Boxes	159
Classroom Unit Ventilator	133
Fan Coil Units	102

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 2002, Oct. 2003, Appendix D, p. 353 for price deflators.

5.7.7 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

5.7.8 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	2002	2002 Value of Shipments ($million)
Solar Thermal Collectors	19,398	11,409	8,354	11,663	33.3
Residential	N.A.	5,851	7,473	11,000	N.A.
Commercial	N.A.	295	810	595	N.A.
Industrial	N.A.	(2)	57	62	N.A.
Utility	N.A.	5,236	5	4	N.A.
Other	N.A.	26	10	1	N.A.
Photovoltaics (kW)	6,897 (3)	13,837	88,221	112,090	342.0

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) Industrial is included in Other. 3) Actually 1982 data.

Source(s): EIA, Renewable Energy Annual 2002, November 2003, Tables 18 and 25 for shipments, Tables 17 and 29 for value of shipments, and Table 14 for import/exports; EIA, Annual Energy Review 1991, June 1992, Table 111, p. 251 for 1990 data by sector; and EIA, Annual Energy Review 2000, Aug. 2001, Tables 10.3 and 10.5, p. 267 and 271 for 1980 and 1990 (revised) total shipment data.

5.8.2 2002 Thermal Solar Collector Shipments, by End Use (including imports and exports) (1)

Type	1000 Square Feet
Pool Heating	11,073
Hot Water	423
Space Heating	146
Space Cooling	-
Combined Space/Water Heating	17
Process Heating	4
Electricity Generation	-
Total	11,663 (2)

Note(s): 1) 5.6% of shipments are exported. 2) Approximately 6,300 systems in 2002.

Source(s): EIA, Renewable Energy Annual 2002, November 2003, Table 18, p. 22, Table 14, p. 20 for Note 1 and Table 19, p. 23 for Note 2.

5.8.3 2002 Top Five Destinations of Thermal Solar Collector Shipments

State or Territory	Percent of U.S. Unit Shipments
Florida	37%
California	28%
New Jersey	8%
Arizona	5%
Hawaii	2%

Source(s): EIA, Renewable Energy Annual 2002, November 2003, Table 14, p. 20.

5.8.4 Thermal Solar Collector Manufacturer Statistics

- Number of Manufacturers in 2002: 27
- Percentage of Shipped Solar Collectors Produced by Top 5 Manufacturers: 92%
- Percentage of Shipped Solar Collectors Produced by Top 10 Manufacturers: 98%

Source(s): EIA, Renewable Energy Annual 2002, November 2003, Table 19, p. 23 for number of companies and Table 21, p. 23 for percentages.

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	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.

Source(s): BTS/Navigant Consulting, U.S. Lighting Market Characterization Phase I National Lighting Inventory and Energy Consumption Estimate, July 2002.

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 in 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 1999 Lighted Floorspace for the Stock of Commercial Buildings, by Type of Lamp

Type of Lamp	Lighted Floorspace (million square feet) (1)	Percent of Lighted Floorspace
Standard Fluorescent	60,344	90%
Incandescent	38,155	57%
Compact Fluorescent	20,666	31%
High-Intensity-Discharge	19,223	29%
Halogen	17,926	27%

Note(s): 1) The percentages of lighted floorspace total more than 100% since most floorspace is lighted by more than one type of lamp. The total lit floorspace in 1995 was 67.3 billion square feet.

Source(s): EIA, 1999 Commercial Buildings Energy Consumption Survey: Building Characteristics Tables, July 2002, Table B39, p. 121.

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 1994 Shipments of Electric Lamps

		Shipments (Quantities in millions of lamps; Values in millions of dollars)					
		Total		Domestic		Export	
Type of Lamp	Companies	Quantity	Value	Quantity	Value	Quantity	Value
Incandescent (1)	14	1,836.6	1,090.6	1,741.6	1,016.6	95.0	74.0
Fluorescent	8	585.4	1,002.3	517.3	902.6	68.2	99.7
Compact Fluorescent	4	35.8	134.8	26.1	107.4	9.7	27.4
High-Intensity-Discharge	9	28.8	330.3	25.0	288.8	3.8	41.5
Buildings Subtotal	N.A.	2,486.7	2,558.1	2,309.9	2,315.5	176.7	242.6
Other (non-Building)	N.A.	1,076.6	488.0	990.7	432.4	85.9	55.6
Total	36	3,563.3	3,046.1	3,300.7	2,747.8	262.6	298.2

Note(s): 1) Incandescent data does not include photographic, Christmas tree, or miniature lamps (e.g., automotive, radio, and flashlight lamps).

Source(s): DOC, Current Industrial Reports: Electric Lamps - Summary for 1994, MQ36B, 1996, Table 2.

5.9.8 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%

Note(s): 1) Standard magnetic type includes uncorrected and corrected power-factor type ballasts.

Source(s): DOC Current Industrial Reports: Fluorescent Lamp Ballasts, MQ335C(03)-4, February 2004 for 2000-2003; 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.

5.9.9 2000 U.S. Lumen-Hour Inventory, by Construction Activity

New Construction	1%
Replacement	27%
Retrofit	5%
Unchanged	67%
Total	100%

Source(s): BTS/A.D. Little, Energy Savings Potential of Solid State Lighting in General Lighting Applications, April 2001, Figure 2.2, p. 8.

5.9.10 Typical Efficacies and Lifetimes of Lamps (1)

Current Technology	Efficacy (lumens/watt)	Typical Rated Lifetime (hours)	CRI (2)
Incandescent	6-24	750-2,000	95+
Torchiere Halogen	2-14	2,000	95+
Tungsten-Halogen	18-33	2,000-4,000	95+
Mercury Vapor	25-50	24,000+	22-52
Fluorescent	50-100	7,500-24,000	49-92
Compact Fluorescent	50-80	10,000-20,000	82-86
Metal-Halide	50-115	6,000-20,000	65-92
High-Pressure Sodium	40-140	16,000-24,000	21-80
Low-Pressure Sodium	120-180	12,000-18,000	0-18

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.

Source(s): Buildings Magazine, Apr. 1995, p. 66 for current technology; Home Energy, Jan./Feb. 1997, p. 13 for torchiere halogen efficacy; and DOE/EE, Advanced Lighting Guidelines: 1993, p. 7-4 for torchiere halogen lifetime and CRI.

