OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

2001 BTS CORE DATABOOK

OFFICE OF

BUILDING TECHNOLOGY,

STATE AND COMMUNITY PROGRAMS

This version is dated: November 30, 2001

REVISED data tables on the web site that have been changed since November 30, 2001 include tables:

5.6.7	5.6.8	5.6.9	5.10.8	5.10.9
5.10.10	5.10.11	5.10.12	5.10.13	5.10.14
5.10.15	5.10.16	5.10.17	5.10.18	

NEW data tables on the web site that have been added since July 13, 2001 include tables:

5.6.14	5.9.7	5.9.8	5.9.9

REVISED data tables on the web site that have been changed since July 13, 2001 include tables:

4.1.1	4.1.2	4.1.4	4.1.5	4.2.1
4.2.2	4.2.3	4.2.4	4.2.5	4.2.9
4.3.1	4.3.2	4.3.3	4.3.4	4.5.1
4.5.2	4.5.3	5.1.2	5.3.1	5.8.1
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These tables are not included in this version of the 2001 BTS Core Databook.

DOE's Office of Building Technology,
State and Community Programs

BTS Core Databook

The Department of Energy's Office of Building Technology, State and Community Programs (BTS) has developed this Core Databook to provide a current and accurate set of comprehensive buildings-related data and to promote the use of such data for consistency throughout BTS programs. Created under BTS's Evaluation and Planning Program, the Databook is considered an evolving document. The Databook will be periodically updated and additional data will be incorporated. Users are requested to submit additional data (e.g., more current, widely accepted, and/or better documented data) and suggested changes to the contacts 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

ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers

BED BTS's Office of Building Equipment (formerly the Building Equipment Division)

BNL Brookhaven National Laboratory

BTS DOE's Office of Building Technology, State and Community Programs

CBECS EIA's Commercial Building Energy Consumption Survey

CF Cubic feet

CFC Chlorofluorocarbon

CO Carbon monoxide

CO_2 Carbon dioxide

COP Coefficient of Performance (dimensionless, heating/cooling capacity (Btu) over electric input (Btu))

CPS Bureau of the Census' Current Population Survey

Delivered Refers to energy used on *site* (including purchased electricity)

DOC U.S. Department of Commerce

DOE U.S. Department of Energy

DSM Demand-Side Management

EER Energy Efficiency Ratio (Btu/watt-hour)

EF Energy Factor

EIA DOE's Energy Information Administration

EPA U.S. Environmental Protection Agency

Key Terminology
(continued)

ESCO	Energy Service Company
FEMP	DOE's Federal Energy Management Program
FT2	Square Feet
FY	Fiscal Year
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

Key Terminology
(continued)

OBE	BTS's Office of Building Equipment
OBT	DOE's Office of Building Technology, State and Community Programs (formerly the Office of Building Technologies)
ODP	Ozone Depletion Potential
ORNL	Oak Ridge National Laboratory
PM-2.5	Particulate matter of aerodynamic diameter less than 2.5 microns
PM-10	Particulate matter of aerodynamic diameter less than 10 microns
PNNL	Pacific Northwest National Laboratory
Primary	Refers to energy used at the source (including fuel input to electric power plants)
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

Buildings-Related Internet Addresses

Federal Government and International Organizations

Office of Building Technology, State and Community Programs . . . www.eren.doe.gov/buildings
Energy Efficiency & Renewable Energy Network . . . . . www.eren.doe.gov
Energy Information Administration . . . . . www.eia.doe.gov
United States Environmental Protection Agency . . . . . www.epa.gov
ENERGY STAR . . . . . www.energystar.gov
U.S. Housing and Urban Development Department . . . . . www.hud.org
U.S. Housing and Urban Development Department User . . . . . www.huduser.org
Partnership for Advancing Technology in Housing . . . . . www.pathnet.org
U.S. Census Bureau . . . . . www.census.gov
U.S. Census Bureau Housing Topics . . . . . www.census.gov/hhes/www/housing.html
Census Bureau Economic Programs . . . . . www.census.gov/ftp/pub/econ/www
International Energy Agency, Energy Conservation in
Buildings and Community Systems . . . . . www.ecbcs.org
Intergovernmental Panel on Climate Change . . . . . www.ipcc.ch

National Laboratories and Research Organizations

Brookhaven National Laboratory . . . . . www.bnl.gov
Building and Fire Research Laboratory (National
Institute of Standards and Technology) . . . . . www.bfrl.nist.gov
Buildings Technology Center (Oak Ridge National Laboratory) . . . . . www.ornl.gov/btc
Environmental Energy Technologies Division (Lawrence
Berkeley National Laboratory) . . . . . http://eande.lbl.gov
Florida Solar Energy Center . . . . . www.fsec.ucf.edu
National Association of Home Builders Research Center . . . . . www.nahbrc.org
Lighting Research Center . . . . . www.lrc.rpi.edu
National Renewable Energy Laboratory . . . . . www.nrel.gov
Pacific Northwest National Laboratory Buildings Program . . . . . www.pnl.gov/buildings/
Renewable Resource Data Center (National Renewable
Energy Laboratory) . . . . . http://rredc.nrel.gov
Gas Technology Institute . . . . . www.igt.org
Electric Power Research Institute . . . . . www.epri.com

Buildings-Related Internet Addresses (continued)

Magazines, Journals, and On-Line Newsletters

Air Conditioning, Heating and Refrigeration News . . . . . www.achrnews.com
Appliance Magazine . . . . . www.appliance.com
Appliance Manufacturer Magazine . . . . . www.ammagazine.com
Builder Magazine . . . . . www.builderonline.com
Building Standards . . . . . www.icbo.org/Building_Standards_Online
Buildings Magazine . . . . . www.buildings.com
Building Operating Management . . . . . www.facilitiesnet.com/fn/bom
Center for Renewable Energy and Sustainable Technology . . . . . www.crest.org
Contracting Business Interactive . . . . . www.contractingbusiness.com
Energy Central Electric Power Information Resource . . . . . www.energycentral.com
Energy Decisions . . . . . www.facilitiesnet.com/fn/energydecisions
Energy Design Update . . . . . www.cutter.com/edu
Energy User News . . . . . www.energyusernews.com
Engineered Systems . . . . . www.esmagazine.com
Environmental Design & Construction . . . . . www.edcmag.com
Environmental Building News . . . . . www.buildinggreen.com
Facilities Design & Management . . . . . www.fdm.com
Heating/Piping/Air Conditioning (HPAC Engineering) . . . . . www.hpac.com
Home Furnishings News . . . . . www.hfnmag.com
Home Power Magazine . . . . . www.homepower.com
Home Energy . . . . . www.homeenergy.org/tocs.html
The Journal of Light Construction . . . . . www.jlconline.com
Remodeling Online . . . . . www.remodeling.hw.net
Residential Architect . . . . . http://ra.hw.net
Solar Today . . . . . www.solartoday.org

Code Groups

American National Standards Institute . . . . . www.ansi.org
American Society for Testing and Materials . . . . . www.astm.org
Building Officials and Code Administrators International . . . . . www.bocai.org
International Code Council . . . . . www.intlcode.org
International Conference of Building Officials . . . . . www.icbo.org
National Conference of States on Building Codes and Standards, Inc. . . . . www.ncsbcs.org
National Fire Protection Association International . . . . . www.nfpa.org
Southern Building Code Congress International . . . . . www.sbcci.org

Buildings-Related Internet Addresses (continued)

Professional, Industry, and Not-for-Profit Associations

Affordable Comfort Incorporated . . . . . www.affordablecomfort.org
Air-Conditioning & Refrigeration Institute . . . . . www.ari.org
Air Conditioning Contractors of America . . . . . www.acca.org
Alternative Fluorocarbons Environmental Acceptability Study . . . . . www.afeas.org
American Architectural Manufacturers Association . . . . . www.aamanet.org
American Council for an Energy-Efficient Economy . . . . . www.aceee.org
American Gas Association . . . . . www.aga.org
American Gas Cooling Center . . . . . www.agcc.org
American Institute of Architects . . . . . www.aiaonline.com
American Society of Heating, Refrigerating and Air-Conditioning Engineers . . . www.ashrae.org
American Society of Mechanical Engineers . . . . . www.asme.org
American Solar Energy Society . . . . . www.ases.org
The Association of Energy Engineers . . . . . www.aeecenter.org
Association of Higher Education Facilities Officers . . . . . www.appa.org
Association of Home Appliance Manufacturers . . . . . www.aham.org
Building Owners and Managers Association . . . . . www.boma.org
Edison Electric Institute . . . . . www.eei.org
Energy & Environmental Building Association . . . . . www.eeba.org
Gas Appliance Manufacturers Association . . . . . www.gamanet.org
Habitat for Humanity International . . . . . www.habitat.org
International Facility Management Association . . . . . www.ifma.org
Manufactured Housing Institute . . . . . www.mfghome.org
National Association of Demolition Contractors . . . . . www.demolitionassociation.com
National Association of Energy Service Companies . . . . . www.naesco.org
National Association of Home Builders . . . . . www.nahb.com
National Association of Housing and Redevelopment Officials . . . . . www.nahro.org
National Association of State Energy Officials . . . . . www.naseo.org
National Center for Appropriate Technology . . . . . www.ncat.org
Natural Resources Defense Council . . . . . www.nrdc.org
Residential Energy Service Network . . . . . www.natresnet.org
Solar Energy Industries Association . . . . . www.seia.org
Weatherization Assistance Program Technical Assistance Center . . . . . www.waptac.org

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	30%	1.7	11%	0.1	0%	N.A.		**15.9**
1990	10.1	61%	4.5	27%	1.3	8%	0.1	0%	0.6	4%	**16.5**
1999	**12.4**	**65%**	**4.8**	**25%**	**1.4**	**7%**	**0.0**	**0%**	**0.4**	**2%**	**19.1**
2000	12.5	65%	5.0	26%	1.4	7%	0.0	0%	0.4	2%	**19.3**
2010	14.8	66%	5.7	25%	1.3	6%	0.1	0%	0.5	2%	**22.3**
2020	16.4	67%	6.3	26%	1.2	5%	0.0	0%	0.5	2%	**24.4**

Commercial Consumption

	Elec		NGas		Oil		Coal		Renew		**Total**
1980	6.5	62%	2.7	25%	1.3	12%	0.1	1%	N.A.		**10.6**
1990	9.1	71%	2.7	21%	0.9	7%	0.1	1%	0.0	0%	**12.8**
1999	**11.7**	**75%**	**3.2**	**20%**	**0.6**	**4%**	**0.1**	**0%**	**0.1**	**1%**	**15.6**
2000	11.9	75%	3.3	20%	0.6	4%	0.1	0%	0.1	1%	**16.0**
2010	14.6	76%	3.9	20%	0.7	3%	0.1	0%	0.1	1%	**19.3**
2020	15.8	76%	4.1	20%	0.7	3%	0.1	0%	0.1	1%	**20.8**

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%	N.A.		**26.5**
1990	19.2	65%	7.2	25%	2.2	7%	0.2	1%	0.6	2%	**29.4**
1999	**24.1**	**69%**	**8.0**	**23%**	**2.0**	**6%**	**0.1**	**0%**	**0.5**	**2%**	**34.7**
2000	24.4	69%	8.2	23%	2.0	6%	0.1	0%	0.5	1%	**35.3**
2010	29.4	71%	9.6	23%	2.0	5%	0.1	0%	0.6	1%	**41.7**
2020	32.2	71%	10.4	23%	1.9	4%	0.1	0%	0.6	1%	**45.2**

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

	Gas	Oil	Coal	Renew	Nuclear	Electric Import
1980	37%	17%	28%	11%	6%	N.A.
1990	31%	10%	36%	9%	14%	N.A.
1999	**30%**	**8%**	**37%**	**9%**	**15%**	**1%**
2000	31%	7%	37%	9%	15%	1%
2010	35%	5%	38%	9%	13%	1%
2020	41%	4%	36%	8%	9%	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%
1999	**20%**	**16%**	**36%**	**36%**	**28%**
2000	20%	16%	**36%**	36%	28%
2010	20%	17%	**36%**	35%	29%
2020	19%	16%	**36%**	34%	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%
1999	**35%**	**33%**	**67%**	**32%**	**1%**
2000	34%	33%	**67%**	32%	1%
2010	35%	35%	**70%**	30%	1%
2020	35%	34%	**70%**	29%	1%

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

	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, 1999

Energy (quads and % of totals)

End Use	Residential		Commercial		**Buildings**	
Space Heating	6.3	33%	2.5	16%	**8.8**	**25%**
Space Cooling	1.9	10%	1.8	12%	**3.7**	**11%**
Ventilation			0.9	6%	**0.9**	**3%**
Water Heating	2.9	15%	1.2	8%	**4.1**	**12%**
Lighting	1.1	6%	3.8	25%	**5.0**	**14%**
Refrigeration	1.7	9%	0.6	4%	**2.3**	**7%**
Wet Clean	0.9	5%			**0.9**	**3%**
Cooking	0.9	5%	0.3	2%	**1.2**	**3%**
Electronics	0.9	5%	0.9	6%	**1.9**	**5%**
Computers	0.2	1%	0.3	2%	**0.5**	**2%**
Other	2.3	12%	1.3	8%	**3.6**	**10%**
Adjust to SEDS			2.0	13%	**2.0**	**6%**
Total	19.1	100%	15.6	100%	**34.7**	**100%**

Expenditures ($1999 and % of totals)

End Use	Residential		Commercial		**Buildings**	
Space Heating	40.3	30%	13.5	14%	53.8	23%
Space Cooling	14.2	11%	12.4	12%	26.6	11%
Ventilation			5.9	6%	5.9	3%
Water Heating	20.3	15%	7.0	7%	27.3	12%
Lighting	8.4	6%	26.1	26%	34.5	15%
Refrigeration	12.9	10%	3.9	4%	16.8	7%
Wet Clean	6.7	5%			6.7	3%
Cooking	6.4	5%	1.8	2%	8.2	4%
Electronics	6.9	5%	6.4	6%	13.2	6%
Computers	1.5	1%	2.2	2%	3.8	2%
Other	17.1	13%	8.2	8%	25.3	11%
Adjust to SEDS			12.4	12%	12.4	5%
Total	134.7	100%	99.7	100%	234.4	100%

8. Buildings Energy Prices and Expenditures

Prices ($1999/10^6 Btu)

	Residential Buildings				Commercial Buildings				Bldgs
	Elec	NGas	Petro	Avg	Elec	NGas	Petro	Avg	Avg
1980	28.81	6.60	13.31	13.91	29.45	6.09	10.34	14.62	14.19
1990	27.76	6.81	10.75	14.76	25.64	5.68	7.15	14.72	14.74
1999	**23.60**	**6.52**	**7.55**	**13.22**	**21.54**	**5.34**	**5.00**	**13.35**	**13.28**
2000	23.62	7.19	10.30	13.89	22.22	5.70	7.23	14.00	13.94
2010	21.88	6.53	9.37	13.21	17.63	5.50	6.17	11.83	12.60
2020	22.17	6.55	9.64	13.64	18.12	5.71	6.50	12.45	13.12

Petroleum includes distillate and residual fuel oils, LPG, kerosene, and motor gasoline.
1999 average electricity cost: resid. $0.081/kWh, comm. $0.073/kWh, and Bldgs. $0.077/kWh.

Expenditures ($1999 billion)

	Residential Buildings				Commercial Buildings				Bldgs
	Elec	NGas	Petro	Total	Elec	NGas	Petro	Total	Total
1980	70.5	32.1	23.3	**125.9**	56.1	16.2	13.3	**85.7**	211.6
1990	87.5	30.8	13.5	**131.8**	73.3	15.3	6.5	**95.1**	226.9
1999	**92.2**	**31.6**	**10.8**	**134.6**	**79.6**	**16.9**	**3.2**	**99.6**	**234.2**
2000	93.4	35.7	14.8	**144.0**	84.1	18.6	4.3	**107.0**	251.0
2010	108.6	37.2	12.1	**157.9**	86.1	21.4	4.1	**111.6**	269.5
2020	128.7	41.3	11.7	**181.6**	101.6	23.6	4.3	**129.4**	311.0

Expenditures exclude wood and coal costs. 1999 U.S. energy expenditures were $581.1 billion.

9. Energy Consumption Intensities, by Year

Residential

	Number of Hhold (10^6)	% Post-90 Hholds	Bldgs (10^6)	*Delivered* Energy Use (10^6Btu/Hhold)	Primary Energy Use (10^6Btu/Hhold)
1980	79.6	N.A.	65.5	125.2	200.0
1990	94.2	N.A.	74.2	102.3	175.5
1999	**104.1**	**16%**	**82.6**	**102.1**	**183.5**
2000	105.3	18%	N/A	102.5	183.6
2010	117.0	33%	N/A	106.3	190.6
2020	129.4	46%	N/A	106.7	188.3

1999 number of buildings actually from 1997.
1997 households: 73% single-family, 21% multi-family, and 6% mobile homes.
1997 *delivered* energy use: 83% single-family, 13% multi-family, and 5% mobile homes.

Commercial

	Floorspace (10^9 SF)	% Post-90 SF	Bldgs (10^6)	*Delivered* Energy Use (10^3Btu/SF)	Primary Energy Use (10^3Btu/SF)
1980	50.9	N.A.	3.1	117.2	208.3
1990	64.3	N.A.	4.5	102.6	200.0
1999	**62.8**	**16%**	**4.6**	**120.9**	**248.5**
2000	64.3	19%	N/A	121.1	247.9
2010	75.8	42%	N/A	126.6	254.8
2020	81.9	58%	N/A	128.8	253.2

1999 number of buildings actually from 1995.
1995 floorspace: 22% mercantile & service, 18% office, 14% warehouse, and 13% education. 1995 *delivered* energy use: 19% office, 18% mercantile & service, 12% education, and 11% health care.