5.10.1 Refrigeration System Shipments, by Type (including exports)

Appliance Type	1990 (1000)	2000 (1000)	2002 (1000)	2002 Value of Shipments ($million)
Refrigerator/Freezers (1)	7,317	9,462	10,007	5,121.0 (2)
Freezers (chest and upright)	1,328	2,007	2,585	506.5
Refrigerated Display Cases	359	347	183	N.A.
Unit Coolers	178	207	209	123.2
Ice-Making Machines	171	385	360	447.5
Water Cooler	253	348	186	192.0
Beverage Vending Machine	229	353	360	N.A.

Note(s): 1) Refrigerator/freezers include imports of units 6.5 cubic feet and over. 2) Does not include commercial products value.

Source(s): Appliance Magazine, 51st Annual Statistical Review, May 2004, 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(02)-1, July 2003, for 2000-2002 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)	2002 (1000)	2002 Value of Shipments ($million)
Room Air Conditioners	**3,799**	**6,496**	**6,153**	**1,091**
Ranges (total)	**5,873**	**8,202**	**8,606**	**3,476**
Electric Ranges	3,350	5,026	5,338	2,159
Gas Ranges	2,354	3,176	3,268	1,317
Microwave Ovens/Ranges	**7,693**	**12,644**	**13,311**	**1,226**
Clothes Washers	**5,591**	**7,495**	**7,745**	**2,535**
Clothes Dryers (total)	**4,160**	**6,570**	**6,892**	**1,844**
Electric Dryers	3,190	5,090	5,402	N.A.
Gas Dryers	970	1,480	1,490	N.A.
Water Heaters (total)	**7,252**	**9,329**	**9,520**	**1,419**
Electric (1,2)	3,246	4,299	4,436	576
Gas and Oil (2)	4,005	5,006	5,084	843
Solar (3)	N.A.	24	N.A.	N.A.
Office Equipment				
Personal Computers (4)	N.A.	47,168	44,893	26,495
Copiers	N.A.	1,989	1,754	N.A.
Facsimile Machines	N.A.	N.A.	6,014	N.A.
Printers	N.A.	27,945	20,355	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) Includes super computers, mainframes, servers, and other host computers. Data is 1999 shipments and values.

Source(s): AHAM, AHAM Fact Book 2000, 2000, Tables 7 and 8, for 1990 data except water heaters; AHAM, AHAM Fact Book 2003, 2003, Table 8 for 2000-2002 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(02)-1, August 2003, Table 2 for value of computer shipments; and Appliance, 51st Annual Statistical Review, May 2004, 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) Assumed electric water heating. 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 Efficient 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

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, 2003 AHAM Fact Book, 2003, Table 23, p. 44 for 1990-2002; 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 list for 2001 and 2002 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

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 1980-2002 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 list for 2001 and 2002 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)	2002 Stock Efficiency	Minimum New Efficiency (2)	2004 Best-Available New Efficiency
Electric Storage	EF	0.87	0.92	0.95
Electric Instantaneous	EF	(3)	0.93	0.99
Electric Heat Pump	EF	(3)	0.92	2.40
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 tank. 3) Included in storage stock efficiency.

Source(s): EIA, Supplement to the AEO 2004, Jan. 2004, Table 21 and Table 22 for stock efficiencies; GAMA, Consumer's Directory of Certified Efficiency Ratings for the Residential and Water Heating Equipment, May 2004 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)	2002 Stock Efficiency	2002 U.S. Average New Efficiency	2001 Best Available New Efficiency	
Dishwashers	EF		0.55	1.50	
Clothes Washers (2)	EF & MEF		1.64 EF	2.2 MEF	
Commercial Appliance Type	**Efficiency Parameter (1)**	**2002 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. 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, 2000 Major Home Appliance Industry Fact Book, Nov. 2000, Tables 29, p. 34 and Table 30, p. 35 for residential efficiencies; DOE/EPA, Energy Star Appliances, www.energystar.gov, July 2001 for best-available dishwashers and clothes washers; EIA, Assumptions to the AEO 2002, Dec. 2001, Table 22 for average cooking efficiency; and BTS/OBE, Characterization of Commercial Building Appliances, Aug. 1993 for commercial efficiencies.

5.10.8 2003 Room Air Conditioner Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
LG Electronics (Goldstar)	32%
Fedders	21%
Electrolux (Frigidaire)	13%
Whirlpool	9%
Haier	9%
Samsung	5%
Sharp	3%
Goodman (Amana)	3%
Matsushita	3%
Others	5%
	100%

Total Units Shipped: 8,215,952

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2004, p. P-2.

5.10.9 2003 Refrigerator Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
GE	30%
Electrolux (Frigidaire)	26%
Whirlpool	24%
Haier	10%
Maytag (Admiral)	7%
Others	3%
	100%

Total Units Shipped: 10,021,000

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2004, p. P-3.

5.10.10 2003 Range Manufacturer Market Shares (by percentage of products produced)

Company	Electric Market Share (%)	Gas Market Share (%)
GE	49%	36%
Whirlpool	23%	8%
Maytag	13%	20%
Electrolux (Frigidaire)	10%	27%
Peerless Premier	5%	8%
Others	----	1%
	100%	100%

Total Electric Units Shipped: 5,622,000

Total Gas Units Shipped: 3,419,000

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2004, p. P-2.

5.10.11 2003 Microwave Oven Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
Samsung	30%
Sharp	27%
LG Electronics (Goldstar)	17%
Whirlpool	12%
Matsushita	10%
Others	4%
	100%

Total Units Shipped: 14,624,975

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2004, p. P-3.

5.10.12 2003 Clothes Washer Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
Whirlpool	51%
Maytag	21%
GE	17%
Electrolux (Frigidaire)	9%
Others	2%
	100%

Total Units Shipped: 8,146,000

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2004, p. P-3.

August 2004

5.10.13 Sales of Energy Star-Labeled Appliances, by year (thousands)

	Room Air Conditioners		Refrigerators		Clothes Washer		Dishwashers	
	Energy Star	Total	Energy Star	Total	Energy Star	Total	Energy Star	Total
1997	474	3,836	2,008	7,924	226	6,326	265	4,619
1998	589	4,528	1,705	8,774	392	6,835	955	4,936
1999	835	6,294	2,218	9,099	624	7,313	664	5,369
2000	1,230	6,496	2,489	9,217	697	7,495	595	5,485
2001	642 (1)	5,575	1,610 (2)	9,305	758	7,362	1,119	5,627
2002	2,195	6,153	1,956	9,744	1,262	7,745	2,262	6,207
2003	2,369	8,216	2,570	10,021	1,879	8,146	1,290	6,428

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, July 2004.