10. Residential (1997) and Commercial (1995) Vintages

Residential	% of Hholds	Commercial	% of SF
1949 or Before	28%	Prior to 1919	6%
1950 to 1959	12%	1920 to 1959	27%
1960 to 1969	14%	1960 to 1979	38%
1970 to 1979	19%	1980 to 1989	21%
1980 to 1989	17%	1990 to 1995	8%
1990 to 1997	10%		

11. Stock Energy Expenditures ($1999)

	Residential ($/Household)	Commercial ($/SF)
1980	1,581	1.68
1990	1,399	1.48
1999	**1,293**	**1.58**
2000	1,368	1.66
2010	1,350	1.47
2020	1,404	1.58

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	312.0	149.9	461.9	34%	8%
1999	**374.6**	**156.4**	**531.1**	**35%**	**9%**
2000	384.2	160.0	544.3	35%	9%
2010	472.7	178.5	651.2	36%	8%
2020	537.1	189.1	726.3	36%	7%

Buildings emissions equal emissions of Japan and United Kingdom combined.
1999 U.S. emissions = 1,511 MMTCE. 1999 Global emissions = 6,091 MMTCE.

13. EPA Emissions for U.S. Buildings, 1999

(10^6 short tons)

	Buildings			Bldgs % of
	Wood/*Site* Fossil	Elec	Total	U.S. Emiss
SO2	0.59	8.55	9.139	48%
NOx	1.18	3.85	5.024	20%
CO	4.61	0.30	4.906	5%
VOCs	0.67	0.04	0.708	4%
PM-2.5	0.49	0.09	0.573	8%
PM-10	0.57	0.15	0.72	3%
Lead	0.41	0.05	0.46	11%

14. Value of New, Improvement & Repair Building Construction ($1999 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	131.3	126.5	257.8	5.0%	84.9	N.A.	N.A.	N.A.
1985	166.9	178.8	345.7	5.8%	114.0	110.8	224.8	3.8%
1990	159.4	179.3	338.6	4.8%	129.5	112.3	241.8	3.4%
1995	187.8	164.3	352.1	4.5%	127.2	110.6	237.8	3.0%
1999	**255.2**	**232.0**	**487.2**	**5.3%**	**142.9**	**110.7**	**253.6**	**2.7%**

1999 U.S. GDP = $9.3 trillion.

15. 1999 Housing Sales Price ($1999)

Housing Type	Median
New Single-Family	159,800
Existing Single-Family	133,300
New Mobile Home	43,800

Excludes land costs

16. Residential New Single-Family Housing Completed

	# of Units	Average SF
1980	957,000	1,730
1990	966,000	2,080
1999	**1,307,200**	**2,225**

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	
1999	**194**	**4,835**	**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 1998 Energy Burdens

	Mean Individual	Median Individual	Mean Group
All Hholds	6.3%	3.9%	2.6%
Fed Elgble Hhold	12.5%	8.3%	8.4%
Fed Ineligible Hhold	3.2%	2.8%	2.1%

Average income of a Federally eligible household was $12,880 in 1998.

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

5.2 million homes were weatherized under DOE through FY 2000 with an additional 209,200 homes weatherized in FY 2000.
DOE Weatherization saves an average of 13-34% on home energy bills with a cost-benefit ratio of 2.1.
Legislation enacted in 2000 for the DOE Weatherization program requires states spend no more than an average of $2,500 per household. States use energy audits to determine the best weatherization measures.

21. 1994 U.S. Private Investment into Construction R&D

Sector	Percent of Sales
Average Construction R&D (1)	< 0.5
Housing (materials/components)	1.7
Construction materials	1.0
Construction machinery	3.0
U.S. Industry Average	3.5
International Industry Composite	4.3

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

22. 1999 Five Largest Residential Homebuilders

Homebuilder	Home Closings	% of Closings
Pulte Corporation	27,781	1.7%
Kaufman and Broad Home Corp.	22,847	1.4%
Lennar Corporation	22,560	1.4%
Centex Corporation	21,767	1.4%
D.R. Horton	18,942	1.2%
Total of Top Five	113,897	7.1%
Habitat for Humanity	3,641	0.23%

2000 total U.S. new home closings was 1.61 million. 1999 total share of top 100 builders was 20.0%. 1996 total share of top 400 builders was 42%.

The summary tables correspond to the following tables in Chapters 1 through 7 of the BTS Core Databook:

1.	1.2.1, 1.3.1	**5.**	1.1.3, 1.5.1	**8.**	4.1.1, 4.1.2	**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.**	1.2.5, 1.2.7, 1.3.4, 1.3.6,	**12.**	3.1.1	**16.**	2.1.6	**20.**	7.1.1, 7.1.3, 7.1.6
3.	1.1.4	**7.**	1.1.7, 1.2.3, 1.3.3,		2.1.1, 2.1.2, 2.2.1, 2.2.2	**13.**	3.3.1	**17.**	4.6.1	**21.**	4.5.4
4.	1.1.2		4.1.4, 4.2.1, & 4.3.1	**10.**	2.1.5, 2.2.6	**14.**	4.5.2, 4.5.3, 5.1.2	**18.**	4.2.7, 7.1.1	**22.**	5.1.1

1.1.1 U.S. Residential and Commercial Buildings Total Primary Energy Consumption (quads and percent of total) (1)

	Natural Gas		Petroleum (2)		Coal		Renewable(3)		Electricity Sales	Electricity Losses	Electricity Total		TOTAL (3)		Growth Rate 1980-Year
1980	7.52	28%	3.04	11%	0.15	1%	0.88	3%	4.35	10.60	14.95	56%	26.53	100%	-
1990	7.22	25%	2.17	7%	0.16	1%	0.64	2%	6.01	13.16	19.17	65%	29.36	100%	1.0%
1999	**8.00**	**23%**	**2.01**	**6%**	**0.11**	**0%**	**0.53**	**2%**	**7.60**	**16.49 (4)**	**24.10**	**69%**	**34.75**	**100%**	1.4%
2000	8.23	23%	2.03	6%	0.11	0%	0.51	1%	7.74	16.69	24.43	69%	35.31	100%	1.4%
2010	9.58	23%	1.96	5%	0.12	0%	0.57	1%	9.85	19.58	29.43	71%	41.66	100%	1.5%
2020	10.43	23%	1.87	4%	0.12	0%	0.59	1%	11.41	20.75	32.16	71%	45.17	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) 1999 *site* -to-source electricity conversion = 3.17.

Source(s): EIA, State Energy Data Report 1999, May 2001, Tables 12 - 15, p. 22-25 for 1980 and 1990; and EIA, Annual Energy Outlook (AEO) 2001, Dec. 2000, Table A2, p. 128-130 for 1999-2020 and Table A18, p. 150 for non-marketed renewable energy.

1.1.2 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
1999	**20%**	**16%**	**36%**	**36%**	**28%**	**100%**	**96.2**
2000	20%	16%	**36%**	36%	28%	100%	97.7
2010	20%	17%	**36%**	35%	29%	100%	114.2
2020	19%	16%	**36%**	34%	30%	100%	127.1

Note(s): 1) Buildings-related energy consumption in the industrial sector in 1991 was 1.96 of 31.76 quads; for comparison, 1999 industrial sector energy use was 35.02 quads. 2) Renewables are not included in the 1980 data.

Source(s): EIA, State Energy Data Report 1999, May 2001, Tables 12 - 15, p. 22-25 for 1980 and 1990; and EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for 1999-2020 data and Table A18, p. 150 for non-marketed renewable energy.

1.1.3 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
1999 (1)	**35%**	**33%**	**67%**	**32%**	**1%**	**100%**	**11.3**
2000	34%	33%	**67%**	32%	1%	100%	11.5
2010	35%	35%	**70%**	30%	1%	100%	14.2
2020	35%	34%	**70%**	29%	1%	100%	16.4

Note(s): 1) Buildings accounted for 78% (or $172 billion) of total U.S. electricity expenditures.

Source(s): EIA, State Energy Data Report 1999, May 2001, Tables 12-15, p. 22-25 for 1980 and 1990; and EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for 1999-2020 consumption, Table A3, p. 131-132 for 1999 expenditures.

1.1.4 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%	28%	7%	4%	11%	6%	(2)	100%
1990	31%	10%	36%	7%	3%	9%	14%	(2)	100%
1999	**30%**	**8%**	**37%**	**6%**	**3%**	**9%**	**15%**	**1%**	**100%**
2000	31%	7%	37%	6%	3%	9%	15%	1%	100%
2010	35%	5%	38%	5%	4%	9%	13%	1%	100%
2020	41%	4%	36%	5%	4%	8%	9%	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 Report 1999, May 2001, Tables 12-15, p. 22-25 for 1980 and 1990; and EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for 1999-2020 consumption and Table A18, p. 150 for non-marketed renewable energy.

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

	Wood (2)	Solar Thermal (3)	Solar PV(3)	GHP (4)	Total
1980	0.8810	0.0000	N.A.	0.0000	0.8810
1990	0.5820	0.0560	N.A.	0.0090	0.6470
1999	**0.4890**	**0.0246**	**0.0001**	**0.0162**	**0.5299**
2000	0.4692	0.0274	0.0001	0.0173	0.5141
2010	0.5130	0.0292	0.0026	0.0259	0.5706
2020	0.5239	0.0299	0.0026	0.0295	0.5859

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 Report 1999, May 2001, Table 12-13, p. 22-23 for 1980 and 1990; and EIA, AEO 2001, Dec. 2000, Table A18, p. 150 for 1999-2020.

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

	Energy Consumption (Quad)				Population (million)				Annual Growth Rate 1990-1999		Annual Growth Rate 1999-2010	
Country/Region	1990	1999		2010	1990	1999		2010	Energy	Pop.	Energy	Pop.
United States	84.0	96.7	25.3%	114.1	254	273	4.6%	300	1.6%	0.7%	1.4%	0.9%
Western Europe (1)	59.8	65.9	17.3%	74.5	377	388	6.5%	389	1.1%	0.3%	1.1%	0.0%
Former Soviet Union	61.0	39.3	10.3%	46.4	290	292	4.9%	294	-4.8%	0.1%	1.5%	0.1%
Other Asia	21.1	33.0	8.6%	46.8	819	974	16.3%	1161	5.1%	1.7%	3.2%	1.6%
China	27.0	32.0	8.4%	55.3	1155	1266	21.2%	1373	1.9%	0.9%	5.1%	0.7%
Japan	17.9	21.7	5.7%	23.5	124	126	2.1%	127	2.2%	0.2%	0.7%	0.1%
Central & S. America	13.7	19.8	5.2%	29.6	354	410	6.9%	478	4.2%	1.5%	3.7%	1.4%
Middle East	13.1	19.3	5.1%	26.9	196	239	4.0%	295	4.4%	2.0%	3.1%	1.9%
Canada	10.9	12.8	3.4%	15.4	28	31	0.5%	34	1.8%	1.0%	1.7%	0.8%
India	7.8	12.2	3.2%	18.4	851	998	16.7%	1152	5.1%	1.6%	3.8%	1.3%
Africa	9.3	11.8	3.1%	16.1	615	767	12.8%	973	2.7%	2.2%	2.9%	2.2%
Eastern Europe	15.3	11.3	3.0%	13.9	122	121	2.0%	121	-3.3%	-0.1%	1.9%	0.0%
Mexico	5.0	6.1	1.6%	8.7	83	97	1.6%	113	2.2%	1.6%	3.3%	1.4%
World Total	346.0	381.8	100%	489.7	5266	5983	100%	6811	1.1%	1.3%	2.3%	1.2%

Note(s): 1) Germany consumed 14.0 quads, France 10.9 quads, United Kingdom 9.8 quads, and Italy 7.6 quads.

Source(s): EIA, International Energy Outlook 2001, March 2001, Table A1, p. 175 and Table A16, p. 192.

1.1.7 1999 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)	4.66	1.06	0.31	0.24	0.42	0.65	7.34	40.2%	2.07	8.76	25.2%
Space Cooling	0.02					1.17	1.19	6.5%	3.72	3.73	10.7%
Ventilation (7)						0.27	0.27	1.5%	0.87	0.87	2.5%
Water Heating	1.92	0.22	0.11		0.02	0.57	2.84	15.6%	1.82	4.09	11.8%
Lighting						1.57	1.57	8.6%	4.96	4.96	14.3%
Refrigeration (8)						0.73	0.73	4.0%	2.31	2.31	6.6%
Wet Clean (9)	0.07					0.27	0.33	1.8%	0.85	0.91	2.6%
Cooking	0.39		0.03			0.24	0.66	3.6%	0.76	1.18	3.4%
Electronics (10)						0.59	0.59	3.2%	1.86	1.86	5.4%
Computers						0.17	0.17	0.9%	0.53	0.53	1.5%
Other (11)	0.26	0.02	0.09	0.03	0.08	0.97	1.46	8.0%	3.08	3.57	10.3%
Adjust to SEDS (12)	0.68	0.02				0.40	1.10	6.0%	1.27	1.97	5.7%
Total	8.00	1.32	0.54	0.26	0.53	7.60	18.26	100%	24.10	34.75	100%

Note(s): 1) See Table 1.3.11 for buildings-related energy consumption in industrial buildings. 2) Includes (1.22 quad) distillate fuel oil and (0.10 quad) residual fuel oil. 3) Kerosene (0.13 quad) and coal (0.11 quad) are assumed attributable to space heating. Motor gasoline (0.03 quad) assumed attributable to other end-uses. 4) Comprised of (0.41 quad) wood space heating, (0.02 quad) geothermal (includes space heating), (0.02 quad) solar water heating, (0.08 quad) biomass, and less than (0.001 quad) solar pv. 5) *Site* -to-source electricity conversion (due to generation and transmission losses) = 3.17. 6) Includes (0.24 quad) furnace fans, 7) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 8) Includes (1.35 quad) refrigerators and (0.37 quad) freezers. Includes commercial refrigeration. 9) Includes (0.09 quad) clothes washers, (0.07 quad) natural gas clothes dryers, (0.68 quad) electric clothes dryers, and (0.07 quad) dishwashers. Does not include water heating energy. 10) Includes (0.38 quad) color television and (1.48 quad) other office equipment. 11) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes a minor amount of residential energy that is an adjustment to SEDS. This includes some energy attributable to the residential buildings sector, but not directly to specific end-uses. Includes commercial service station equipment, automated teller machines, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, manufacturing performed in commercial buildings. 12) 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 2001, Dec. 2001, Tables A2, p. 128-130, Table A4, p. 133-134, Table A5, p. 135-136, and Table A18, p. 150; EIA, National Energy Modeling System for AEO 2001, Dec. 2000; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses; and 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.

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 1980-Year
1980	4.86	30%	1.75	11%	0.06	0%	0.86	5%	2.45	5.96		8.41	53%	15.93	100%	-
1990	4.52	27%	1.27	8%	0.06	0%	0.64	4%	3.15	6.90		10.05	61%	16.54	100%	0.4%
1999	**4.85**	**25%**	**1.42**	**7%**	**0.04**	**0%**	**0.43**	**2%**	**3.91**	**8.48**	**(3)**	**12.39**	**65%**	**19.12**	**100%**	1.0%
2000	4.97	26%	1.44	7%	0.04	0%	0.41	2%	3.96	8.53		12.48	65%	19.34	100%	1.0%
2010	5.69	25%	1.29	6%	0.05	0%	0.46	2%	4.96	9.87		14.83	66%	22.33	100%	1.1%
2020	6.30	26%	1.21	5%	0.05	0%	0.48	2%	5.80	10.55		16.36	67%	24.40	100%	1.1%

Note(s): 1) Petroleum includes distillate and residual fuels, liquefied petroleum gas, kerosene, and motor gasoline. 2) Includes *site* marketed and non-marketed renewable energy. 3) 1999 *site* -to-source electricity conversion = 3.17.

Source(s): EIA, State Energy Data Report 1999, May 2001, Tables 12 - 15, p. 22-25 for 1980 and 1990; and EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for 1999-2020 consumption and Table A18, p. 150 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
1999	**0.4060**	**0.0051**	**0.0000**	**0.0162**	**0.4274**
2000	0.3862	0.0051	0.0000	0.0173	0.4087
2010	0.4300	0.0049	0.0010	0.0259	0.4617
2020	0.4409	0.0047	0.0010	0.0295	0.4760

Note(s): 1) Does not include renewable energy consumed by electric utilities (including hydroelectric). 2) Includes only solar energy. Commercial sector cannot be seperated out for 1980-1990. 3) GHP = Ground-Coupled Heat Pumps.

Source(s): EIA, State Energy Data Report 1999, May 2001, Table 12, p. 22 for 1980 and 1990; and EIA, AEO 2001, Dec. 2000, Table A18, p. 150 for 1999-2020.