January 2005

5.10.14 2003 Clothes Dryer Manufacturer Market Shares (by percentage of products produced)

Company	Electric Market Share (%)	Gas Market Share (%)
Whirlpool	56%	55%
Maytag	18%	26%
GE	15%	11%
Electrolux (Frigidaire)	11%	8%
	100%	100%

Total Electric Units Shipped: 5,718,000

Total Gas Units Shipped: 1,616,000

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2004, p. P-3.

5.10.15 2003 Water Heater Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
Rheem Manufacturing	38%
State Industries	16%
American Water Heater	16%
Bradford-White	15%
A.O. Smith	14%
	100%

Total Units Shipped: 9,552,295

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2004, p. P-3.

5.10.16 2003 Facsimile and Copier Machine Manufacturer Market Shares (by percentage of products produced)

Company	Facsimile Machine Market Share (%)	Copier Market Share (%)
Hewlett-Packard	22%	-
Brother	22%	-
Panasonic Panafax	20%	-
Sharp	15%	13%
Lexmark	12%	-
Canon	5%	37%
Xerox	1%	10%
Others	4%	40%
	100%	100%

Total Facsimile Machine Units Shipped:	4,541,205
Total Copier Units Shipped:	1,494,309

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2004, p. P-2.

5.10.17 2003 Personal Computer Manufacturer Market Shares (by percentage of products produced)

Company	Desktop Computer Market Share (%)	Portable Computer Market Share (%)
Dell	32%	27%
Hewlett-Packard	20%	20%
Gateway	4%	4%
IBM	4%	9%
eMachines	4%	-
Apple	2%	6%
Toshiba	-	12%
Sony	-	5%
Others	34%	17%
	100%	100%

Total Desktop Computer Units Shipped:	36,959,328
Total Portable Computer Units Shipped:	13,807,700

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2004, p. P-2.

5.10.18 2003 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	54%	64%	-
Lexmark	17%	9%	11%
Epson	15%	-	22%
Canon	13%	-	-
Samsung	-	6%	-
Brother	-	5%	-
Okidata	-	3%	52%
Panasonic	-	-	6%
Others	1%	13%	9%
	100%	100%	100%

Total Ink Jet Units Shipped:	12,870,207
Total Laser Units Shipped:	3,421,693
Total Dot Matrix Units Shipped:	385,053

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2004, p. P-2.

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 2005
Refrigerators (1)	10 - 16	13	8	7,760,800
Freezers	7 - 15	11	12	1,692,200
Room Air Conditioners	7 - 15	11	8	4,119,800
Microwave Ovens	7 - 10	9	N.A.	9,061,000
Ranges (2)				
Electric	10 - 16	13	N.A.	3,574,000
Gas	12 - 18	15	N.A.	2,428,600
Clothes Washers	7 - 15	11	N.A.	7,309,700
Clothes Dryers				
Electric	6 - 15	11	N.A.	4,035,800
Gas	6 - 15	11	N.A.	1,303,100
Water Heaters				
Electric	6 - 18	12	9	3,398,605
Gas	5 - 13	9	9	4,453,337
Facsimile Machines	3 - 6	4	N.A.	6,766,610
Portable Computers	2 - 4	3	N.A.	9,795,445

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. 2004, 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.

August 2004

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

Appliance Type	1982 Hholds	1982 %	1990 Hholds	1990 %	1996 Hholds	1996 %	2001 Hholds	2001 %
Room Air Conditioners	22.6	27%	30.2	32%	30.4	31%	26.9	26%
Refrigerators	83.4	100%	91.2	98%	96.8	98%	100	96%
Freezers	35.7	43%	42.4	45%	41.9	42%	42.8	41%
Electric Ranges/Cooktops	48.4	58%	58.4	63%	65.3	66%	69.2	66%
Gas Ranges/Cooktops	35.7	43%	36.1	39%	38.3	39%	39.4	38%
Microwave Ovens	21.4	26%	77.2	83%	89.5	91%	94.6	91%
Clothes Washers	61.5	74%	86.4	93%	94.3	95%	96.9	93%
Electric Clothes Dryers	42.3	51%	56.1	60%	60.4	61%	61.8	59%
Gas Clothes Dryers	12.3	15%	19.1	21%	21.1	21%	19.8	19%
Personal Computers	N.A.	N.A.	N.A.	N.A.	43.5	44%	N.A.	N.A.
Total U.S. Households	83.6		94.0		98.9		109.1	

Source(s): AHAM, 2000 Major Home Appliance Industry Fact Book, Nov. 2000, Table 13, p. 21; 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

One quad equals:

- 48 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.)
- 974 billion cubic feet natural gas
- 8 billion gallons of gasoline = 22 days of U.S. gasoline use
  - = 16.7 million new passenger cars and light-duty trucks each driven 11,900 miles
  - = all new passenger cars and light-duty trucks sold each driven 11,900 miles
  - = 15. million stock passenger cars each driven 11,700 miles = 11% of all passenger cars each driven 11,900 miles
  - = all new passenger cars each making 5 round trips from New York to Los Angeles
- 168 million barrels of crude oil = 16 days of U.S. imports = 159 days of oil flow in the Alaska pipeline at full capacity
  - = the amount of crude oil transported by 486 supertankers
- 22 hours of world energy use
- the electricity *delivered* from 194 coal-fired power plants (250-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: Arizona, Arkansas, Colorado, Iowa, Kansas, Mississippi, or Oregon (2000)

Source(s): EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136, Table A7, p. 144, Table A8, p. 145-146, Table A9, p. 147-148, Table A11, p. 150 for consumption, Table H1, p. 262 for heat rates; EIA, State Energy Data 2000, April 2003, Table R1-R2, p. 13-14; EIA, Electric Power Annual 2002, December 2003, Table 2.2, p. 16; EIA, International Energy Outlook 2004, April 2004, Table A1, p. 163; DOC, Statistical Abstract of the United States 2003, Apr. 2004, No. 1095, p. 702; and Newport News Shipbuilding Website.