1.2.3 1999 Residential Energy End-Use Splits, by Fuel Type (quads)

	Natural Gas	Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (4)	Primary Total	Primary Percent
Space Heating (5)	3.22	0.73	0.31	0.14	0.42	0.46	5.28	49.6%	1.45	6.27	32.8%
Space Cooling (6)	0.00					0.60	0.60	5.7%	1.91	1.91	10.0%
Water Heating (7)	1.26	0.13	0.11		0.01	0.43	1.94	18.2%	1.36	2.87	15.0%
Lighting						0.36	0.36	3.3%	1.13	1.13	5.9%
Refrigeration (8)						0.54	0.54	5.1%	1.73	1.73	9.0%
Wet Clean (9)	0.07					0.27	0.33	3.1%	0.85	0.91	4.8%
Cooking (10)	0.19		0.03			0.21	0.43	4.0%	0.66	0.88	4.6%
Electronics (11)						0.29	0.29	2.7%	0.92	0.92	4.8%
Computers						0.06	0.06	0.6%	0.20	0.20	1.1%
Other (12)	0.11	0.00	0.01		0.00	0.69	0.81	7.6%	2.18	2.30	12.0%
Total	4.85	0.86	0.46	0.14	0.43	3.91	10.65	100%	12.39	19.12	100%

Note(s): 1) Includes 0.86 quads distillate fuel oil. 2) Kerosene (0.10 quad) and coal (0.04 quad) are assumed attributable to space heating. 3) Comprised of 0.41 quad wood (space heating), 0.01 quad geothermal (assumed space heating), 0.01 quad solar (water heating), and less than 0.001 quad pv electric generation (other). 4) *Site* -to-source electricity conversion (due to generation and transmission losses) = 3.17. 5) Fan (0.24 quad) and pump energy use included. 6) Fan energy use included. 7) Includes electric recreational water heating (0.12 quad). 8) Includes (1.35 quad) refrigerators and (0.37 quad) freezers. 9) Includes (0.10 quad) clothes washers, (0.09 quad) natural gas clothes dryers, (0.68 quad) electric clothes dryers, and (0.07 quad) dishwashers. Does not include water heating energy. 10) Includes (0.15 quad) microwaves and other "small" electric cooking appliances. 11) Includes (0.38 quad) color televisions and (0.54 quad) other electronics. 12) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes a minor amount of energy that is an adjustment to SEDS. This energy is attributable to the residential buildings sector, but not directly to specific end-uses.

Source(s): EIA, AEO 2001, Dec. 2000, Tables A2, p. 128-130, Table A4, p. 133-134, and Table A18, p. 150; and BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Appendix A for electric end-uses.

1.2.4 Small Primary Electricity Consumption, by Year and End-Use (quads and percents of total) (1)

	1996 End-Use Consumption			1999 End-Use Consumption		
	Total	Small		Total	Small	
Space Heating	1.66	0.01	0.1%	1.45	0.01	0.1%
Space Cooling	1.76	0.25	2.1%	1.91	0.26	2.1%
Water Heating	1.27	0.11	0.9%	1.36	0.11	0.9%
Lighting	1.28	0.05	0.4%	1.13	0.05	0.4%
Refrigeration	1.73			1.73		
Wet Clean	0.85			0.85		
Cooking	0.74	0.32	2.7%	0.66	0.33	2.7%
Electronics	0.80	0.51	4.4%	0.92	0.54	4.4%
Computers						
Motors and Heating	0.49	0.49	4.1%	N.A.		
Adjustment to SEDS	1.11	1.11	9.4%	2.18	2.18	17.6%
Total	11.76	2.85	24.2%	12.39	3.50	28.2%

Note(s): 1) This table lists aggregated electricity consumption of appliances and equipment which have a small unit electricity consumption.

Source(s): EIA, AEO 1999, Dec. 1998, Table A2, p. 113-115 and Table A4, p. 118-119 for 1996 totals; EIA, AEO 2001, Dec. 2000, Tables A2, p. 128-130, Table A4, p. 133-134, and Table A18, p. 150; and BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for electric end-uses.

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

	Number of Households (10^6)	Percent Post-1990 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.	10.0	125.2	15.9	200
1990	94.2	N.A.	9.6	102.3	16.5	175.5
1999	**104.1**	**16%**	**10.6**	**102.1**	**19.1**	**183.5**
2000	105.3	18%	10.8	102.5	19.3	183.6
2010	117.0	33%	12.4	106.3	22.3	190.6
2020	129.4	46%	13.8	106.7	24.4	188.3

Note(s): 1) Percent of houses built after December 31, 1989.

Source(s): EIA, State Energy Data Report 1999, May 2001, Table 12, p. 22 for 1980 and 1990; EIA, AEO 2001, Dec. 2000, Tables A2 and A4, p. 128-130, and p. 133-134 for 1999-2020; and DOC, Statistical Abstract of the United States 2000, Dec. 2000, Table No. 1207, p. 718 for 1980 and 1990 households.

1.2.6 1997 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 1980	66.8	106.3	41.6	77%
1980 to 1986	46.4	76.4	30.3	9%
1987 to 1989	48.4	93.9	33.7	5%
1990 to 1995	45.3	93.8	33.5	8%
1996 to 1997	46.6	100.2	32.2	1%
Average	60.7	101.0	39.0	

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

1.2.7 1997 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:	**59.0**	**114.7**	**42.0**	**82.6%**
- Detached	58.4	117.9	42.2	73.4%
- Attached	64.4	94.4	40.5	9.2%
Multi-Family:	**67.3**	**59.9**	**31.5**	**12.5%**
- 2 to 4 units	93.2	91.5	28.4	5.0%
- 5 or more units	56.7	48.6	40.7	7.5%
Mobile Homes	**80.0**	**79.5**	**23.7**	**4.9%**
				100.0%

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

1.2.8 1997 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	68.8	120.6	48.2	23%
Midwest	69.9	134.0	51.5	31%
South	53.6	83.9	32.8	29%
West	51.0	74.9	27.8	16%
				100%

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

1.2.9 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.

1.2.10 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.

1.2.11 1997 Residential *Delivered* Energy Consumption Intensities, by Principal Building Type and Vintage

	Consumption (10^3 Btu/SF)		Consumption (10^6 Btu/Hhold)		Consumption (10^6 Btu/Member)	
Building Type	Pre-1990	1990-1997	Pre-1990	1990-1997	Pre-1990	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 1980-Year
1980	2.67	25%	1.29	12%	0.09	1%	0.02	**0%**	1.91	4.64		6.54	62%	10.61	100%	-
1990	2.70	21%	0.91	7%	0.09	1%	0.00	**0%**	2.86	6.26		9.12	71%	12.82	100%	1.9%
1999	**3.15**	**20%**	**0.59**	**4%**	**0.07**	**0%**	**0.10**	**1%**	**3.70**	**8.01**	**(5)**	**11.71**	**75%**	**15.63**	**99%**	2.1%
2000	3.27	20%	0.59	4%	0.06	0%	0.11	1%	3.78	8.16		11.94	75%	15.97	99%	2.1%
2010	3.88	20%	0.67	3%	0.07	0%	0.11	1%	4.89	9.71		14.60	76%	19.33	99%	2.0%
2020	4.13	20%	0.66	3%	0.08	0%	0.11	1%	5.61	10.20		15.81	76%	20.78	99%	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) 1980 and 1990 Renewables are estimated at below 0.01 quads. 5) 1999 *site* -to-source electricity conversion = 3.17.

Source(s): EIA, State Energy Data Report 1999, May 2001, Table 13, p. 23 for 1980 and 1990; and EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for 1999-2020 and Table A18, p. 150 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	N.A.	N.A.	N.A.	0.0030	0.0030
1999	**0.0830**	**0.0195**	**0.0000**	**N.A.**	**0.1025**
2000	0.0830	0.0223	0.0001	N.A.	0.1054
2010	0.0830	0.0243	0.0016	N.A.	0.1089
2020	0.0830	0.0252	0.0016	N.A.	0.1098

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 Report 1999, May 2001, Table 12-13, p. 22-23 for 1980 and 1990; and EIA, AEO 2001, Dec. 2000, Table A18, p. 150 for 1999-2020.

1.3.3 1999 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
Space Heating	1.44	0.33		0.10		0.19	2.06	27.1%	0.61	2.49	15.9%
Space Cooling	0.02					0.57	0.59	7.7%	1.81	1.82	11.7%
Ventilation						0.27	0.27	3.6%	0.87	0.87	5.6%
Water Heating	0.66	0.09			0.02	0.14	0.91	11.9%	0.46	1.22	7.8%
Lighting						1.21	1.21	15.9%	3.83	3.83	24.5%
Refrigeration						0.18	0.18	2.4%	0.58	0.58	3.7%
Cooking	0.21					0.03	0.24	3.1%	0.10	0.31	2.0%
Office Equipment						0.30	0.30	3.9%	0.94	0.94	6.0%
Computers						0.10	0.10	1.4%	0.33	0.33	2.1%
Other (6)	0.15	0.02	0.08	0.03	0.08	0.29	0.65	8.5%	0.90	1.27	8.1%
Adjust to SEDS (7)	0.68	0.02				0.40	1.10	14.5%	1.27	1.97	12.6%
Total	3.15	0.46	0.08	0.12	0.10	3.70	7.61	100%	11.71	15.63	100%

Note(s): 1) See Table 1.3.11 for buildings-related energy consumption in industrial buildings. 2) Includes (0.36 quad) distillate fuel oil and (0.10 quad) residual fuel oil. 3) Kerosene (0.03 quad) and coal (0.07 quad) are assumed attributable to space heating. Motor gasoline (0.03 quad) assumed attributable to other end-uses. 4) Includes (0.02 quad) solar water heating, (0.08 quad) biomass, and less than (0.001 quad) solar pv. 5) *Site* -to-source electricity conversion (due to generation and transmission losses) = 3.17. 6) Includes service station equipment, automated teller machines, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, 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 2001, Dec. 2001, Tables A2, p. 128-130, Table A4, p. 133-134, Table A5, p. 135-136, and Table A18, p. 150; EIA, National Energy Modeling System for AEO 2001, Dec. 2000; and 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.

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

		Floorspace (10^9 SF)	Percent Post-1990 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	117.2	10.6	208.3
1990		64.3	N.A.	6.6	102.6	12.9	200.0
1999	**(3)**	**62.8**	**16%**	**7.6**	**120.9**	**15.6**	**248.5**
2000	(3)	64.3	19%	7.8	121.1	15.9	247.9
2010	(3)	75.8	42%	9.6	126.6	19.3	254.8
2020	(3)	81.9	58%	10.6	128.8	20.7	253.2

Note(s): 1) See Tables 1.3.11 and 2.2.8 for buildings-related energy consumption and floorspace of the industrial sector. 2) Percent built after December 31, 1989. 3) EIA now excludes parking garages and commercial buildings on multibuilding manufacturing facilities from the commercial buildings sector.

Source(s): EIA, State Energy Data Report 1999, May 2001, Table 13, p. 23 for 1980 and 1990; EIA, AEO 1994, Jan. 1994, Table A5, p. 62 for 1990 floorspace; and EIA, AEO 2001, Dec. 2000, Tables A2 and A5, p. 128-130 and 135-136 for 1999-2020.

1.3.5 1995 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	90.2	70.9%
1980 to 1989	86.5	19.9%
1990 to 1995	104.7	9.1%
		100%
Average	90.6	

Note(s): 1) Parking garages and commercial buildings on multibuilding manufacturing facilities are excluded from CBECS 1995.

Source(s): EIA, Commercial Building Energy Consumption and Expenditures 1995, April 1998, Table 3.

1.3.6 1995 Commercial *Delivered* End-Use Energy Consumption Intensities, by Principal Building Type (1)

	Consumption (10^3 Btu/SF)					
Building Type	Space Heating	Space Cooling	Water Heating	Lighting	Total (2)	Percent of Total Consumption
Office	24.3	9.1	8.7	28.1	97.2	19%
Mercantile and Service	30.6	5.8	5.1	23.4	76.4	18%
Education	32.8	4.8	17.4	15.8	79.3	12%
Health Care	55.2	9.9	63.0	39.3	240.4	11%
Lodging	22.7	8.1	51.4	23.2	127.3	9%
Public Assembly	53.6	6.3	17.5	21.9	113.7	8%
Food Service	30.9	19.5	27.5	37.0	245.5	6%
Warehouse and Storage	15.7	0.9	2.0	9.8	38.3	6%
Food Sales	27.5	13.4	9.1	33.9	213.5	3%
Vacant (3)	38.0	1.4	5.5	4.5	30.1	3%
Public Order and Safety	27.8	6.1	23.4	16.4	97.2	2%
Other (4)	59.6	9.3	15.3	26.7	172.2	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.

1.3.7 1995 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
Mercantile and Service	155.3	19%	Health Care	422.6	10%
Office	227.2	23%	Food Service	487.8	6%
Warehouse and Storage	76.3	6%	Food Sales	585.7	4%
Education	136.8	10%	Public Order/Safety	142.4	2%
Public Assembly	169.7	6%	Vacant (2)	49.1	2%
Lodging	235.2	8%	Other (3)	281.9	3%
					100%

Note(s): 1) Parking garages and commercial buildings on multibuilding manufacturing facilities are excluded from CBECS 1995.
2) Includes vacant and religious worship. 3) Includes mixed uses, hangars, crematoriums, laboratories, and other.
Source(s): EIA, Commercial Building Energy Consumption and Expenditures 1995, April 1998, Table 1.

1.3.8 1995 Commercial *Delivered* Energy Consumption Intensities, by Ownership of Unit (1)

Ownership	Consumption (10^3 Btu/SF)	Percent of Total Consumption
Nongovernment Owned	**84.6**	**74.2%**
Owner-Occupied	92.4	61.8%
Nonowner-Occupied	66.7	12.2%
Government Owned	**113.6**	**25.8%**
		100%

Note(s): 1) Parking garages and commercial buildings on multibuilding manufacturing facilities are excluded from CBECS 1995.
Source(s): EIA, Commercial Buildings Energy Consumption and Expenditures 1995, April 1998, Table 3.

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* Energy Consumption Intensities, by Principal Building Type and Vintage (1)

	Consumption (10^3 Btu/SF)	
Building Type	Pre-1990	1990-1995
Education	80.0	68.7
Food Sales	198.5	N.A.
Food Service	223.0	N.A.
Health Care	244.8	199.7
Lodging	128.5	110.4
Mercantile and Service	75.7	84.5
Office	98.2	84.5
Public Assembly	111.0	138.2
Public Order and Safety	94.0	N.A.
Warehouse and Storage	36.6	55.8
Vacant (2)	29.9	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 1995. 2) Includes vacant and religious worship.

Source(s): EIA, Commercial Building Energy Consumption and Expenditures 1995, April 1998, Table 8.

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	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	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	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, 1999 industrial primary energy consumption was 35.02 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 Report 1999, May 2001, Table 14, p. 24 for industrial sector note; EIA, AEO 2001, Table A2, p. 128-130; and DOE/BTS Memorandum, AEO98 Data Clarification for building Energy Analysts, May 13, 1998.

1.4.1 FY 1999 Federal Primary Energy Consumption

Buildings and Facilities	**0.64 quads**	
Vehicles/Equipment/Energy-Intensive Operations	0.76 quads	(mostly jet fuel and diesel)
Total Federal Government Consumption	1.39 quads	

Source(s): DOE/FEMP, Annual Report to Congress on FEMP, May 10, 2001, Table 1-A, p. 11 for total consumption and Table 4-A, p. 45 for buildings consumption.

1.4.2 FY 1999 Federal Building Energy Use Shares, by Fuel Type, and by Agency

Fuel Type	*Site* Percent	Primary Percent	Agency	Primary Percent		FY 1999 Quads
Electricity	43.3%	70.1%	Defense	61.9%	Total *Delivered*	
Natural Gas	35.4%	18.6%	Postal	8.1%	Energy Consumption =	0.34
Fuel Oil	10.2%	5.4%	DOE	6.8%	Total Primary	
Coal	5.3%	2.8%	VA	7.2%	Energy Consumption =	0.64
Other	5.8%	3.1%	GSA	4.9%		
	100%	100%	Other	11.1%		
				100%		

Note(s): See Table 2.3.1 for floorspace.
Source(s): DOE/FEMP, Annual Report to Congress on FEMP, May 10, 2001, Tables 6-B, p. 50 for fuel types, and Table 4-A, p. 44 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 1994	124.2
FY 1986	132.3	FY 1995 (2)	120.7
FY 1987	137.4	FY 1996	118.6
FY 1988	137.2	FY 1997	116.6
FY 1989	133.1	FY 1998	110.8
FY 1990	130.6	FY 1999	109.7
FY 1991	126.8	FY 2000 (3)	111.5
FY 1992	129.2	FY 2005 (4)	97.6
FY 1993	126.1	FY 2010 (4)	90.6

Note(s): 1) See Table 2.3.1 for floorspace. 2) Exceeds the National Energy Conservation Policy Act goal of 125,700 Btu/SF. 3) Executive Order 12759 and EPAct goals. 4) Executive Order 13123 goal.
Source(s): DOE/FEMP, Annual Report to Congress on FEMP, May 10, 2001, Table 4-B, p. 45 for 1985 and 1990-1999 energy consumption and Table 7-A, p. 53 for 1985 and 1999 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
1999 (1)	**35%**	**33%**	**67%**	**32%**	**1%**	**100%**	**11.3**
2000	34%	33%	**67%**	32%	1%	100%	11.5
2010	35%	35%	**70%**	30%	1%	100%	14.2
2020	35%	34%	**70%**	29%	1%	100%	16.4

Note(s): 1) Buildings accounted for 78% (or $172 billion) of total U.S. electricity expenditures.

Source(s): EIA, State Energy Data Report 1999, May 2001, Tables 12 -16, p. 22-26 for 1980 and 1990; and EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for 1999-2020 consumption, and Table A3, p. 131-132 for 1999 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%
1999	**11%**	**3%**	**52%**	**9%**	**2%**	**11%**	**22%**	**1%**	**100%**
2000	11%	2%	54%	8%	2%	10%	22%	1%	100%
2010	17%	0%	53%	7%	4%	11%	18%	1%	100%
2020	25%	0%	51%	7%	3%	10%	13%	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 Report 1999, May 2001, Table 16, p. 26 for 1980 and 1990; and EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for 1999-2020 consumption and Table A18, p. 150 for renewables.

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

				Renewables				Net	
	Natural Gas	Petroleum	Coal	Hydro.	Oth(2)	Total	Nuclear	Electric Imports	Total
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	3.01	0.21	3.22	6.16	(1)	29.58
1999	**3.85**	**1.08**	**18.78**	**3.17**	**0.77**	**3.94**	**7.79**	**0.34**	**35.78**
2000	3.98	0.71	19.45	2.94	0.81	3.75	7.98	0.35	36.22
2010	7.07	0.16	22.41	3.08	1.57	4.64	7.69	0.31	42.28
2020	11.55	0.18	23.46	3.06	1.60	4.66	6.13	0.22	46.20

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 Report 1999, May 2001, Table 16, p. 26 for 1980 and 1990; and EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for 1999-2020 consumption and Table A18, p. 150 for renewables.

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

	1990	1999	2000	2010	2020
Coal Steam	300	306	306	315	316
Other Fossil Steam	144	138	137	120	116
Combined Cycle	7	20	25	126	229
Combustion Turbine/Diesel	46	75	81	164	211
Nuclear Power	100	97	97	94	72
Pumped Storage	18	19	19	19	19
Fuel Cells	0	0	0	0	0
Conv. Hydropower	75	78	78	79	79
Geothermal	3	3	3	4	4
Municipal Solid Waste	2	3	3	4	5
Biomass	7	2	2	2	2
Solar Thermal	0	0	0	0	0
Solar Photovoltaic	0	0	0	0	1
Wind	2	3	3	6	6
Total	703	745	754	934	1061
Distributed Generation	N.A.	0	0	6	13

Source(s): EIA, AEO 1994, Table A9, p. 66 and Table A16, p. 73 for 1990; and EIA, AEO 2001, Dec. 2000, Table A9, Table 140-141 and Table A17, p. 149 for 1999-2020.

1.5.5 U.S. Utility and Nonutility Cumulative Power Plant Additions Needed to Meet Future Electricity Demand (1)

	Typical New Plant Capacity (MW)		Number of New Power Plants to Meet Demand 2000	2010	2020
Coal Steam	428		0	43	51
Other Fossil Steam	428		0	0	0
Combined Cycle	400		12	265	522
Combustion Turbine/Diesel	160		32	587	883
Nuclear Power	600		0	0	0
Pumped Storage	135	(2)	0	0	0
Fuel Cells	10		0	15	29
Conventional Hydropower	24	(2)	0	25	25
Geothermal	50		1	29	31
Municipal Solid Waste	30		2	54	71
Wood and Other Biomass	100		0	5	9
Solar Thermal	100		0	1	1
Solar Photovoltaic	5		0	39	106
Wind	50		3	58	64
Total			51	1120	1791
Distributed Generation	160		0	37	79

Note(s): 1) Cumulative additions after December 31, 1999. 2) Based on current stock averaged capacity.

Source(s): EIA, AEO 2001, Dec. 2000, Table A9, p. 140-141 and Table A17, p. 149; EIA, Assumption to the AEO 2001, Dec. 2000, Table 43, p. 69; and EIA, Inventory of Electric Utility Power Plants in the U.S. 1999, Sept. 2000, Table 1, p. 9.

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

	Households (millions)	Percent Post-1990 Households (1)	Buildings (millions)	Floorspace (billion sf)	U.S. Population (millions)	Average Household Size (2)
1980	79.6	N/A	65.5	142.5	228	2.9
1990	94.2	N/A	74.2	169.2	250	2.7
1999	**104.1**	**16%**	**82.6 (3)**	**168.8 (3)**	**273**	**2.6**
2000	105.3	18%	N.A.	N.A.	275	2.6
2010	117.0	33%	N.A.	N.A.	300	2.6
2020	129.4	46%	N.A.	N.A.	325	2.5

Note(s): 1) Percent built after December 31, 1989. 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.

Source(s): DOC, Statistical Abstract of the U.S. 2000, Dec. 2000, No. 1207, p. 718 for number of households (1980/1990), No. 2-3, p. 7-8 for populations; EIA, AEO 2001, Dec. 2000, Table A4, p. 133-134 for households (1999-2020); EIA, NEMS for AEO 2001 (unpublished data) for 1990-2020 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; and EIA, RECS 1997 for 1997 buildings and floorspace.

2.1.2 Share of Households, by Housing Type, and by Type of Ownership as of 1997 (percent)

Housing Type	Owned	Rented	Total
Single-Family:	**60.3%**	**12.4%**	**72.7%**
-Detached	54.8%	8.0%	62.8%
-Attached	5.4%	4.4%	9.9%
Multi-Family:	**2.1%**	**19.0%**	**21.1%**
- 2 to 4 units	0.9%	4.6%	5.5%
- 5 or more units	1.2%	14.4%	15.6%
Mobile Homes	**5.2%**	**1.1%**	**6.3%**
	67.6%	32.5%	100%

Source(s): EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table HC1-2a, p. 35.

2.1.3 Share of Households, by Census Region and Vintage as of 1997 (percent)

Region	Prior to 1960	1970 to 1979	1980 to 1989	1990 to 1997	Total
Northeast	13.4%	2.6%	2.3%	1.2%	19.4%
Midwest	15.0%	3.9%	2.9%	2.0%	23.8%
South	15.0%	7.7%	8.1%	4.5%	35.3%
West	10.7%	5.0%	3.8%	1.9%	21.5%
					100%

Source(s): EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table HC1-2a, p. 34.

2.1.4 Residential Floorspace (heated square feet) as of 1997 (percent of total households)

Fewer than 600	8.5%
600 to 999	23.3%
1,000 to 1,599	32.9%
1,600 to 1,999	16.6%
2,000 to 2,399	8.5%
2,400 to 2,999	5.7%
3,000 or more	4.4%
	100%

Note(s): The 1997 average new single-family housing floorspace was 2,150 square feet.

Source(s): EIA, A Look at Residential Energy Consumption in 1997, Table HC1-2a, p. 34; DOC, Current Construction Reports: Characteristics of New Housing: 1997, C25/97-A, Table 16, p. 37 for average new square footage.

2.1.5 Housing Vintage as of 1997

Vintage	
1949 or Before	27.5%
1950 to 1959	12.3%
1960 to 1969	14.2%
1970 to 1979	19.3%
1980 to 1989	17.1%
1990 to 1997	9.6%
	100%

Source(s): EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table HC1-2a, p. 34.

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	208	1473
1982	632	N.A.	374	N.A.	234	1240
1983	924	N.A.	467	N.A.	278	1669
1984	1025	N.A.	627	N.A.	288	1940
1985	1073	N.A.	631	N.A.	283	1987
1986	1120	1825	636	911	256	2012
1987	1123	N.A.	546	N.A.	239	1908
1988	1085	1995	445	990	224	1754
1989	1026	2035	397	1000	203	1626
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	291	1638
1995	1066	2095	247	1080	319	1632
1996	1129	2120	284	1070	338	1751
1997	1116	2150	284	1095	336	1737
1998	1160	2190	315	1065	374	1848
1999	1307	2225	329	1105	311	1948
2000	1283	N.A.	326	N.A.	257	1866

Source(s): DOC, Current Construction Reports: Housing Completions - Annual Data, March 2001 for single- and multi-family home completions; DOC, Manufactured Housing Statistics: Manufactured Homes Placements by Region, 1980-1993, Nov. 2000; DOC, Manufactured Housing Statistics: Manufactured Homes Placements by Region, 1994-2000, Nov. 2000; NAHB, Housing Economics, March 1995 for 1981-1993 average floorspace; DOC, Current Construction Reports: Characteristics of New Housing, C25/98-A, Table 16, p. 37 and Table 18, p. 44 for 1994 floorspace; and DOC, Current Construction Reports: Characteristics of New Housing, C25/99-A, Table 16, p. 37 and Table 18, p. 44 for 1995-99 floorspace.

2.1.7 Materials Used in the Construction of a 2,085 Sq. Ft. New Single-Family Home, 1995

13,127 board-feet of lumber
6,212 square feet of sheathing
14 tons of concrete
2,325 square feet of exterior siding material
3,100 square feet of roofing material
3,061 square feet of insulation
6,144 square feet of interior wall material
2,100 square feet of interior ceiling material
120 linear feet of ducting
15 windows
5 exterior doors (4 hinged, 1 sliding)
2,085 square feet of flooring material
12 interior doors
7 closet doors
2 garage doors
1 fireplace
3 toilets; 2 bathtubs; 1 shower stall
3 bathroom sinks
13 kitchen cabinets; 2 other cabinets
1 kitchen sink
1 range; 1 refrigerator; 1 dishwasher; 1 garbage disposer; 1 range hood
1 washer; 1 dryer
1 heating and cooling system

Source(s): NAHB, 1997 Housing Facts, Figures and Trends, 1997, p. 8.

2.1.8 2000 New Homes Completed/Placed, by Census Region
(thousand units and percent of total units by housing type)

	Single-Family		Multi-Family (1)		Mobile Homes		
Region	Units	% of Total	Units	% of Total	Units	% of Total	Total
Northeast	126	10%	22	7%	13	5%	161
Midwest	277	22%	64	20%	44	17%	385
South	585	46%	164	50%	167	65%	916
West	294	23%	75	23%	33	13%	402
Total	1,282	100%	325	100%	257	100%	1,864

Source(s): DOC, Current Construction Reports: Housing Completions, C22/01-01, Table 2, p. 4 for single- and multi-family; and DOC, Manufactured Housing Statistics, Manufactured Homes Placements by Region and Size of Home, March 2001 for mobile home placements.

2.1.9 1999 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	106	9%	10	24%	3	9%	119
Midwest	255	21%	19	45%	9	26%	283
South	559	45%	10	24%	19	54%	587
West	310	25%	3	7%	4	11%	318
Total	1,231	100%	41	100%	35	100%	1,307

Source(s): DOC, Current Construction Reports: Characteristics of New Housing 1999, C25/99-A, Table 5, p. 10.

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

	Commercial Sector Floorspace (10^9 square feet)	Percent Post-1990 Floorspace (3)	Buildings (10^6)
1980	50.9 (2)	N.A.	3.1 (4)
1990	64.3	N.A.	4.5 (4)
1999 (5)	**62.8**	**16%**	**4.6 (6)**
2000 (5)	64.3	19%	N.A.
2010 (5)	75.8	42%	N.A.
2020 (5)	81.9	58%	N.A.

Note(s): 1) Excludes floorspace of industrial buildings (see Table 2.2.8). 2) Based on PNNL calculations. 3) Percent built after January 1, 1990. 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 1995. In 1995, commercial building floorspace = 58.8 billion square feet.

Source(s): EIA, AEO 1994, Jan. 1994, Table A5, p. 62 for 1990 floorspace; EIA, AEO 2001, Dec. 2000, Table A5, p. 135-136 for 1998-2020 floorspace; EIA, Commercial Building Characteristics 1989, June 1991, Table A4, p. 17 for 1990 number of buildings; EIA, Commercial Building Characteristics 1995, Oct. 1997, Table 1 for 1995 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 1995 (percent of total floor space) (1)

Mercantile and Service	22%	Public Assembly	7%	Food Sales	1%
Office	18%	Lodging	6%	Public Order/Safety	2%
Warehouse/Storage	14%	Health Care	4%	Vacant (2)	9%
Education	13%	Food Service	2%	Other (3)	2%
					100%

Note(s): 1) For primary energy intensities by building type, see Table 1.3.7. Total CBECS 1995 commercial building floorspace is 58.8 billion square feet. 2) Includes vacant (4%) and religious worship (5%). 3) Includes mixed uses, hangars, crematoriums, laboratories, and other.

Source(s): EIA, Commercial Building Characteristics 1995, Oct. 1997, Table 2.

2.2.3 Number of Floors and Type of Ownership as of 1995 (percent of total floorspace) (1)

Floors		Ownership	
One	42%	**Nongovernment Owned**	**79%**
Two	24%	Owner-Occupied	61%
Three	12%	Nonowner-Occupied	16%
Four to Nine	15%	Unoccupied	2%
Ten or More	7%	**Government Owned**	**21%**
	100%	Federal	3%
		State	4%
		Local	13%
			100%

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

Source(s): EIA, Commercial Building Characteristics 1995, Oct. 1997, Table 2 for floors and Table 17 for ownership

2.2.4 Share of Commercial Floorspace, by Census Region and Vintage as of 1995 (percent) (1)

Region	Prior to 1980	1980 to 1989	1990 to 1995	Total
Northeast	15%	4%	1%	20%
Midwest	19%	4%	2%	24%
South	23%	9%	3%	35%
West	14%	4%	2%	20%
				100%

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

Source(s): EIA, Commercial Building Characteristics 1995, Oct. 1997, Table 3.

2.2.5 Commercial Building Size as of 1995 (percent of total floorspace) (1)

Square Foot Range	Percent
1,001 to 5,000	10.8%
5,001 to 10,000	12.8%
10,001 to 25,000	19.8%
25,001 to 50,000	13.1%
50,001 to 100,000	13.6%
100,001 to 200,000	11.5%
200,001 to 500,000	9.4%
Over 500,000	9.0%
	100%

Note(s): 1) Excludes floorspace of industrial buildings.
Source(s): EIA, Commercial Building Characteristics 1995, Oct. 1997, Table 2.

2.2.6 Commercial Building Vintage (as of 1995) and Lifetimes (1)

	Percent of Total Floorspace	Median Lifetimes (2) Source	(years)
Prior to 1919	6.2%	EIA	59
1920 to 1959	27.2%	PNNL	90
1960 to 1979	37.8%		
1980 to 1989	20.8%		
1990 to 1995	7.9%		
	100%		

Note(s): 1) Excludes floorspace of industrial buildings. 2) One-half of buildings of a given vintage are retired (demolished) by the median lifetime.
Source(s): EIA, Commercial Building Characteristics 1995, Oct. 1997, Table 3 for vintages; EIA, Assumptions for the Annual Energy Outlook 2001, Dec. 2000, p. 28 for EIA building lifetime; and BNL, BTS Evaluation and Planning Report, Jun. 1994 p. 5-3 for PNNL lifetime.

2.2.7 1995 Average Commercial Building Floorspace, by Principal Building Type and Vintage (1)

	Average Floorspace/Building (1000 SF)		
Building Type	Pre-1990	1990-1995	All
Mercantile and Service	25.8	11.3	9.9
Office	15.1	12.9	14.9
Warehouse/Storage	16.5	6.7	14.6
Education	25.8	17.7	25.0
Public Assembly	N.A.	N.A.	12.1
Lodging	N.A.	N.A.	22.9
Health Care	N.A.	N.A.	22.2
Food Service	N.A.	N.A.	4.7
Food Sales	N.A.	N.A.	4.7
Public Order and Safety	N.A.	N.A.	14.6
Vacant (2)	N.A.	N.A.	18.5

Note(s): 1) Parking garages and commercial buildings on multibuilding manufacturing facilities are excluded from CBECS 1995. 2) Includes vacant and religious worship.
Source(s): EIA, Commercial Building Energy Consumption and Expenditures 1995, April 1998, Tables 3 and 8; and EIA, Commercial Buildings Characteristics 1995, Table A10, p. 70 for buildings.

2.2.8 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

Agency	1999 Percent of Total Floorspace
Defense	65.4%
Postal	10.7%
GSA	6.1%
VA	5.0%
DOE	2.6%
Other	10.2%
	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; and DOE/FEMP, Annual Report to Congress on FEMP, May 10, 2001, Table 7-A, p. 56 for FY 1985 and FY 1999 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 1980-Year	Total	Growth Rate 1980-Year	Buildings % of Total U.S.	Buildings % of Total Global	
1980	172.0	255.2	427.1	-	1281.7	-	33%	9%	
1990	149.9	312.0	461.9	0.8%	1348.0	0.5%	34%	8%	
1999 (2)	**156.4**	**374.6**	**531.1**	**1.2%**	**1510.8**	**0.9%**	**35%**	**9%**	
2000	160.0	384.2	544.3	1.2%	1535.4	0.9%	35%	9%	**(3)**
2010	178.5	472.7	651.2	1.4%	1809.1	1.2%	36%	8%	
2020	189.1	537.1	726.3	1.3%	2040.6	1.2%	36%	7%	

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 2001, Dec. 2000, Table A19, p. 151 by less than 1%. U.S. buildings approximately equal the carbon emissions of Japan and the United Kingdom combined. 3) Global emissions for 1999.