6.1.3 Carbon Emission Comparisons

One million metric ton of carbon equivalent equals:

- the combustion of 1.88 million short tons of coal
- the coal input to 3 coal plant (250-MW) in one year
- the combustion of 68 billion cubic feet of natural gas
- the combustion of 432 million gallons of gasoline = the combustion of gasoline for 28 hours in the U.S.
  - = 1.0 million new cars each driven 11,900 miles
  - = 799 thousand new light trucks each driven 11,700 miles
  - = 0.5 million new passenger cars each making 5 round trips of New York to Los Angeles
  - = 0.5 million stock passenger cars driven once around the Equator
- the combustion of 698 million gallons of LPG
- the combustion of 389 million gallons of kerosene
- the combustion of 374 million gallons of distillate fuel
- the combustion of 321 million gallons of residual fuel
- 86 minutes of world energy emissions
- 6 hours of U.S. energy emissions
- 15 hours of U.S. Buildings energy emissions
- 29 hours of U.S. Residential energy emissions
- 34 hours of U.S. Commercial energy emissions
- 5 days of U.S. Buildings lighting energy emissions
- average annual per capita emissions of 175 thousand people in the U.S.
- the approximate emissions from cities approximately the size of any one of the following cities: Boise City, ID, Chandler, AZ, Cincinnati, OH, Columbus, GA, Henderson, NV, Jackson, MS, Knoxville, TN, Laredo, TX, Little Rock, AR, Newport News, VA, Orlando, FL, Oxnard, CA

Source(s): EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136, Table A7, p. 144 for consumption, Table A19, p. 158 for emissions, and Table H1, p. 262 for heat rates; EIA, Electric Power Annual, December 2003, Table 2.2, page 16; International Energy Outlook 2003, May 2003, Table A10, p. 191; EIA, Assumptions to the AEO 2004, Jan. 2004, Table 2, p. 8 for carbon coefficients; and DOC, Statistical Abstract of the United States 2003, Apr. 2004, No. 2, p. 8, No. 39, p. 39-42 for populations, and No. 1080, p. 684.

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	1982 million Btu	66.4	536,600
Office Building	1475 million Btu	49.4	399,400
Passenger Car	545 gallons - Gasoline	1.3	10,400
Standard Pickup Truck	668 gallons - Gasoline	1.6	12,800
SUV- Small	570 gallons - Gasoline	1.4	10,900
SUV - Medium	669 gallons - Gasoline	1.6	12,800
SUV- Large	787 gallons - Gasoline	1.9	15,100
CAFE Car	710 gallons - Gasoline	1.7	13,600
CAFE Light Truck	828 gallons - Gasoline	2.0	15,900

Source(s): EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 and Table A19, p. 158 for electricity emissions, and Table H1, p. 249 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, A Look at Commercial Buildings in 1999, August 2002, Table C3, p. 135 for commercial buildings; ORNL, An Analysis of the Impact of Sport Utility Vehicles in the U.S., Aug. 2000, Figure 10, p. 12 for mpg and Table 2, p. 13 for mileage; ORNL, Transportation Energy Data Book: Edition 22, 2002, Table 7.1, p. 7-2 and Table 7.2, p. 7-3, Table 7.18, p. 7-19, Table 7.19, p. 7-20, Table 10.4, p. 10-4, and Figure 10.1, p. 10-2 for mileage and efficiencies; and EIA, Assumptions to the Annual Energy Outlook 2004, Jan. 2004, Table 2, p. 8 for carbon coefficients.

6.2.1 2000 Utility Impacts of Saving an Electric Quad (1)

Plant fuel type	Utility Fuel Input Shares (%)	Average-sized Utility Unit (MW) in 2000	Aggregate Number of Units to Provide the Fuel's Share of the Electric Quad (2)
Natural Gas	14.8%	61	113
Petroleum	2.2%	15	59
Coal	52.1%	204	48
Nuclear	21.3%	1023	3
Renewable (3)	9.6%	19	218
Total	100%		440

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 2000. 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, Inventory of Electric Utility Power Plants in the United States 2000, March 2002, Table 1, p. 12; EIA, Inventory of Nonutility Electric Utility Power Plants in the United States 2000, Jan. 2003, Table 1, p. 12; and EIA, Annual Energy Outlook 2003, Jan. 2003, Table A2, p. 120-122 for consumption and Table A8, p. 131-132 for electricity supply.

6.2.2 Cost of an Electric Quad Used in the Buildings Sector ($2002 billion)

	2000	2002	2005	2010	2020	2025
Residential	7.47	7.68	7.54	7.40	7.80	7.95
Commercial	6.67	7.09	6.59	6.47	6.98	7.15
Buildings Sector	7.08	7.39	7.07	6.93	7.37	7.52

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 2004, Jan. 2004, Table A2, p. 134-136 and Table A3, p. 137-138.

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

New Plant Type	2002 Heat Rate (Btu/kWh)	2010 Heat Rate (Btu/kWh)	2002 Installed Capital Costs of a Typical Power Plant: Price ($2002 thousand per MW)	Size (MW)	Cost ($2002 million)
Pulverized Coal	9,000	8,600	1,168	600	701
Coal-Gasification Combined Cyc	8,000	7,200	1,383	550	761
Combined Cycle	7,444	7,000	542	250	136
Advanced Combined-Cycle	6,928	6,350	615	400	246
Combustion Turbine	10,878	10,450	413	160	66
Advanced Combustion Turbine	9,289	8,550	466	230	107
Fuel Cell	7,446	6,750	2,162	10	22
Wind	10,280	10,280	1,015	50	51

Stock Plant Type	2002	2005	2010	2020	2025
Fossil Fuel Steam Heat Rate (Btu/kWh)	11,018	10,675	10,499	9,920	9,707
Nuclear Energy Heat Rate (Btu/kWh)	10,442	10,442	10,442	10,442	10,442

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 2004, Table 38, p. 71 for fuels cells and wind, Table 48, p. 84 for fossil-fueled technologies; and EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136, and Table A8, p. 145-146.

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

	2000	2002	2005	2010	2020	2025
Average Utility Delivery Efficiency (1, 2)	30.5%	31.1%	31.3%	31.7%	32.9%	33.3%
Average Utility Delivery Ratio (Btu/kWh) (2, 3)	11,179	10,986	10,913	10,749	10,376	10,251

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 2004, Jan. 2004, Table A2, p. 134-136 for generator consumption and Table A8, p. 145-146 for electricity sales; and EIA, Annual Energy Review 2002, October 2003, Diagram 5, p. 219 for T&D losses.