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. 1999, Oct. 2000, Tables 6-10, p. 26-28 for 1990 and; EIA, Assumptions to the AEO 2001, Dec. 2000, Table 2, p. 9 for fossil fuel carbon coefficients; EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for 1999 energy consumption and Table A19, p. 151 for 2000-2020 U.S. emissions; EIA, International Energy Outlook 2001, March 2001, Table A10, p. 185 for 1990-2020 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 1999 Buildings Energy End-Use Carbon Dioxide Splits, by Fuel Type (10^6 metric tons of carbon equivalent) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (4)	Total	Percent
Space Heating (4)	67.1	19.1	2.1	5.3	2.5	28.9	2.8	31.9	130.7	24.6%
Space Cooling	0.2							57.0	57.3	10.8%
Ventilation (5)								13.5	13.5	2.5%
Water Heating	27.6	4.3		1.8		6.2		28.3	62.1	11.7%
Lighting								77.1	77.1	14.5%
Refrigeration (6)								35.8	35.8	6.7%
Wet Clean (7)	1.0							13.1	14.1	2.7%
Cooking	5.7			0.5		0.5		11.8	18.0	3.4%
Electronics (8)								28.9	28.9	5.4%
Computers								8.3	8.3	1.6%
Other (9)	3.8	0.4		1.6	0.5	2.5		47.9	54.2	10.2%
Adjust to SEDS (10)	9.8	0.3				0.3		20.8	31.0	5.8%
Total	115.2	24.1	2.1	9.2	3.0	38.4	2.8	374.6	531.1	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 2001 and differ by as much as 3% from EIA, AEO 2001, Table A18. Buildings sector total varies by less than 0.5% from EIA, AEO 2001. 2) Includes kerosene space (2.5 MMTCE) heating and motor gasoline other uses (0.5 MMTCE). 3) Excludes electricity imports from utility consumption. 4) Includes residential furnace fans (3.7 MMTCE). 5) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 6) Includes refrigerators (21.0 MMTCE) and freezers (5.8 MMTCE). 7) Includes clothes washers (1.5 MMTCE), natural gas clothes dryers (1.0 MMTCE), electric clothes dryers (10.6 MMTCE), and dishwashers (1.0 MMTCE). Does not include water heating energy. 8) Includes color television (6.0 MMTCE) and other office equipment (22.9 MMTCE). 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills. Includes a minor amount of residential energy that is an adjustment to SEDS. This includes some energy attributable to the residential building sector, but not directly to specific end-uses. Includes commercial service station equipment, automated teller machines, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, and manufacturing in commercial buildings. 10) 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 2001, Dec. 2000, Table A2, p. 128-130, Table A4, p. 133-134 and Table A5, p. 135-136 for energy consumption, and Table A19, p. 151 for emissions; EIA, National Energy Modeling System for AEO 2001, Dec. 2000; EIA, Assumptions to the AEO 2001, Dec. 2000, p. 9 for emission coefficients; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses; and A.D. Little/BTS, Energy Consumption Characterisitics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2.

3.1.3 1999 Residential Energy End-Use Carbon Dioxide 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)	46.3	14.4	5.3	1.9	21.6	1.1	22.6	91.7	31.6%
Space Cooling	0.0						29.7	29.7	10.2%
Water Heating	18.2	2.6	1.8		4.4		21.2	43.8	15.1%
Lighting							17.5	17.5	6.0%
Refrigeration (4)							26.8	26.8	9.2%
Wet Clean (5)	1.0						13.1	14.1	4.9%
Cooking	2.7		0.5		0.5		10.2	13.5	4.6%
Electronics (6)							14.4	14.4	4.9%
Computers							3.2	3.2	1.1%
Other (7)	1.6	0.0	0.2		0.2		33.9	35.7	12.3%
Total	69.8	17.0	7.8	1.9	26.8	1.1	192.6	290.3	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 2001 and differ by as much as 3% from EIA, AEO 2001, Table A18. Sector total varies by less than 0.5% from EIA, AEO 2001. 2) Excludes electricity imports from utility consumption. 3) Includes residential furnace fans (3.7 MMTCE). 4) Includes refrigerators (21.0 MMTCE) and freezers (5.8 MMTCE). 5) Includes clothes washers (1.5 MMTCE), natural gas clothes dryers (1.0 MMTCE), electric clothes dryers (10.6 MMTCE), and dishwashers (1.0 MMTCE). Does not include water heating energy. 6) Includes color television (6.0 MMTCE) and other office equipment (8.3 MMTCE). 7) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills. Includes a minor amount of residential energy that is an adjustment to SEDS. This includes some energy attributable to the residential building sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2001, Dec. 2000, Table A2, p. 128-130, and Table A4, p. 133-134 for energy consumption, and Table A19, p. 151 for emissions; EIA, Assumptions to the AEO 2001, Dec. 2000, 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 1999 Commercial Energy End-Use Carbon Dioxide 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	20.8	4.6	2.1		0.6	7.3	1.7	9.3	39.0	16.2%
Space Cooling	0.2							27.4	27.6	11.5%
Ventilation								13.5	13.5	5.6%
Water Heating	9.5	1.7				1.7		7.1	18.3	7.6%
Lighting								59.6	59.6	24.8%
Refrigeration								9.0	9.0	3.7%
Cooking	3.0							1.6	4.5	1.9%
Electronics								14.6	14.6	6.0%
Computers								5.1	5.1	2.1%
Other (4)	2.2	0.4		1.4	0.5	2.3		14.1	18.5	7.7%
Adjust to SEDS (5)	9.8	0.3				0.3		20.8	31.0	12.9%
Total	45.4	7.1	2.1	1.4	1.1	11.6	1.7	182.1	240.8	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 2001 and differ by as much as 3% from EIA, AEO 2001, Table A18. Sector total varies by less than 0.5% from EIA, AEO 2001. 2) Includes kerosene space (0.6 MMTCE) heating and motor gasoline other uses (0.5 MMTCE). 3) Excludes electricity imports from utility consumption. 4) Includes service station equipment, automated teller machines, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, and manufacturing in commercial buildings. 5) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2001, Dec. 2000, Table A2, p. 128-130, and Table A5, p. 135-136 for energy consumption, and Table A19, p. 151 for emissions; EIA, National Energy Modeling System for AEO 2001, Dec. 2000; EIA, Assumptions to the AEO 2001, Dec. 2000, p. 9 for emissions coefficients; and A.D. Little/BTS, Energy Consumption Characterisitics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2.

3.1.5 World Carbon Dioxide Emissions (1)

	Emissions (10^6 metric tons of carbon)				Annual Growth Rate	
Nation/Region	1990	1999		2010	1990-1999	1999-2010
United States	1,345	1,511	24.8%	1,809	1.3%	1.6%
Western Europe	930	940	15.4%	1,040	0.1%	0.9%
Former Soviet Union	1,036	607	10.0%	712	-5.8%	1.5%
Other Asia	372	565	9.3%	785	4.8%	3.0%
China	617	669	11.0%	1,131	0.9%	4.9%
Japan	269	307	5.0%	330	1.5%	0.7%
Central & S. America	178	249	4.1%	394	3.8%	4.3%
Middle East	231	330	5.4%	451	4.0%	2.9%
Canada	126	150	2.5%	165	2.0%	0.9%
India	153	242	4.0%	351	5.2%	3.4%
Africa	179	218	3.6%	294	2.2%	2.8%
Eastern Europe	301	203	3.3%	227	-4.3%	1.0%
Mexico	84	101	1.7%	145	2.1%	3.3%
World Total	5,821	6,091	100%	7,835	0.5%	2.3%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. See Table 1.1.6 for Energy and Population.

Source(s): EIA, International Energy Outlook 2001, March 2001, Table A10, p. 185; and EIA, AEO 2001, Dec. 1999, Table A19, p. 151 for Note 1.

3.1.6 1999 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	0.2	0.1	0.3
Natural Gas	7.6	5.0	12.6
Coal	0.0	0.1	0.1
Wood	2.0	0.0	2.0
Electricity (2)	7.2	6.8	14.0
Total	17.1	11.9	29.0

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 21 times that of carbon dioxide) and carbon dioxide to carbon. 2) Emissions of electricity generators attributable to the buildings sector.

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 1999, Oct. 2000, Table 14, p. 39 for energy production emissions, and Table 18, p. 42 for stationary combustion emissions; and EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for energy consumption.

3.1.7 1999 Carbon Dioxide Emission Coefficients for Buildings (10^6 metric tons of carbon per quad) (1)

	All Buildings	Residential Buildings	Commercial Buildings
Coal			
Average	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	19.17	-	-
Liquefied Petroleum Gas	17.09	-	-
Residual Fuel Oil	21.28	-	-
Average (2)	19.09	18.88	19.60
Electricity Consumption (3)			
Average - Primary (4)	15.70	15.70	15.70
Average - *Site* (5)	49.74	49.74	49.74
New Generation			
Gas Combined Cycle - *Site* (6)	33.14	33.14	33.14
Gas Combustion Turbine - *Site* (6)	49.51	49.51	49.51
Stock Gas Generator - *Site* (7)	43.80	43.80	43.80
All Fuels (3)			
Average - Primary	15.42	15.22	15.66
Average - *Site*	29.33	27.27	32.06

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 2001 and were adjusted using Assumptions to the AEO 2001. 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 (2001) 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, Emissions of Greenhouse Gases in the U.S. 1999, Oct. 2000, Table B1, www.eia.doe.gov for fossil fuel carbon emission coefficients; EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130, Table A8, p. 139, Table A18, p. 150 for consumption and Table A19, p. 151 for emissions; EIA, Assumptions to the AEO 2001, Dec. 2000, Table 2, p. 9 for selected coefficients and Table 43, p. 69 for generator efficiencies; EIA, AER 1999, Diagram 5, p. 209 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	1320	1.00	Blowing Agent, Chillers
CFC-12 (1)	6650	1.00	Auto A/C, Chillers, & Blowing Agent
CFC-113	9300	0.80	Solvent
CFC-114	9300	1.00	Solvent
CFC-115 (2)	9300	0.60	Solvent, Refrigerant
Hydrochlorofluorocarbons			
HCFC-22 (2)	1350	0.06	Residential A/C
HCFC-123	93	0.02	Refrigerant
HCFC-124	480	0.02	Sterilant
HCFC-141b	270	0.11	CFC Replacement
HCFC-142b	1650	0.07	CFC Replacement
Bromofluorocarbons			
Halon-1211	N.A.	3.00	Fire Extinguishers
Halon-1301	-31400	10.00	Fire Extinguishers
Hydrofluorocarbons			
HFC-23	11700	0.00	HCFC Byproduct
HFC-125	2800	0.00	CFC/HCFC replacement
HFC-134a	1300	0.00	Auto A/C, Refrigeration
HFC-152a (1)	140	0.00	Aerosol Propellant
HFC-227ea	2900	0.00	CFC Replacement

Note(s): 1) R-500: 74% CFC-12 and 26% HFC-152a. 2) R-502: 49% HCFC-22 and 51% CFC-115.

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 1995, Oct. 1996, Table 31, p. 53 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 (2)	452	3,324	3,776	49%
2002 (2)	372	3,433	3,805	54%
2003 (2)	312	3,558	3,870	59%
Total	9,073	38,042	47,115	

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, 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 8, 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, 1987-1999 (10^6 metric tons of carbon equivalent)

Gas	1987	1990	1995	1998	1999 (1)
Chlorofluorocarbons					
CFC-11	93	58	39	27	26
CFC-12	255	261	120	49	32
CFC-113	113	36	12	0	0
CFC-114	N.A.	12	4	0	N.A.
CFC-115	N.A.	11	8	7	N.A.
Bromofluorocarbons					
Halon-1211	N.A.	0	0	0	N.A.
Halon-1301	N.A.	3	3	3	N.A.
Hydrochlorofluorocarbons					
HCFC-22	32	37	34	35	34
HCFC-123	N.A.	0	0	0	N.A.
HCFC-124	0	0	1	1	N.A.
HCFC-141b	N.A.	0	4	5	6
HCFC-142b	N.A.	0	4	5	6
Hydrofluorocarbons					
HFC-23	13	10	7	11	8
HFC-125	N.A.	0	0	1	1
HFC-134a	N.A.	0	5	10	11
Cumulative	505	428	241	153	124

Note(s): 1) Preliminary.

Source(s): EPA, Ozone-Depleting Substances, Nov. 2000, www.epa.gov/ozone for GWPs; EIA, Emissions of Greenhouse Gases in the U.S. 1999, Oct. 2000, Table D-2, www.eia.doe.gov for 1999 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; EIA, Emissions of Greenhouse Gases in the U.S. 1998, Oct. 1999, Table 28, p. 59 for 1990-1998; and EIA, Emissions of Greenhouse Gases in the U.S. 1985-1994, Oct. 1995, Table 34, p. 54 for 1987.

3.3.1 1999 EPA Emission Summary Table for U.S Buildings Energy Consumption (thousand short tons) (1)

	Buildings				Buildings Percent
	Wood/*Site* Fossil	Electricity	Total	U.S. Total	of U.S. Total
SO2	588	8,551 (2)	9,139	18,867	48%
NOx	1,175	3,849	5,024	25,393	20%
CO	4,606	300	4,906	97,441	5%
VOCs	670	38	708	18,145	4%
PM-2.5	487	86	573	6,773	8%
PM-10	568	152	720	23,679	3%
Lead	412	48	460	4,199	11%

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 17% lower for 1999 than 1994 estimates since Phase I of the 1990 Clean Air Act Amendments began in 1995.

Source(s): EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130; and EPA/OAQPS, 1999 All Criteria Pollutants Average Annual Emissions, June 2001.

3.3.2 1999 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	1.125	(2)	0.069	(2)	0.355
NOx	0.506	0.089	0.123	(2)	0.160
CO	0.039	(2)	(2)	(2)	0.012

Commercial

	Electricity (1)	Gas	Oil(3)	Coal	Electricity (per primary quad) (1)
SO2	1.125	(2)	0.414	(2)	0.355
NOx	0.506	0.084	0.135	(2)	0.160
CO	0.039	(2)	(2)	(2)	0.012

All Buildings

	Electricity (1)	Gas	Oil(3)	Coal	Electricity (per primary quad) (1)
SO2	1.125	(2)	0.171	(2)	0.355
NOx	0.506	0.087	0.127	(2)	0.160
CO	0.039	(2)	(2)	(2)	0.012

Note(s): 1) Emissions of SO2 are 17% lower for 1999 than 1994 estimates since Phase I of the 1990 Clean Air Act Amendments began in 1995. 2) Data not available, significant enough, or reliable. 3) Oil includes distillate and residual fuel oils, LPG, motor gasoline, and kerosene.

Source(s): EPA/OAQPS, 1999 All Criteria Pollutants Average Annual Emissions, June 2001 for emissions; and EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 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 ($1999/10^6 Btu) (1)

	Residential Buildings				Commercial Buildings				Buildings
	Electricity	Natural Gas	Petroleum (2)	Avg	Electricity	Natural Gas	Petroleum (2)	Avg	Average (3)
1980	28.81	6.60	13.31	13.91	29.45	6.09	10.34	14.62	14.19
1990	27.76	6.81	10.75	14.76	25.64	5.68	7.15	14.72	14.74
1999	**23.60 (4)**	**6.52**	**7.55 (5)**	**13.22**	**21.54 (6)**	**5.34**	**5.00 (7)**	**13.35**	**13.28**
2000	23.62	7.19	10.30	13.89	22.22	5.70	7.23	14.00	13.94
2010	21.88	6.53	9.37	13.21	17.63	5.50	6.17	11.83	12.60
2020	22.17	6.55	9.64	13.64	18.12	5.71	6.50	12.45	13.12

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 1999, Buildings average electricity price was $22.60/10^6 Btu (or $0.077/kWh), average natural gas price was $6.05/10^6 Btu ($6.22/1000 CF), and petroleum was $6.80/10^6 Btu (81.2¢/gal.). Averages do not include wood or coal prices. 4) Equals $0.081/kWh. 5) Distillate fuel: 87.0¢/gal., LPG: $0.81/gal., kerosene: $0.852/gal. 6) Equals $0.073/kWh. 7) Distillate fuel: 60.6¢/gal., residual fuel: 39.3¢/gal., LPG: 89.4¢/gal., kerosene: 83.6¢/gal., motor gasoline: $1.24/gal.

Source(s): EIA, State Energy Price and Expenditures Report 1997, July 2000, p. 14-15 for 1980, 1990 and prices for note; EIA, State Energy Data Report 1999, May 2001, Tables 12-13, p. 22-23; EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130, Table A3, p. 131-132, Table A12, p. 144, and Table A14, p. 146 for 1999-2020 consumption and prices; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price deflators.

4.1.2 Buildings Aggregate Energy Expenditures, by Year and Major Fuel Type ($1999 billion) (1)

	Residential Buildings				Commercial Buildings				Total Building
	Electricity	Natural Gas	Petroleum (2)	Total	Electricity	Natural Gas	Petroleum (2)	Total	Expenditures
1980	70.5	32.1	23.3	125.9	56.1	16.2	13.3	85.7	211.6
1990	87.5	30.8	13.5	131.8	73.3	15.3	6.5	95.1	226.9
1999	**92.2**	**31.6**	**10.8**	**134.6**	**79.6**	**16.9**	**3.2**	**99.6**	**234.2**
2000	93.4	35.7	14.8	144.0	84.1	18.6	4.3	107.0	251.0
2010	108.6	37.2	12.1	157.9	86.1	21.4	4.1	111.6	269.5
2020	128.7	41.3	11.7	181.6	101.6	23.6	4.3	129.4	311.0

Note(s): 1) Excludes expenditures from buildings-related energy consumption in the industrial sector. Expenditures exclude wood and coal costs. 1999 U.S. energy expenditures were $581.1 billion. 2) Petroleum products include distillate fuel oil, residual fuel oil, LPG, kerosene, and motor gasoline.

Source(s): EIA, State Energy Price and Expenditures Report 1997, July 2000, p. 14-15 for 1980 and 1990; EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 and Table A3, p. 1131-132 for 1999-2020; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price deflators.