6.3.1 Cost of a Generic Quad Used in the Buildings Sector ($2002 billion) (1)

	2000	2002	2005	2010	2020	2025
Residential	7.84	7.84	7.95	7.66	8.12	8.26
Commercial	6.68	6.90	6.65	6.46	7.00	7.16
Buildings Sector	7.27	7.38	7.34	7.09	7.56	7.70

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 2004, Jan. 2004, Table A2, p. 134-136 and Table A18, p. 157 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				Net	
		Natural Gas	Petroleum	Coal	Hydro.	Other	Total	Nuclear	Electric Imports	Total
2000		32%	8%	37%	5%	3%	8%	14%	1%	100%
2002	(2)	**32%**	**7%**	**37%**	**4%**	**4%**	**8%**	**15%**	**0%**	**100%**
2005		32%	7%	37%	5%	3%	9%	15%	0%	100%
2010		32%	7%	38%	5%	4%	9%	14%	0%	100%
2020		33%	6%	39%	5%	5%	9%	12%	0%	100%
2025		32%	6%	41%	4%	5%	9%	12%	0%	100%

Note(s): 1) See Table 6.1.1 for generic quad definition. 2) The total 2002 Buildings sector primary energy consumption was 38.33 quads. Excludes buildings-related energy consumption in the industrial sector.
Source(s): EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for energy consumption and Table A18, p. 157 for non-marketed renewable energy consumption.

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

					Renewables				Net	
		Natural Gas	Petroleum	Coal	Hydro.	Other	Total	Nuclear	Electric Imports	Total
2000		34%	9%	34%	5%	4%	8%	13%	1%	100%
2002	(2)	**34%**	**9%**	**35%**	**4%**	**5%**	**8%**	**14%**	**0%**	**100%**
2005		34%	8%	35%	5%	4%	9%	14%	0%	100%
2010		35%	8%	35%	5%	4%	9%	13%	0%	100%
2020		36%	7%	36%	4%	5%	9%	12%	0%	100%
2025		35%	7%	38%	4%	5%	9%	11%	0%	100%

Note(s): 1) See Table 6.1.1 for generic quad definition. 2) The total 2002 Residential buildings sector primary energy consumption was 20.91 quads.
Source(s): EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136 for energy consumption and Table A18, p. 157 for non-marketed renewable energy consumption.

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

					Renewables				Net	
		Natural Gas	Petroleum	Coal	Hydro.	Other	Total	Nuclear	Electric Imports	Total
2000		30%	6%	40%	5%	2%	8%	15%	1%	100%
2002	(2)	**30%**	**6%**	**40%**	**4%**	**4%**	**8%**	**16%**	**0%**	**100%**
2005		29%	6%	41%	6%	3%	9%	16%	0%	100%
2010		29%	6%	41%	5%	3%	9%	15%	0%	100%
2020		30%	5%	42%	5%	4%	9%	13%	0%	100%
2025		29%	5%	44%	5%	5%	9%	13%	0%	100%

Note(s): 1) See Table 6.1.1 for generic quad definition. 2) The total 2002 Commercial buildings sector primary energy consumption was 17.43 quads. Excludes buildings-related energy consumption in the industrial sector.
Source(s): EIA, AEO 2004, Jan. 2004, Table A2, p. 137-138 for energy consumption and Table A18, p. 157 for non-marketed renewable 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			
	2002	2005	2010	2020	2025
Petroleum	0.51	0.00	0.00	0.00	0.00
Natural Gas	2.13	1.13	3.02	3.88	2.75
Coal	13.37	12.94	14.38	13.75	16.40
Nuclear	0.00	0.00	0.00	0.00	2.00
Renewable Energy (2)	0.00	0.00	0.00	0.00	0.00
Total	16.02	14.07	17.40	17.63	19.29

Note(s): 1) This table provides estimates of the carbon emissions resulting from consumption of a primary quad at electric utilities. Projected (2005-2025) new marginal capacity emissions will result from natural gas- and coal-fired power plants and renewable energy technologies. Limited nuclear energy will be used to meet near-term demand growth. 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 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 2004, Jan. 2004, Table A2, p. 134-136 and Table A19, p. 158.

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								
	2002			2010			2020			2025		
	Resid.	Comm.	Bldgs.	Resid.	Comm.	Bldgs.	Resid.	Comm.	Bldgs.	Resid.	Comm.	Bldgs.
Electricity (2)	10.67	12.20	11.36	11.89	13.84	13.06	13.20	14.61	14.12	14.99	15.74	15.55
Petroleum	1.34	0.81	1.10	1.02	1.19	1.12	0.36	0.75	0.60	0.17	0.65	0.47
Natural Gas	3.49	2.66	3.11	4.08	1.60	2.60	3.44	1.57	2.31	3.22	1.60	2.24
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	0.14	0.07	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.51	15.81	15.64	16.99	16.65	16.78	17.01	16.94	17.03	18.39	17.99	18.26

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 met 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 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, 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 2004, Jan. 2004, Table A2, p. 134-136 and Table A18, p. 157 for energy consumption and Table A19, p. 158 for carbon emissions; and EIA, Assumptions to the AEO 2004, Jan. 2004, Table 2, p. 8.

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 2002 was $15,533, 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.
- Over 5 million homes have been weatherized under DOE.
- In FY 2002, the energy burden on Federally eligible households was four times the burden on Federally ineligible households (12.6% versus 2.7%).
- DOE Weatherization saves an average of 13-34% on home energy bills (depending on main heating fuel). This equates to $1.30 in energy benefits being produced for every $1.00 invested. These services reduce average annual energy costs by $218 per household.

Note(s): For weatherization eligibility terminology, see Table 7.1.10. For acronyms, see the Directory of this Databook.

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 2002, April 2004, Table A-2a, p. 50 for Federally eligible average income and Table A-2b, p 51 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 Executive Summary, July 2003, www.waptac.org. for weatherization savings.

7.1.2 Weatherization Program Facts

- In FY 2001, DOE contributed 31% to all Federal weatherization funding, LIHEAP 45%, 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 $3 billion annually to pay all or part of the total utility bills (including water/sewer) for about 4.3 million low-income households. Energy costs are typically 75% of total bills in these households, so HUD spends typically $2.25 billion on energy for these households.
- 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. In FY 1995, 74% was spent on fuel subsidies and 10% on weatherization for 103,000 households. LIHEAP spent $158 million on weatherization activities in FY 1995 and $228 million in FY 2001.