4.1.3 FY 1999 Federal Buildings Energy Prices and Expenditures, by Fuel Type ($1999)

Fuel Type	Average Fuel Prices ($/million Btu)		Total Expenditures ($million) (2)
Electricity	17.13 (1)		2,496.9
Natural Gas	3.89		463.0
Fuel Oil	5.01		172.8
Coal	2.07		37.2
Purchased Steam	13.52		213.2
LPG/Propane	8.55		19.0
Other	5.67		8.6
Average	10.12	Total	3,410.8

Note(s): 1) $0.058/kWh. 2) Energy used in buildings FY 99 accounted for 42.9% of the total Federal energy bill.

Source(s): DOE, Annual Report to Congress on FEMP, May 10, 2001, p. 50 for buildings expenditures, and p. 14 for Federal energy expenditures.

4.1.4 1999 Buildings Energy End-Use Expenditure Splits, by Fuel Type ($1999 billion) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity	Total	Percent
Space Heating (3)	28.7	5.6	0.3	3.2	0.8	9.9	0.2	15.0	53.8	22.9%
Space Cooling	0.1							26.5	26.6	11.3%
Ventilation (4)								5.9	5.9	2.5%
Water Heating (5)	11.7	1.2		1.1		2.3		13.3	27.3	11.7%
Lighting								34.5	34.5	14.7%
Refrigeration (6)								16.8	16.8	7.2%
Wet Clean (7)	0.4							6.3	6.7	2.9%
Cooking	2.3			0.3		0.3		5.6	8.2	3.5%
Electronics (8)								13.2	13.2	5.6%
Computers								3.8	3.8	1.6%
Other (9)	1.5	0.1		1.0	0.3	1.3		22.4	25.3	10.8%
Adjust to SEDS (10)	3.6	0.1				0.1		8.6	12.4	5.3%
Total	48.4	7.0	0.3	5.6	1.1	13.9	0.2	171.8	234.4	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 ($0.3 billion). 3) Includes furnace fans ($1.8 billion). 4) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 5) Includes residential recreation water heating ($0.9 billion). 6) Includes refrigerators ($10.1 billion) and freezers ($2.8 billion). 7) Includes clothes washers ($0.7 billion), natural gas clothes dryers ($0.4 billion), electric clothes dryers ($5.1 billion), and dishwashers ($0.5 billion). 8) Includes color televisions ($2.9 billion) and other electronics ($10.4 billion). 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes a minor amount of residential energy that is an adjustment to SEDS. This includes some energy attributable to the residential buildings sector, but not directly to specific end-uses. Includes commercial service station equipment, automated teller machines, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, manufacturing performed in commercial buildings. 10) 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 2001, Dec. 2000, Table A2, p. 128-130, Table A3, p. 131-132 for prices, Table A4, p. 133-134 for residential energy consumption, and Table A5, p. 135-136 for commercial energy consumption; EIA, National Energy Modeling System for AEO 2001, Dec. 2000; EIA, State Energy Price and Expenditure Report 1997, July 2000, p. 14-15 for coal and minor petroleum prices; EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 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; and 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 for commercial ventilation.

4.1.5 Implicit Price Deflators (1996 = 1.00)

Year	Implicit Price Deflator	Year	Implicit Price Deflator
1980	0.57	1990	0.87
1981	0.62	1991	0.90
1982	0.66	1992	0.92
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 1999, July 2000, Appendix E, p. 347.

4.2.1 1999 Residential Energy End-Use Expenditure Splits, by Fuel Type ($1999 billion) (1)

	Natural Gas	Petroleum				Coal	Electricity	Total	Percent
		Distil.	LPG	Kerosene	Total				
Space Heating (2)	21.0	4.6	3.2	0.6	8.4	0.1	10.8	40.3	29.9%
Space Cooling (3)	0.0						14.2	14.2	10.5%
Water Heating (4)	8.2	0.8	1.1		1.9		10.2	20.3	15.1%
Lighting							8.4	8.4	6.2%
Refrigeration (5)							12.9	12.9	9.5%
Wet Clean (6)	0.4						6.3	6.7	5.0%
Cooking	1.2		0.3		0.3		4.9	6.4	4.8%
Electronics (7)							6.9	6.9	5.1%
Computers							1.5	1.5	1.1%
Other (8)	0.7	0.0	0.1		0.1		16.2	17.1	12.7%
Total	31.6	5.4	4.8	0.6	10.8	0.1	92.2	134.7	100%

Note(s): 1) Expenditures include coal and exclude wood (unlike Table 4.1.2). 2) Includes furnace fans ($1.8 billion). 3) Fan energy use included. 4) Includes residential recreation water heating ($0.9 billion). 5) Includes refrigerators ($10.1 billion) and freezers ($2.8 billion). 6) Includes clothes washers ($0.7 billion), natural gas clothes dryers ($0.4 billion), electric clothes dryers ($5.1 billion), and dishwashers ($0.5 billion). 7) Includes color televisions ($2.9 billion) and other electronics ($4.0 billion). 8) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes a minor amount of residential energy that is an adjustment to SEDS. This includes some energy attributable to the residential buildings, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2001, Dec. 2000, Table A2, p. 128-130, Table A3, p. 131-132 for prices, and Table A4, p. 133-134 for residential energy; EIA, State Energy Price and Expenditure Report 1997, July 2000, p. 14-15 for coal and minor petroleum prices; EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 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 ($1999)

1980	1,581
1990	1,399
1999	**1,293**
2000	1,368
2010	1,350
2020	1,404

Source(s): EIA, State Energy Price and Expenditures Report 1997, July 2000, p. 14 for 1980 and 1990; EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130, Table A4, p. 133-134 for consumption, Table A3, p. 131-132 for prices 1999-2020; EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price deflators; and DOC, Statistical Abstract of the United States 2000, Dec. 2000, Table No. 1207, p. 718 for 1980 and 1990 occupied units.

4.2.3 1997 Energy Expenditures per Household, by Housing Type and Square Footage ($1999)

	Per Household	Per Square Foot
Single Family	**1,532**	**0.79**
-Detached	1,570	0.78
-Attached	1,289	0.88
Multi-Family	**870**	**0.98**
Mobile Home	**1,238**	**1.24**

Source(s): Data taken originally from EIA, 1997 Residential Energy Consumption Survey, 2000; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price inflators.

4.2.4 1997 Energy Expenditures per Household, by Census Region ($1999)

Northeast	1,688
Midwest	1,433
South	1,363
West	1,040

Source(s): Data taken originally from EIA, 1997 Residential Energy Consumption Survey, 2000; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price inflators.

4.2.5 1997 Household Energy Expenditures, by Vintage ($1999)

Year	Per Household	Per Square Foot	Per Household Member	Percent of Residential Sector Expenditures
Prior to 1980	1,378	0.87	540	74%
1980 to 1986	1,284	0.78	509	11%
1987 to 1989	1,460	0.75	525	5%
1990 to 1995	1,422	0.69	508	9%
1996 to 1997	1,295	0.61	416	1%
				100%
Average	1,374	0.80	531	

Source(s): Data taken originally from EIA, 1997 Residential Energy Consumption Survey, 2000; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price inflators.

4.2.6 1997 Households and Energy Expenditures, by Income Level ($1997)

	Households		Energy Expenditures by		Percent of Income for
Family Income/Year	Number(10^6)	Percent	Household	Household Member	Energy Expenditures (1)
Less than $5,000	3.8	4%	1,028	456	32.5%
$5,000 to $7,499	5.1	5%	942	527	14.9%
$7,500 to $9,999	4.5	4%	1,034	499	11.7%
$10,000 to $14,999	10.3	10%	1,063	462	8.5%
$15,000 to $19,999	10.4	10%	1,182	484	6.7%
$20,000 to $24,999	8.4	8%	1,233	520	5.5%
$25,000 to $34,999	15.6	15%	1,276	493	4.3%
$35,000 to $49,999	15.5	15%	1,394	512	3.3%
$50,000 or $74,999	16.4	16%	1,599	543	2.6%
$75,000 or More	11.5	11%	1,835	592	1.7%
Total	101.5	100%			3.5%

Note(s): 1) See Tables 4.2.7 and 7.1.10 for more on energy burdens.
Source(s): Data taken originally from EIA, 1997 Residential Energy Consumption Survey, 2000.

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 1998 (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%	6.3%	3.9%	2.6%
Federally Eligible	13.0%	14.4%	N.A.	10.1%	12.5%	8.3%	8.4%
Federally Ineligible	4.0%	3.5%	N.A.	N.A.	3.2%	2.8%	2.1%
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 1997, adjusted to reflect FY 1998, HDD, CDD, and fuel prices.

Source(s): HHS, LIHEAP Home Energy Notebook FY 1998, Oct. 2000, Tables A-2a to A-2c, p. 50-52 for FY1998 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 1999 Housing Sales Prices ($1999)

Housing Type	Median Sales Price	
New Single-Family	159,800	
Existing Single-Family	133,300	
New Mobile Homes	43,800	(1)

Note(s): 1) Average sales price. Excludes land costs.

Source(s): DOC, Statistical Abstract of the United States 2000, Dec. 2000, Tables 1199-1201, p. 715-716.

4.2.9 1998 Cost Breakdown of a 2,150 Square Foot, New Single-Family Home ($1999) (1)

	Cost	Percent
Finished Lot	54,295	24%
Construction Cost		
Inspection/Fees	3,548	2%
Shell/Frame		
Framing	25,983	11%
Windows/Doors	8,630	4%
Exterior Finish	9,497	4%
Foundation	13,552	6%
Wall/Finish Trim	23,702	10%
Flooring	6,058	3%
Equipment		
Plumbing	7,424	3%
Electrical Wiring	4,737	2%
Lighting Fixtures	1,311	1%
HVAC	5,184	2%
Appliances	1,819	1%
Property Features	14,759	6%
Financing	4,328	2%
Overhead & General Expenses	13,143	6%
Marketing	3,226	1%
Sales Commission	7,761	3%
Profit	21,140	9%
Total	230,097	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 1999, July 2000, Appendix E, p. 347 for price inflators.

4.3.1 1999 Commercial Energy End-Use Expenditure Splits, by Fuel Type ($1999 billion) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity	Total	Percent
Space Heating	7.7	1.0	0.3		0.2	1.5	0.1	4.2	13.5	13.5%
Space Cooling	0.1							12.3	12.4	12.4%
Ventilation								5.9	5.9	5.9%
Water Heating	3.5	0.4				0.4		3.1	7.0	7.0%
Lighting								26.1	26.1	26.1%
Refrigeration								3.9	3.9	3.9%
Cooking	1.1					0.0		0.7	1.8	1.8%
Electronics								6.4	6.4	6.4%
Computers								2.2	2.2	2.3%
Other (3)	0.8	0.1		0.9	0.3	1.2		6.2	8.2	8.2%
Adjust to SEDS (4)	3.6	0.1				0.1		8.6	12.4	12.4%
Total	16.9	1.6	0.3	0.9	0.5	3.2	0.1	79.6	99.7	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 ($0.2 billion) and motor gasoline other uses ($0.3 billion). 3) Includes service station equipment, automated teller machines, medical equipment, telecommunications equipment, pumps, lighting, emergency electric generators, manufacturing performed in commercial buildings. 4) 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 2001, Dec. 2000, Table A2, p. 128-130, Table A3, p. 131-132 for prices, and Table A5, p. 135-136 for commercial energy consumption; EIA, National Energy Modeling System for AEO 2001, Dec. 2000; EIA, State Energy Price and Expenditure Report 1997, July 2000, p. 14-15 for coal and minor petroleum prices; EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price deflators; and 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 for commercial ventilation.

4.3.2 Average Annual Energy Expenditures per Square Foot of Commercial Floorspace, by Year ($1999)

1980	1.68
1990	1.48
1999	**1.58**
2000	1.66
2010	1.47
2020	1.58

Source(s): EIA, State Energy Price and Expenditures Report 1997, July 2000, p. 15 for 1980 and 1990; EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 and Table A5, p. 135-136 for consumption, Table A3, p. 131-132 for prices for 1999-2020; EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price deflators; EIA, AEO 1994, Jan. 1994, Table A5, p. 62 for 1990 floorspace; and PNNL for 1980 floorspace.

4.3.3 1995 Energy Expenditures per Square Foot of Commercial Floorspace and per Building, by Building Type ($1999)

	per Square Foot	per Building (10^3)		per Square Foot	per Building (10^3)
Food Sales	4.38	20.6	Public Order and Safety	1.30	19.0
Food Service	3.80	18.0	Mercantile and Service	1.17	11.6
Health Care	2.41	53.4	Education	0.98	24.6
Office	1.61	24.0	Warehouse and Storage	0.60	8.6
Lodging	1.50	34.4	Vacant (1)	0.41	4.0
Public Assembly	1.34	16.3			

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

Source(s): EIA, Commercial Buildings Energy Consumption and Expenditures 1995, Apr. 1998, Table 4; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price deflators.

4.3.4 1995 Energy Expenditures per Square Foot of Commercial Floorspace, by Vintage ($1999)

Prior to 1980	1.21
1980 to 1989	1.39
1990 to 1995	1.54
Average	1.27

Source(s): EIA, Commercial Buildings Energy Consumption and Expenditures 1995, Apr. 1998, Table 4; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price inflators.

4.4.1 Annual Energy Expenditures per Gross Square Foot of Federal Floorspace Stock, by Year ($1999)

FY 1985	1.66
FY 1999	1.11

Note(s): Total Federal buildings and facilities energy expenditures in FY 1999 were $3.41 billion (in $1999).
Source(s): DOE/FEMP, Annual Report to Congress on FEMP, May 10, 2001, Table 6-B, p. 50 for energy costs and Table 7-A, p. 53 for floorspace.

4.4.2 Expenditures on Federal Buildings Energy Conservation and Capital Equipment ($1999 million)

FY 1985	40.0	FY 1990	71.2	FY 1995	305.8	FY 2000 (1)	120.0
FY 1986	290.2	FY 1991	132.3	FY 1996	186.7		
FY 1987	83.4	FY 1992	164.9	FY 1997	205.4		
FY 1988	85.0	FY 1993	133.7	FY 1998	264.7		
FY 1989	65.1	FY 1994	249.4	FY 1999	205.2		

Note(s): 1) Projected.
Source(s): DOE/FEMP, Annual Report to Congress on FEMP, May 10, 2001, Table 3-B, p. 28.

4.5.1 Estimated Value of All U.S. Construction Relative to the GDP ($1999)

- 1999 estimated value of all U.S. construction is $1,230 billion (including renovation; heavy construction; public works; residential, commercial, and industrial new construction; and non-contract work).
- Compared to the $9.3 trillion U.S. gross domestic product (GDP), all construction holds a 13.2% share.
- In 1999, residential and commercial building renovation (valued at $254 billion) and new building construction (valued at $528 billion) is estimated to account for just over 70% (or around $869 billion, including an additional $87 billion for non-contract work) of the $1,230 billion.

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, U.S. Industry and Trade Outlook 1998, 1998, Table 6-6, p. 6-9 for commercial renovation; DOC, Current Construction Reports: Expenditures for Residential Improvements and Repairs, C50, Dec. 2000, Table 2, p. 4 for residential renovation; DOC, Current Construction Reports: Value of Construction Put in Place, C30, Jan. 2001, Table 1, p. 3 for new construction; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price deflators.

4.5.2 Value of New Building Construction Relative to GDP, by Year ($1999 billion)

	Value of New Construction Put in Place				Bldgs. Percent of
	Residential	Commercial (1)	All Bldgs. (1)	GDP	Total U.S. GDP
1980	131.3	126.5	257.8	5,127	5.0%
1985	166.9	178.8	345.7	5,981	5.8%
1990	159.4	179.3	338.6	7,017	4.8%
1995	187.8	164.3	352.1	7,892	4.5%
1999	255.2	232.0	487.2	9,256	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, Feb. 1996, Table 1, p. 7-9 for 1980-1990; DOC, Current Construction Reports: Value of Construction Put in Place, C30, Feb. 2000, Table 1, p. 3 for 1995; DOC, Current Construction Reports: Value Put in Place, C30, Jan. 2000, Table 1, p. 3 for 1999; and EIA, Annual Energy Review 1998, July 1999, Appendix E, p. 337 for GDP and price deflators.

4.5.3 Value of Building Improvements and Repairs Relative to GDP, by Year ($1999 billion) (1)

	Value of Improvements and Repairs				Bldgs. Percent of
	Residential	Commercial	All Bldgs.	GDP	Total U.S. GDP
1980	84.9	N.A.	N.A.	5,127	N.A.
1985	114.0	110.8 (2)	224.8	5,981	3.8%
1990	129.5	112.3 (3)	241.8	7,017	3.4%
1995	127.2	110.6	237.8	7,892	3.0%
1999	142.9	110.7 (4)	253.6	9,256	2.7%

Note(s): 1) Improvements includes additions, alterations, reconstruction, and major replacements. Repairs include maintenance. 2) 1986. 3) 1989. 4) 1997.

Source(s): NAHB, 1997 Housing Facts, Figures and Trends, 1997, p.33 for residential 1980-1985; DOC, Current Construction Reports: Expenditures for Residential Improvements and Repairs, C50, Feb. 1998, Table 1, p. 3 for 1990; DOC, Current Construction Reports: Expenditures for Residential Improvements and Repairs, C50, July 1999, Table 2, p. 4 for 1995; DOC, Current Construction Reports: Expenditures for Residential Improvements and Repairs, C50, Dec. 2000, Table 2, p. 4 for 1998; DOC, Current Construction Reports: Expenditures for Nonresidential Improvements and Repairs: 1992, CSS/92, Sept. 1994, Table A, p. 2 for 1986-1990 expenditures; DOC, U.S. Industry and Trade Outlook 1998, Table 6-6, p. 6-9 for 1995-1997 commercial; and EIA, Annual Energy Review 1998, July 1999, Appendix E, p. 337 for GDP and price deflators.

4.5.4 1994 U.S. Private Investment into Construction R&D

Sector	Percent of Sales
Average Construction R&D (1)	**< 0.5**
Housing (materials and components)	1.7
Construction materials	1.0
Construction machinery	3.0
U.S. Industry Average (2)	**3.5**
International Industry Composite (3)	**4.3**

Note(s): 1) Includes all construction (e.g., bridges, roads, dams, buildings, etc.). 2) Japan's industry average was 2.7% in 1995. 3) For 1991; U.S. industry average was 3.6% in 1991.

Source(s): Business Week, Blue-Sky Research Comes Down to Earth, July 3, 1995, p. 78 for the Housing and Industry values; Business Week, R&D Scoreboard, July 3, 1995, p. 1 for U.S. industry average; Business Week, R&D Scoreboard, June 29, 1992, p. 106 for international composite; Government of Japan, Statistics Bureau, Management and Coordination Agency, Quick Report on the Survey of Research and Development, p. 28 for 1995 Japanese industry average; and The Civil Engineering Research Foundation, 1994 for remaining values.

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
1999 (4)	194	4835	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. 2000, Dec. 2000, Table 669, p. 416 for architect employment, Table 684, p. 428-430; 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	1999
Air Conditioning and Refrigeration Equipment (incl. warm-air furnaces): SIC 3585					
- Total Employment	118.4	122.8	126.9	136.3	140.2
- Production Workers	81.6	87.2	92.4	102.4	105.5
Plumbing, Heating, and Air-Conditioning Contractors: SIC 171					
- Total Employment	532.8	605.1	649.2	736.5	865.0
- Construction Workers	400.4	447.3	476.7	542.4	637.4
Wholesalers of Hardware, Plumbing and Heating Equipment: SIC 507					
- Total Employment	242.7	254.1	283.8	288.2	307.3

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.

5.1.1 1999 Five Largest Residential Homebuilders

Homebuilder	Number of Home Closings (1)	Gross Revenue ($million)	Market Share of Total New Home Closings (%) (2)
Pulte Corporation	27,781	4,309	1.73%
Kaufman and Broad Home Corp.	22,847	3,930	1.42%
Lennar Corporation	22,560	5,535	1.40%
Centex Corporation	21,767	6,387	1.35%
D.R. Horton	18,942	3,732	1.18%
Total of Top Five	113,897	23,893	7.08%
Habitat for Humanity (3)	3,641	N.A.	0.23%

Note(s): 1) 2000 total U.S. new home closings were 1.61 million (includes single-family and multi-family). 2) Total share of closings of top 100 builders was 20.0%. The top 400 builders accounted for 42% of 1996 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 1900 worldwide affiliates completed 17,208 homes in FY 2000.

Source(s): Builder Magazine, May 2001, www.builderonline.com; NREL for top 400 portion of Note 3; and NAHB, 1997 Housing Facts, Figures and Trends, 1997, p. 35 for NAHB portion of Note 3; and DOC, Current Construction Reports: Housing Completions, Jan. 2001, C22/01-01, Table 1, p. 3 for total closings.

5.1.2 Value of New Building Construction, by Year ($1999 billion)

	Residential	Commercial	All Bldgs.
1980	131.3	126.5	257.8
1985	166.9	178.8	345.7
1990	159.4	179.3	338.6
1995	187.8	164.3	352.1
1999 (1)	255.2	232.0	487.2
2000	264.9	257.4	522.3

Note(s): 1) In 1999, new Buildings construction accounted for 5.3% of the $9.3 trillion U.S. GDP. Refer to Chapter 2 for more new building statistics.

Source(s): DOC, Current Construction Reports: Value of New Construction Put in Place, C30, Feb. 1996, Table 1 p. 7-9 for 1980-1990; DOC, Current Construction Reports: Value of New Construction Put in Place, C30, Feb. 2000, Table 1, p. 3 for 1995; DOC, Current Construction Reports: Value of New Construction Put in Place, C30, Dec. 2000, Table 1, p. 3 for 1999 and Note 1; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price deflators.

5.2.1 Industrialized Housing Production versus Stick-Built, by Year (1000 units)

Year	Panelized Units (1)	Modular Units	HUD-Code Units (mobile homes) (2)	Production Units (stick-built)	Total	
1981	315	52	241	810	1,418	
1985	540	77	283	909	1,809	
1990	494	79	195	662	1,436	
1991	450	74	171	503	1,198	
1992	504	84	206	528	1,318	
1993	548	91	233	559	1,431	
1994	625	109	304	632	1,670	
1995	679	109	340	627	1,755	
1996	740	112	390	696	1,918	
1997	762	124	353	698	1,937	
1998	793	140	373	792	2,098	
1999	801	163	348	889	2,201	(3)
2000	841	148	268	960	2,217	

Note(s): 1) Includes pre-cut homes (e.g., log cabins). 2) Statistics completed by the National Conference of States on Building Codes and Standards. The Automated Builder Magazine numbers shown for HUD-Code (mobile home) units are within 5% of U.S. Census data. 3) Top 100 industrialized builders' total 1999 gross sales was $10.5 billion (includes some commercial modular/factory-built component sales). For 1999, Automated Builder total estimates exceeded Census new housing completion data by 13%, since these estimates include some multi-family and small commercial units.

Source(s): Automated Builder Magazine, Jan. 1992, p. 12 for 1981; Jan. 1996, p. 30 for 1985; Jan. 2001, p. 15 for 1990-2000; and Dec. 2000, p. 33 for sales volume.

5.2.2 1999 Top Five Manufacturers of Panelized Homes (including pre-cut homes) (1)

Company	Units Produced	Gross Sales Volume ($million)	Market Share of Top 42 Company Sales (2)	Number of Employees
Wausau Homes	N/A	197.5	41%	N.A.
Lindal Cedar Homes	400	39.5	8%	N.A.
Boozer Lumber Co.	N/A	36.0	4%	N.A.
Barden & Robeson	900	28.0	8%	N.A.
Linwood Homes Ltd.	326	21.3	6%	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 42 IH producers responding to the survey. In 1999, surveyed panelized home sales were estimated at $477.9 million and 6,000 housing units produced.

Source(s): Automated Builder Magazine, June 2000, p. 30-33.

5.2.3 1999 Top Five Manufacturers of Modular Homes (1)

Company	Units Produced	Gross Sales Volume ($million)	Market Share of Top 27 Company Sales (2)	Number of Employees
All American Homes, Inc.	2,949	130.3	17%	1323
New Era Building Systems Inc.	4,100	112.3	14%	650
Crest Homes (div. Oakwood)	3,442	72.9	9%	350
Muncy Homes, Inc.	3,616	61.8	8%	525
Nationwide Homes	863	55.5	7%	550

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 27 IH producers responding to the survey. In 1999, surveyed modular home sales were estimated at $787 million and 27,126 units produced. The top 27 companies responding to the survey employ roughly 6,000 people.

Source(s): Automated Builder Magazine, May 2000, p. 50-52.

5.2.4 1999 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.	115,376	1,900	25.0%	15,000
Oakwood Homes	59,769	1,490	19.6%	11,315
Fleetwood Enterprises, Inc	59,458	1,450	19.1%	20,000
Clayton Homes	39,323	624	8.2%	4,300
Cavalier Homes	34,294	587	7.7%	4,890

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 1999, surveyed HUD-Code home sales were estimated at $7.61 billion and 348,283 units. The top 24 IH producers responding to the survey employ 27,390 people.

Source(s): Automated Builder Magazine, October 2000, p. 30-31.

5.2.5 1999 Top Five Manufacturers of Factory-Fabricated Components (trusses, wall panels, doors) (1)

Company	Gross Sales Volume ($million)	Market Share of Top 100 Company Sales (2)	Number of Employees (3)
Carolina Holdings, Inc.	350.0	23.9%	1540
Trussway	250.0	17.0%	1400
Stark Truss	80.0	5.5%	800
Automated Bldg. Comp's	39.8	2.7%	297
Littfin Lumber Co.	38.8	2.6%	340

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 100 IH producers responding to the survey. In 1999, surveyed component sales was estimated at $1.47 billion. 3) The top 100 companies employ a total of 10,900 people at their plants.

Source(s): Automated Builder Magazine, September 2000, p. 43-45.

5.2.6 2000 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	2200
Special (Commercial) Units	170

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

Source(s): Automated Builder Magazine, Jan. 2001, p. 15.

5.2.7 1999 HUD-Code (Mobile) Home Shipments, by Census Region and Top Five States (percent of national total)

Region		Top Five States	
Northeast	4%	Texas	11.3%
Midwest	16%	North Carolina	8.4%
South	66%	Tennessee	6.6%
West	13%	Florida	5.9%
	100%	Georgia	5.5%

Source(s): DOC, Manufactured Housing Statistics, 1999 New Manufactured Homes Placed by Size of Home, by State, Jan. 2001.

5.3.1 Value of Building Improvements and Repairs, by Sector ($1999 billion) (1)

	Value of Improvements and Repairs		
	Residential	Commercial	All Bldgs.
1980	84.9	N.A.	N.A.
1985	114.0	110.8 (2)	224.8
1990	129.5	112.3 (3)	241.8
1995	127.2	110.6	237.8
1999	142.9 (4)	110.7 (5)	253.6

Note(s): 1) Improvements includes additions, alterations, reconstruction, and major replacements. Repairs include maintenance. 2) 1986. 3) 1989. 4) Includes 70% Improvements and 30% Maintenance & Repairs. 5) 1997. Includes 57% Improvements and 43% Maintenance and Repairs.

Source(s): NAHB, 1997 Housing Facts, Figures and Trends, 1997, p.33 for residential 1980-1985; DOC, Current Construction Reports: Expenditures for Residential Improvements and Repairs, C50, Feb. 1998, Table 1, p. 3 for 1990; DOC Current Construction Reports: Expenditures for Residential Improvements and Repairs, C50, July 1999, Table 2, p. 4 for 1995; DOC, Current Construction Reports: Expenditures for Residential Improvements and Repairs, C50, Dec. 2000, Table 2, p. 4 for 1999; DOC, Current Construction Reports: Expenditures for Nonresidential Improvements and Repairs: 1992, CSS/92, Sept. 1994, Table A, p. 2 for 1986-1990 expenditures; DOC, U.S. Industry and Trade Outlook 1998, Table 6-6, p. 6-9 for 1995-1997 commercial; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price deflators.

5.3.2 1994-1995 Professional and Do-It-Yourself Improvements by Homeowners, by Project ($1999)

	Professional Installation			DIY Installation		
Repair/Improvement	Homeowners (10^6)	Total Expenditures ($10^9)	Mean Expenditures ($)	Homeowners (1000)	Total Expenditures ($10^9)	Mean Expenditures ($)
Kitchen Remodeled	2.07	12.3	5,927	2.10	5.1	2,403
Bathroom Remodeled or Added	2.15	15.0	6,960	2.82	6.4	2,257
Additions Built	3.31	19.4	5,875	3.48	8.3	2,398
Exterior Improvements	4.99	18.0	3,614	4.33	6.4	1,478
Disaster Repairs	0.99	8.4	8,462	0.27	1.3	4,960
Roof Replacement	3.66	12.9	3,542	0.82	1.4	1,690
Siding Replaced or Added	1.29	6.8	5,237	0.47	0.9	1,893
Plumbing Replacement	1.07	1.1	985	0.75	0.2	335
Electric System Replacement	2.32	1.6	687	1.34	0.4	289
Windows/Doors Installed	4.24	8.1	1,907	3.31	2.4	723
Insulation Added	0.98	0.6	675	1.45	0.4	266
Flooring/Paneling/Ceiling Replacement	4.07	6.5	1,597	2.90	1.7	579
HVAC Replacement	3.85	11.3	2,924	0.58	1.0	1,700
Appliance/Major Equipment Replacement	4.86	1.9	406	3.77	1.1	276
Total	22.81	125.0	5,482	16.72	37.3	2,231

Note(s): Expenditures are $35.1 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, Table A.3, p. 42; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price deflators.

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 1999 Industry Use Shares of Mineral Fiber (Glass/Wool) Insulation (1)

Insulating Buildings (2)	70.6%
Industrial, Equipment, and Appliance Insulation	25.4%
Unknown	4.0%
	100%

Note(s): 1) Based on value of shipments. 2) Including industrial.
Source(s): DOC, 1999 Annual Survey of Manufacturers: Value of Product Shipments, Mar. 2001, p. 43.

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	1985	1990	1995	2000	1985	1990	1995	2000	1985	1990	1995	2000
Aluminum (2)	9.5	5.9	4.7	3.7	7.2	3.6	3.9	4.0	16.7	9.5	8.6	7.7
Wood (3)	8.6	9.4	11.6	12.9	6.6	7.6	9.4	10.2	15.2	17.0	21.0	23.1
Vinyl	0.2	1.2	4.8	8.8	3.3	7.1	9.6	14.9	3.5	8.3	14.4	23.7
Other	0.2	0.1	0.3	0.4	0.2	0.1	0.2	0.2	0.4	0.2	0.5	0.6
Total	18.5	16.6	21.4	25.9	17.3	18.4	23.1	29.3	35.8	35.0	44.5	55.2

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 1985 and 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 1995-2000; 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	1985	1990	1995	2000	1985	1990	1995	2000	1985	1990	1995	2000
Aluminum	16.3	9.9	9.2	8.0	2.6	1.9	3.8	4.3	18.9	1.9	13.0	12.3
Wood	1.0	0.5	1.8	2.3	0.1	0.4	1.3	1.4	1.1	0.4	3.1	3.7
Other (1)	N.A.	0.1	0.3	0.3	0.7	0.1	0.1	0.1	0.7	0.1	0.4	0.4
Total	17.3	10.5	11.3	10.6	3.4	2.4	5.2	5.8	20.7	2.4	16.5	16.4

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

Source(s): AAMA/Ducker Research, Industry Statistical Review and Forecast 1992, 1993 for 1985; AAMA/NWWDA/Ducker Research, Industry Statistical Review and Forecast 1996, 1997, Table 7, p. 7 for 1990; and American Architectural Manufacturers Association/Window & Door Manufacturers Association, 2000 AAMA/WDMA Industry Statistical Review and Forecast, Feb. 2001, p. 7 for 1995-2000.

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

	Northeast		Midwest		South		West		Total	
Type	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
New Construction										
Commercial Windows (2)	9	10	14	21	22	34	14	22	59	87
Curtain Wall	6	4	7	6	11	15	8	8	32	33
Store Front	6	15	7	15	15	22	9	21	40	73
Total	21	29	31	42	48	71	31	51	131	193
Remodeling/Replacement										
Commercial Windows (2)	6	23	11	36	24	63	14	36	55	158
Curtain Wall	3	8	3	7	5	16	6	17	17	48
Store Front	6	14	9	22	21	29	16	26	52	91
Total	15	45	23	65	50	108	36	79	124	297
Total										
Commercial Windows (2)	15	33	25	57	46	97	28	58	114	245
Curtain Wall	9	12	10	13	16	31	14	25	49	81
Store Front	12	29	19	37	36	51	25	47	92	164
Total	36	74	54	107	98	179	67	130	255	490

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 1992, 1993 for 1990; and American Architectural Manufacturers Association/Window & Door Manufacturers Association, 2000 AAMA/WDMA Industry Statistical Review and Forecast, Feb. 2001, p. 17 for 2000.

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

Sector	1985	1990	1995	1998	1999
Residential	73%	86%	89%	91%	91%
Nonresidential	63%	80%	84%	84%	85%

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 1992, 1993 for 1990; and American Architectural Manufacturers Association/Window & Door Manufacturers Association, 2000 AAMA/WDMA Industry Statistical Review and Forecast, Feb. 2001, p. 12 for 1995-1999.

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 1995 Nonresidential Window Stock and Usage, by Type (1)

	Existing U.S. Stock	Glass Area Usage	
Type	(% of buildings)	(million sf)	(% of sf)
Single-Pane	59%	39	16%
Insulating Glass (2)	41%	311	84%
Total	100%	350	100%
Clear	**74%**	**126**	**36%**
Tinted	**26%**	**140**	**40%**
Reflective	**(3)**	**24**	**7%**
Low-e	**(3)**	**60**	**17%**
- Non-gas-filled	N.A.	4	1%
- Gas-filled	N.A.	56	16%
Total	**100%**	**350**	**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 1995, Oct. 1997, Table 42 for stock data; American Architectural Manufacturers Association/Window & Door Manufacturers Association, 2000 AAMA/WDMA Industry Statistical Review and Forecast, Feb. 2001, p. 12 for usage values; and AAMA/NWWDA, Study of the U.S. Market for Windows and Doors, 1996, p. 64 and 69 for glass-type vision area.