Source(s): National Association for State Community Services Programs, Weatherization Assistance Program Funding Survey for Program Year 2002, April 2003, p. 7 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; and EERE/OWIP for HUD data.

7.1.3 Weatherization Costs and Savings

- DOE Weatherization program requires that states spend no more than an average of $2,568 per household in PY 2002. All states are using energy audits to determine the most cost-effective weatherization measures.
- 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.
- Total costs for all single-family and small multi-family dwellings weatherized in Program Year 1989 were $1,550/unit. (1)
- Total costs for all units in large multi-family buildings weatherized in Program Year 1989 were $1000/unit. (1)
- DOE Weatherization saves an average of 22% on home energy space heating bills with a range of 13-34%, a benefit-cost ratio of 1.3. On average, weatherized residences that use natural gas save $300 per year. (1)

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

Source(s): EERE/OWIP, Weatherization Program Notice 02-1, Oct. 21, 2001 for average expenditures; ORNL, Description of the Weatherization Assistance Program in Larger Multifamily Buildings for Program Year 1989, Apr. 1993, p.26 for 1989 installed costs; ORNL, Weatherization Works: Final Report of the National Weatherization Evaluation, Sept. 1994, p 56 for FY 1989; and ORNL, Progress Report of the National Weatherization Assistance Program, Sept. 1997; EERE/OWIP, Weatherization Works, Progress Report of the National Weatherization Assistance Program, Feb. 1998; ORNL, Weatherization Plus Progress Report: Poised to Move Forward, June 2001; and EERE/OWIP, Weatherization Assistance Program Executive Summary, July 2003, www.waptac.org. for weatherization savings.

7.1.4 Residential Energy Burdens, by Weatherization Eligibility and Year

	1987	1990			FY 2002 (2)		
	Mean Group (1)	Mean Indvdl	Mdn Indvdl	Mean Group	Mean Indvdl	Mdn Indvdl	Mean Group
Total US Households	4.0%	6.8%	N.A.	3.2%	5.9%	3.2%	2.4%
Federally Eligible	**13.0%**	**14.4%**	**N.A.**	**10.1%**	**12.6%**	**7.5%**	**7.5%**
Federally Ineligible	4.0%	3.5%	N.A.	N.A.	2.7%	2.4%	1.9%
Below 125% Poverty Line	13.0%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Note(s): 1) Mean and median individual burdens not available. 2) Data are derived from RECS 2001, adjusted to reflect FY 2002 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; and HHS, LIHEAP Home Energy Notebook for FY 2002, April 2004, Tables A-2a, A-2b, and A-2c, p. 50-52.

7.1.5 FY 2002 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	7.0%	3.5%	2.4%	6.5%	3.5%	2.7%	5.6%	3.2%	2.4%	4.2%	2.5%	1.8%
Federally Eligible	**15.0%**	**8.0%**	**8.1%**	**14.3%**	**8.6%**	**8.7%**	**12.1%**	**7.1%**	**7.9%**	**8.4%**	**4.9%**	**5.2%**
Federally Ineligible	2.9%	2.6%	2.0%	3.0%	2.6%	2.2%	2.7%	2.5%	2.0%	2.2%	2.0%	1.5%

Note(s): 1) Data are derived from RECS 2001, adjusted to reflect FY 2002 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 2002, April 2004, Tables A-2a, A-2b, and A-2c, p. 50-52.

7.1.6 Weatherized Households and Households, by Weatherization Eligibility and Year (million)

	Weatherization Recipient (1)	Federally Eligible (2)	Federally Ineligible	Below 125% Poverty Line	Total Households
1977	0.03	N.A.	N.A.	N.A.	74.8
1980	0.18	N.A.	N.A.	N.A.	79.6
1985	0.30	N.A.	N.A.	N.A.	87.9
1987	0.31	N.A.	N.A.	18.2	90.5
1990	0.25	27.9	66.1	18.2	94.2
1991	0.23	N.A.	N.A.	N.A.	95.3
1992	0.22	N.A.	N.A.	N.A.	96.4
1993	0.21	30.7	65.9	19.4	96.6
1994	0.25	N.A.	N.A.	N.A.	98.7
1995	0.23	N.A.	N.A.	N.A.	100.0
1996	0.15	N.A.	N.A.	N.A.	101.0
1997	0.15	34.1	67.4	19.7	101.5
1998	0.16	N.A.	N.A.	N.A.	102.8
1999	0.16	N.A.	N.A.	N.A.	104.1
2000	0.16	N.A.	N.A.	N.A.	105.2
2001	0.08	N.A.	N.A.	N.A.	106.3
Total 1977-2001	5.12	N/A	N/A	N/A	N/A

Note(s): 1) Recipients are reported according to a DOE Weatherization Program Year of April 1-March 31. 2) Federally eligible for DOE and HHS (LIHEAP) Weatherization. Includes previously DOE and HHS 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, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table HC1-3a, p. 38-39; EIA, Residential Energy Consumption Survey 1997 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 Household's Housing Unit Ownership by Income Level and Weatherization Eligibility (million)

	Single-Family		Multi-Family Unit		Mobile Home	
2001 Family Income	Own	Rent	Own	Rent	Own	Rent
Less than $15,000	5.7	2.9	0.3	8	1.2	0.4
$15,000 to $30,000	10.9	2.5	1	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	0.9	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 ($2002)

	Per Household Member	Members/ Hhold	Per Square Foot	Square Feet/ Hhold
Total U.S. Households	590	2.6	0.77	1975
Federally Eligible	**484**	**2.7**	**0.90**	**1435**
Federally Ineligible	640	2.5	0.73	2225
Below 100% Poverty Line	449	2.6	0.94	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 2002, Oct. 2003, Appendix D, p. 353 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 DOE and HHS 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 income 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 Residential Stock Electric Appliance and Building Equipment Usage

		Power Draw (W) (1)		Annual Usage (hours/year)		Annual Consumption	Annual Cost
		Operating	Stand-by	Operating	Stand-by	(kWh/year)	($) (2)
Kitchen							
	Coffee Maker	219	0	421	0	90	7
	Dishwasher	(3) 0.332	0	(4) 365	0	120	10
	Microwave Oven	1500	3	72	8688	140	11
	Refrigerator-Freezer					940	76
	Freezer					680	55
Lighting							
	18-W Compact Fluorescent	18	0	1189	0	20	2
	60-W Incandescent Lamp	60	0	672	0	40	3
	100-W Incandescent Lamp	100	0	672	0	70	6
	Torchiere Lamp-Halogen	300	0	1460	0	440	36
Bedroom and Bathroom							
	Hair Dryer	710	0	50	0	40	3
	Waterbed Heater	350	0	3051	0	1070	87
Laundry Room							
	Clothes Dryer			(4) 359		1000	81
	Clothes Washer	(3) 0.276	0	(4) 392	0	110	9
Home Electronics							
	Cable Box	20	12	1456	7304	110	9
	Computer (CPU & Monitor)	182/30	0	1337/632	0	260	21
	Portable Stereo	7	2	526	5606	20	2
	Compact Stereo		12	964	7796	110	9
	Rack Stereo	53	12	1664	7096	150	12
	Color Television	83	5	2810	5950	(5) 260	21
	VCR	14	6	2424	6336	70	6
Heating and Cooling							
	Dehumidifier	600	0	1620	0	970	79
	Furnace Fan	295	0	1350	0	400	32
	Window Fan	30	0	270	0	10	1
Water Heating							
	Water Heater-Family of 4	4500	0	(6) 64	N.A.	4770	386
	Water Heater-Family of 2	4500	0	(6) 32	N.A.	2340	190
Miscellaneous							
	Clock/Radio	2	2	131	8629	20	2
	Lawn Mower	1500	0	20	0	30	2
	Pool Pump	1000	0	792	0	790	64
	Well Pump	725	0	115	0	80	6
Total Standby		0	57	0	8760	500	41

Note(s): 1) Power draw will vary due to appliance components and modes of operation. 2) $0.080/kWh. 3) Excludes water heating. Units are in kWh/cycle. 4) Cycles/year. 5) Energy consumption is not multiplicative for multiple units. Electricity consumption increases approximately 40 kWh per unit. 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 coffee maker, cable box, clothes washer, computer, dehumidifier, dishwasher, furnace fan, microwave oven, 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, p. D-1-D-9 for hair dryer, window fan, and lawn mower; EIA, Supplement to AEO 2000, Dec. 1999, Table 21 for refrigerator and freezer; BTS/LBNL, Energy Use of Home Audio Products in the U.S., Dec. 1999, Table 4-9, 28 and p. 31-35 for audio electronics; BTS/LBNL, Energy Use of Televisions and Videocassette Recorders in the U.S., Mar. 1999, Tables 3-6 - 3-8, p. 19-22, and Tables 4-6 - 4-8, p. 32-34; GAMA, Consumer's Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment, April 2000 for water heater power draw; and LBNL for total standby.

7.2.2 Residential Stock Natural Gas Appliance Usage

	Average Capacity (10^3 Btu/hr)	Appliance Usage		Annual Consumption (10^6 Btu/year)	Annual Cost ($) (1)
Range	10			4.2	27
Clothes Dryer		(2)	359	4.3	28
Water Heating					
Water Heater-Family of 4	40	(3)	64	25.8	168
Water Heater-Family of 2	40	(3)	32	12.3	80

Note(s): 1) $0.652/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.

7.3.1 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	9,088	8,018	4,537	4,226	6,114
Space Cooling	1,468	2,064	4,747	2,172	3,200
Water Heating	2,938	2,627	3,137	2,532	2,916
Refrigerator	1,445	2,043	2,466	1,798	2,070
Other Appliances & Lighting	6,963	8,702	9,233	7,131	8,184
Total	21,903	23,454	24,120	17,859	22,483

Source(s): EIA, A Look at Residential Energy Consumption in 2001, April 2004, Tables CE(2-5)-(9-12)c; EIA, AEO 2004, Jan. 2004, Table A2, p. 134-136, Table A18, p. 157 for consumption data, and Table A19, p. 158 for emissions data; and EIA, Assumptions to the AEO 2004, Jan. 2004, Table 2, p. 8 for coefficients.

7.3.3 2001 Energy End-Use Expenditures for an Average Household, by Region ($2002)

	Northeast	Midwest	South	West	National
Space Heating	714	625	369	329	485
Space Cooling	112	124	285	159	199
Water Heating	228	186	217	185	205
Refrigerator	152	123	146	120	137
Other Appliances & Lighting	601	524	547	498	541
Total (1)	1761	1558	1546	1181	1510

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 2002, Oct. 2003, Appendix D, p. 353 for price deflators.

7.3.4 Materials Used in the Construction of a 2,272-Sq.-Ft. Single-Family Home, 2000

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

Source(s): NAHB, 2004 Housing Facts, Figures and Trends, 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 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	254
Cooling	4.8	37
Ventilation	1.6	13
Water Heating	17.4	134
Lighting	15.8	122
Cooking	1.4	11
Refrigeration	1	8
Office Equipment	1.5	11
Other	2.9	22
Total	79.3	614

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 Number of Public K-12 Schools in the United States and Students per School, 2001-2002

Total Number of Schools in the U.S.

Regular (1)	84,919
Special	1,641
Vocational	328
Alternative	4,492
Total (2)	91,380

Average Number of Students per School (3)

Elementary	441
Middle	612
High	753
Other	267

Note(s): 1) Regular schools are those responsible for providing free public education for school age children residing within their jurisdiction. 2) Data is based on total number of schools reporting current student enrollment, which varies from the actual number of schools, 94,112. "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), Statistical Analysis Report, Overview of Public Secondary and Elementary Schools and Districts: School year 2001-02 (NCES 2003-411), May 2003.

7.5.3 Distribution of Public K-12 Schools and Students by Community Type, 2001-2002

	Total Schools (1)		Total Students (millions)	
Large City	23,158	25%	13.92	29%
Urban Town	42,319	45%	23.80	50%
Rural	28,635	30%	9.97	21%
Total	94,112	100%	47.69	100%

Source(s): U.S. Department of Education/National Center for Educational Statistics (NCES), Statistical Analysis Report, Overview of Public Secondary and Elementary Schools and Districts: School Year 2001-02 (NCES 2003-411), May 2003.

7.5.4 National Enrollment and Expenditures for Public K-12 Facilities

	National Enrollment (millions)	Expenditures ($ billion)	Expenditures per Pupil
1986	39.42	225.6	5,722
1990	40.54	264.2	6,516
1995	44.11	288.9	6,549
2000	46.86	340.8	7,273
2005	48.18	385.2	7,997
2010	48.76	430.7	8,833

Source(s): National Center for Educational Statistics (NCES), Projections of Educational Statistics to 2011, Table 33, p. 88 October 2001 for 1986 data; National Center for Educational Statistics (NCES), Projections of Educational Statistics to 2013, Table 33, p .82 October 2003 for 1990-2010 data; and EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price inflators.

7.5.5 Total Expenditures for K-12 Plant Operation and Maintenance by Function ($2002 billion)

	1990		1995		1999	
Salaries and Benefits	214.7	83%	271.4	83%	339.8	82%
Supplies	18.9	7%	24.0	7%	33.1	8%
Other	3.8	1%	3.3	1%	4.1	1%
Purchased Services	21.0	8%	27.6	8%	37.2	9%
O & M (1)	7.3		9.8		11.3	
Total	258.4	100%	326.3	100%	414.2	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 2001, Table 165, p. 189 for 1990 data; U.S. Department of Education/National Center for Educational Statistics (NCES), Digest of Educational Statistics 2002, Table 164, p. 192 for 1995-1999 data; EIA, Annual Energy Review 2002, Oct. 2003, Appendix D, p. 353 for price inflators.

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

	1992	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
New Schools	N.A.	N.A.	7.89	8.17	9.39	10.40	12.41	11.25
Additions	N.A.	N.A.	3.90	5.85	6.13	5.36	5.254	5.06
Renovations	N.A.	N.A.	3.67	3.95	5.64	4.58	3.962	3.65
Total	**10.73**	**10.42**	**15.46**	**17.96**	**21.16**	**20.34**	**21.63**	**19.96**

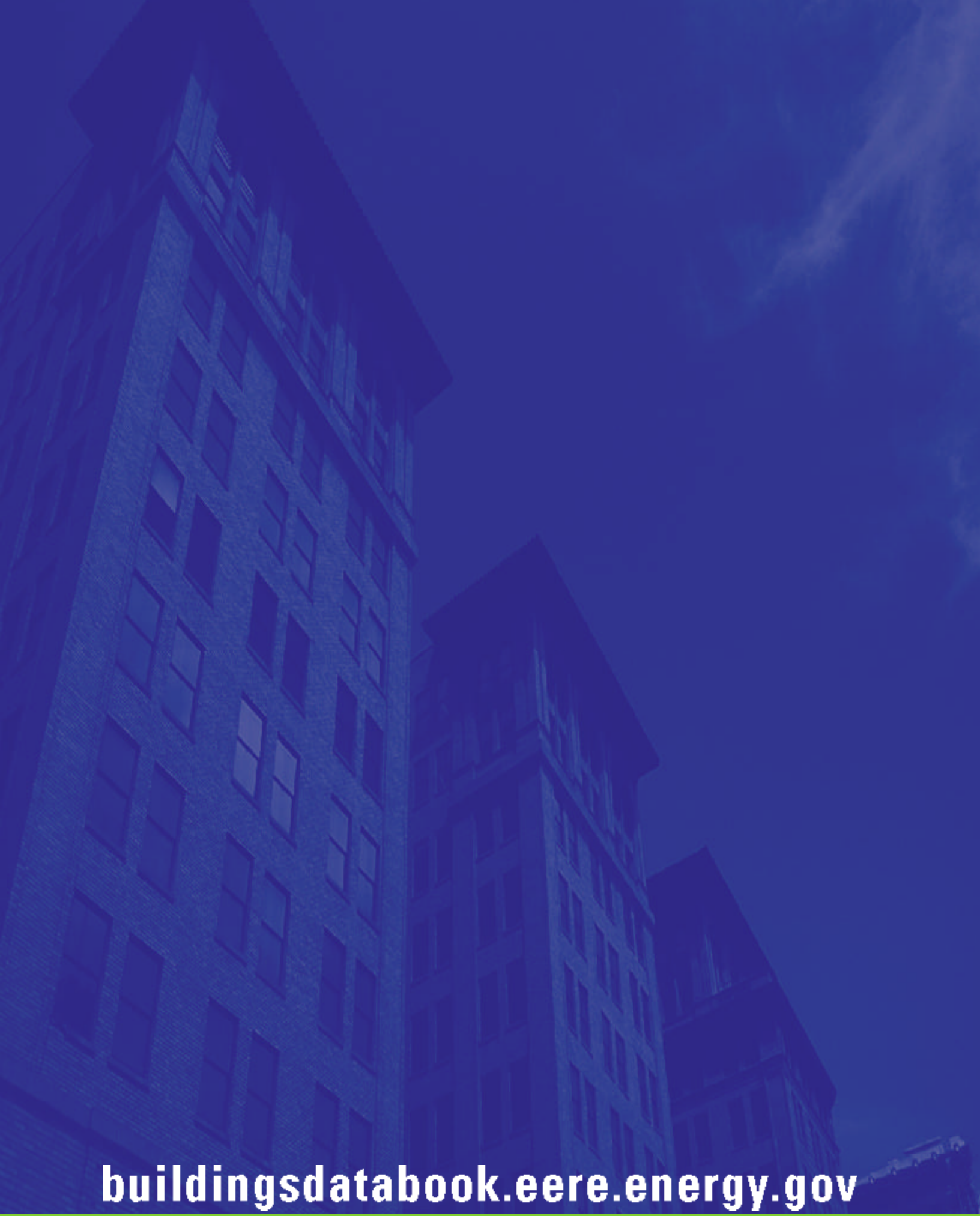
Source(s): American School and University Magazine, 28th Annual Official Education Report, p. 26, May 2002 for 1992 and 1995 data, www.asumag.com; and School Planning and Management 2004 Construction Report, Feb 2004, Table 1 p. 3 for 1998 to 2003.

7.5.7 Percentage of Public K-12 Schools with Inadequate Building Features, 1995 (1)

	Small	**Medium**	**Large**
Roofs	25.6	25.1	32.0
Framing, floors, and foundations	18.4	18.4	16.9
Exterior walls, finishes, windows and doors	26.1	25.7	28.2
Interior finishes	23.3	22.8	26.7
Plumbing	32.6	27.6	30.4
HVAC	35.9	35.3	38.5
Electrical power	27.8	25.4	26.6
Electrical lighting	25.4	24.3	26.3

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): 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.



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