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	1985 (1000s)	1990 (1000s)	1999 (1000s)	1999 Value of Shipments ($million) (7)
Air Conditioners (1)	**2,470.0**	**2,928.0**	**5,353.7**	**4,421**
Heat Pumps	**885.0**	**948.0**	**1,370.1**	**1,102**
Air-to-Air Heat Pumps	820.0	808.0	1,293.4	997
Water-Source Heat Pumps (2)	65.0	140.0	76.8	105
Chillers (3)	**11.8**	**15.0**	**22.3**	**1,059**
Reciprocating	8.2	9.8	15.4	N.A.
Centrifugal/Screw	3.5	5.0	6.5	N.A.
Absorption	0.1	0.2	0.4	N.A.
Furnaces	**2,335.0**	**2,367.9**	**3,706.5**	**N.A.**
Gas-Fired (4)	1,822.0	1,950.5	3,126.1	1,388
Electric	366.0	279.0	455.0	N.A.
Oil-Fired (5)	147.0	138.5	125.4	107
Boilers (6)	**305.2**	**328.7**	**350.0**	**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 49,000 units shipped in 1999. 3) Chiller value of shipments are based on Census unit shipment data, which is 9,100 units higher than the industry data shown. 4) Gas-fired furnace value of shipments are based on Census unit shipment data, which is 171,000 units higher than the industry data shown. 5) Oil-fired furnace value of shipments are based on Census unit shipment data, which is 15,100 units higher than the industry data shown. 6) 57% of boiler shipments were gas-fired and 43% were oil-fired. 7) Total 1999 value of shipments for refrigeration, air-conditioning, and heating equipment was $21.9 billion, including industrial and excluding boilers and electric furnaces.

Source(s): The Air Conditioning, Heating and Refrigeration News: Statistical Panorama, April 16, 1996, p. 8-9 for 1985-1990 shipment data; Appliance, May 2001, p. 51-54 for 1999 shipments; Appliance Manufacturer, Feb. 1998 for electric furnace; ARI, Statistical Profile of the Air-Conditioning, Refrigeration, and Heating Industry, 2001, Table 22, p. 32 for centrifugal/screw chiller shipments; ARI, Kool Fax, Mar. 2000, p.4 for reciprocating chiller shipments; EIA, Renewable Energy Annual 2000, Mar. 2001, Table 35, p. 27 for GSHP shipment data; and DOC, Current Industrial Reports: Refrigeration, Air Conditioning, and Warm Air Heating Equipment, MA35M, Sept. 2000, Table 2 for 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			
	Minimum Efficiency (1)		New		Existing		New		Existing	
Heating Equipment	1992	2006	North	South	North	South	North	South	North	South
Natural Gas, Furnace	78 AFUE	78 AFUE	1170	445	1489	771	1170	445	1489	771
Oil, Boiler	80 AFUE	80 AFUE	1014	N.A.	129	585	1014	N.A.	129	585
Electric, Heat Pump	6.8 HSPF	7.4 HSPF	12923	4685	11232	5546	11875	4305	10321	5097

			Typical Maximum Electricity Use for Space Cooling a Single-Family Residence							
			1992				2006			
	Minimum Efficiency (3)		New		Existing		New			
Cooling Equipment	1992	2006 (4)	North	South	North	South	North	South	North	South
Central Air-Conditioning	10 SEER	12 SEER	1113	2543	1000	3743	927	2119	833	3119
Electric, Heat Pump	10 SEER	12 SEER	1100	2414	813	2657	917	2012	677	2214

Note(s): 1) AFUE = Annual Fuel Utilization Efficiency. HSPF = Heating Season Performance Factor. 2) Gas and oil use are in therms. Electricity use is in kWh. 3) SEER = Seasonal Energy Efficiency Ratio. 4) Proposed by DOE.

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. 7, April 20, 2001, p. 20191 for proposed AC standard.

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

Gas-Fired

AFUE Range	1985	AFUE Range	2000
Below 65%	15%	75% to 88%	76%
65% to 71%	44%	88% and Over	24%
71% to 80%	10%		100%
80% to 86%	19%		
over 86%	12%		
	100%		

Average shipped in 1985 (2):	74% AFUE
Average shipped in 1995:	84% AFUE
Best Available in 1981:	85% AFUE
Best Available in 2000:	97% AFUE

Oil-Fired

AFUE Range	1985	AFUE Range	2000
Below 75%	10%	75% to 88%	100%
75% to 80 %	56%	88% and Over	0%
Over 80%	35%		100%
	100%		

Average shipped in 1985 (2):	79% AFUE
Average shipped in 1995:	81% AFUE
Best Available in 1981:	85% AFUE
Best Available in 2000:	87% 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 2000 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, Apr. 2000, p. 12-13 and 96-97 for 2000 best-available AFUEs.

5.6.4 Residential Boiler Efficiencies (1)

Gas-Fired Boilers

Average shipped in 1985 (2):	74% AFUE
Best Available in 1981:	81% AFUE
Best Available in 2000:	95% AFUE

Oil-Fired Boilers

Average shipped in 1985 (2):	79% AFUE
Best Available in 1981:	86% AFUE
Best Available in 2000:	89% AFUE

Note(s): 1) Federal appliance standards effective January 1, 1992 require a minimum of 80% AFUE (except gas-fired steam boiler which must have a 75% AFUE or higher). 2) Includes furnaces.
Source(s): GAMA, Consumer's Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment, Apr. 2000, p. 112 and 126 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	2000 Best-Available New Efficiency
Air Conditioners	SEER	10.95	18 and over
Heat Pump - Cooling			
Air-Source	SEER	11.21	17 and over
Ground-Source	EER	N.A.	22 and over
Heat Pump - Heating			
Air-Source	HSPF	7.50 (2)	8.55
Ground-Source	COP	N.A.	4.0

Note(s): 1) Federal appliance standards effective January 1, 1992 require a minimum SEER of 10. 2) 1998.
Source(s): ARI ratings for best-available in 2000; ARI, Statistical Profile of the Air-Conditioning, Refrigeration, and Heating Industry, Apr. 2001, p. 28 for shipment-weighted SEERs; and EIA, Technology Forecast Updates, Sept. 2, 1998, p. 22 for heat pump HSPF.

5.6.6 Commercial Equipment Efficiencies

Equipment Type	Efficiency Parameter	1995 Stock Efficiency	1998 U.S. Average New Efficiency	1998 Best-Available New Efficiency
Chiller				
Reciprocating	COP	2.5	3.2	3.2
Centrifugal	COP	4.6	5.9	7.3
Gas-Fired Absorbtion	COP	1.0	1.0	
Gas-Fired Engine Driven	COP	1.0	2.0	
Rooftop A/C	COP	2.1	2.5	3.4
Rooftop Heat Pump	EER	12	12	15
Boilers				
Gas-Fired	Thermal Efficiency	75	80	90
Oil-Fired	Thermal Efficiency	78	83	87
Electric	Thermal Efficiency	98	98	98
Gas-Fired Furnace	AFUE	75	77	92
Water Heater				
Gas-Fired	Thermal Efficiency	76	80	96
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, Sept. 1998, p. 36-60.

5.6.7 1999 Air-Conditioner/Heat Pump Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
UTI/Carrier	29%
Goodman	18%
American Standard (Trane)	14%
Rheem	12%
Lennox	12%
York	7%
Nordyne	5%
Others	3%
	100%

Total Units Shipped: 6,647,071 (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. 2000, p. 84.

5.6.8 1999 Gas Furnace Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
ITC/Carrier	31%
Goodman	17%
Lennox	15%
Rheem	12%
American Standard (Trane)	12%
York	5%
Others	8%
	100%

Total Units Shipped: 3,126,127

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sep. 2000, p. 84.

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 2001
Central Air Conditioners	**8 - 19**	**13**	**9**	**3,214,606**
Heat Pumps	**6 - 21**	**14**	**8**	**918,432**
Furnaces				**2,551,695**
Electric	9 - 20	14	11	375,055
Gas-Fired	11 - 23	17	12	2,049,335
Oil-Fired	13 - 23	18	N.A.	127,305
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. 2000, p. 87 for service and average lifetimes, and units to be replaced; ASHRAE, 1999 ASHRAE Handbook: HVAC Applications, Table 3, p. 35.3 for boilers service lifetimes; and EIA, Housing Characteristics 1990, May 1992, Table 7, p. 24 for 1990 average stock ages.

5.6.10 Major Commercial HVAC Equipment Lifetimes and Ages

Equipment Type	Median Lifetime	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	13	N.A.
Oil-Fired	20	N.A.
Cooling Towers (metal or wood)	20	N.A.

Source(s): ASHRAE, 1999 ASHRAE Handbook: HVAC Applications, Table 3, p. 35.3 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 1997 (percent of total households)

Heating Fuel	1990 to 1997	1980 to 1989	1970 to 1979	1960 to 1969	1950 to 1959	1949 or Before
Natural Gas	49%	36%	42%	58%	65%	66%
Electricity	41%	54%	44%	24%	18%	8%
Fuel Oil	3%	3%	5%	11%	11%	17%
Other (1)	6%	7%	9%	7%	6%	9%
	100%	100%	100%	100%	100%	100%

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

Source(s): EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table HC3-2a, p. 55.

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

Equipment Type	1987	1993	1997
Natural Gas	**55%**	**53%**	**53%**
Central Warm-Air Furnace	35%	36%	38%
Steam or Hot-Water System	10%	9%	7%
Floor/Wall/Pipeless Furnace	6%	4%	4%
Room Heater/Other	4%	3%	4%
Electricity	**20%**	**26%**	**29%**
Central Warm-Air Furnace	8%	10%	11%
Heat Pump	5%	8%	10%
Built-In Electric Units	6%	7%	7%
Other	1%	1%	2%
Fuel Oil	**12%**	**11%**	**9%**
Steam or Hot-Water System	7%	6%	5%
Central Warm-Air Furnace	4%	5%	4%
Other	1%	0%	0%
Other	**13%**	**11%**	**9%**
	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 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 (percent of total floorspace) (1)

Heating Equipment		Cooling Equipment	
Individual Space Heaters	29%	Packaged Air Conditioning Units	45%
Boilers	29%	Individual Air Conditioners	21%
Packaged Heating Units	29%	Central Chillers	19%
Furnaces	25%	Residential Central Air Conditioners	16%
Heat Pumps	10%	Heat Pumps	12%
District Heat	10%	District Chilled Water	4%
Other	11%	Swamp Coolers	4%
		Other	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, Oct. 1997, Tables 34 and 36.

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 Typical Commercial Building Thermal Energy Distribution Design Load Intensities (Watt/Sq.Ft.)

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

Note(s): 1) Unducted units are lower than those with some ductwork. 2) Strong dependence on building type.

Source(s): BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, Table 3-1, p. 3-6.

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

Type	1980	1990	1998	1999 Value of Shipments ($million)
Solar Thermal Collectors	19,398	11,409	8,583	26.2
Residential	N.A.	5,851	7,774	N.A.
Commercial	N.A.	295	785	N.A.
Industrial	N.A.	(2)	18	N.A.
Utility	N.A.	5,236	4	N.A.
Other	N.A.	26	2	N.A.
Photovoltaics	6,897 kW (3)	13,837 kW	76,787 kW	185.0

Note(s): 1) Includes imports and exports; 1999 solar thermal collector imports were 2,352,000 square feet, and exports were 537,000 square feet. 2) Industrial is included in Other. 3) Actually 1982 data.
Source(s): EIA, Renewable Energy Annual 2000, Mar. 2001, Tables 16 and 23 for 1999 shipments, Tables 15 and 27 for value of shipments, and Table 9 for imports/exports; EIA, Annual Energy Review 1991, June 1992, Table 111, p. 251 for 1990 data by sector; and EIA, Annual Energy Review 1994, July 1995, Tables 10.4 and 10.6, p. 271 and 275 for 1980 and 1990 (revised) total shipment data.

5.8.2 1999 Thermal Solar Collector Shipments, by End Use (including imports and exports) (1)

Type	1000 Square Feet
Pool Heating	8,141
Hot Water	373
Space Heating	42
Space Cooling	-
Combined Space/Water Heating	16
Process Heating	5
Electricity Generation	4
Total	8,583 (2)

Note(s): 1) 6% of shipments are exported. 2) Approximately 23,800 systems in 1999.
Source(s): EIA, Renewable Energy Annual 2000, Mar. 2001, Table 16, p. 20, Table 12, p. 17 for Note 1 and Table 17, p. 20 for Note 2.

5.8.3 1999 Top Five Destinations of Thermal Solar Collector Shipments

State or Territory	Percent of U.S. Unit Shipments
Florida	46%
California	27%
Arizona	5%
Nevada	4%
Hawaii	3%

Source(s): EIA, Renewable Energy Annual 2000, Mar. 2001, Table 11, p. 16 and Table 12, p. 17 for total shipments.

5.8.4 Thermal Solar Collector Manufacturer Statistics

- Number of Manufacturers in 1999: 29
- Percentage of Shipped Solar Collectors Produced by Top 5 Manufacturers: 91%
- Percentage of Shipped Solar Collectors Produced by Top 10 Manufacturers: 98%

Source(s): EIA, Renewable Energy Annual 2000, Mar. 2001, Tables 17, p. 20 and Table 19, p. 21.

5.8.5 Thermal Solar Collector System Characteristics

- A SDHW system produces as much energy as a 2-kW photovoltaic system.
- SDHW systems range in efficiency from a solar energy factor (SEF) of 0.8 to 4.8 (1).
- Typical SDHW system collector area is 50 sf. Typical solar pool heating system collector area is 300 sf.

Note(s): 1) SEF is the hot water energy *delivered* by the system divided by the electric or gas energy input to the system.
Source(s): SRCC, Summary of SRCC Certified Solar Collector and Water Heating System Ratings, Apr. 2000 for SDHW SEFs.

5.9.1 1995 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 (2)	54,183	96.0%
Compact Fluorescent	14,382	25.5%
Incandescent	35,883	63.6%
High-Intensity-Discharge	16,370	29.0%
Halogen	9,747	17.3%

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 56.5 billion square feet. 2) In 1995, 48% of the existing commercial building stock lighted by fluorescent lamps used corrected power factor-type ballasts or electronic ballasts.

Source(s): EIA, Commercial Buildings Characteristics 1995, Oct. 1997, Table 40.

5.9.2 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.

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.

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

Lighting Fixture Type	1985	1990	1999
Residential	786.8	827.6	1,160.8
Commercial/Institutional (except spotlight)	1,832.3	2,379.7	3,457.5
Industrial	389.2	529.4	640.2
Vehicular (1)	1,001.2	1,620.7	N.A.
Outdoor	905.5	1,061.5	1,905.4

Note(s): 1) Data for vehicular lighting fixtures was discontinued in 1992.

Source(s): 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. 19995, Table 1 for 1985.

5.9.4 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	1836.6	1090.6	1741.6	1016.6	95.0	74.0
Fluorescent	8	585.4	1002.3	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.	2486.7	2558.1	2309.9	2315.5	176.7	242.6
Other (non-Building)	N.A.	1076.6	488.0	990.7	432.4	85.9	55.6
Total	36	3563.3	3046.1	3300.7	2747.8	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.

5.9.5 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%
1987	74.3	420.9	0.7	15.1	74.9	436.0	1%
1988	74.6	450.9	1.1	25.5	75.7	476.4	1%
1989	76.3	481.5	1.4	39.8	77.7	521.3	2%
1990	78.4	546.3	3.0	69.3	81.4	615.6	4%
1991	80.4	538.3	8.3	180.0	88.7	718.3	9%
1992	83.7	537.7	13.3	274.6	97.0	812.3	14%
1993	82.9	523.0	24.5	446.5	107.4	969.5	23%
1994	83.5	550.0	24.6	390.8	108.1	940.7	23%
1995	72.4	495.2	32.9	507.0	105.3	1,002.2	31%
1996	67.0	457.8	30.3	451.4	97.3	909.2	31%
1997	67.4	412.4	36.5	494.0	103.9	906.4	35%
1998	63.9	401.4	39.8	512.8	103.7	914.3	38%
1999	60.7	384.5	41.6	500.1	102.4	884.5	40%

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

Source(s): 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.

5.9.6 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	1986 (1000)	1990 (1000)	1999 (1000)	1999 Value of Shipments ($million)
Refrigerator/Freezers (1)	6,261	7,317	9,332	4,510.8 (2)
Freezers (chest and upright)	1,236	1,328	2,030	548.6 (2)
Refrigerated Display Cases	310	359	340	N.A.
Unit Coolers	139	178	227	166.4
Ice-Making Machines	203	171	296	434.9
Water Cooler	N.A.	253	345	N.A.
Beverage Vending Machine	246	229	350	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, 48th Annual Statistical Review, May 2001, p. 51-54 for refrigerator, freezer, refrigerated display cases, water cooler, and beverage vending machines shipments; AHAM, 2000 Major Home Appliance Industry Fact Book, Nov. 2000, Table 7, p. 10, and Table 8, p. 12 for refrigerator and freezer value of shipments; The Air Conditioning, Heating and Refrigeration News, November 11, 1995, p. 19 for 1986 and 1990 unit cooler and ice-making machine shipments; DOC, Current Industrial Reports: Air-Conditioning and Refrigeration Equipment, MA333M(99)-1, Sept. 2000, Table 2 for 1999 unit cooler and ice-making machine data; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price deflator.

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

Appliance Type	1980 (1000)	1990 (1000)	1999 (1000)	1999 Value of Shipments ($million)
Room Air Conditioners	**3,203**	**3,799**	**6,294**	**1,486**
Ranges (total)	**4,069**	**5,873**	**8,075**	**3,060**
Electric Ranges	2,530	3,350	4,938	1,895
Gas Ranges	1,539	2,354	3,137	1,165
Microwave Ovens/Ranges	**3,608**	**7,693**	**11,422**	**1,445**
Clothes Washers	**4,550**	**5,591**	**7,313**	**2,277**
Clothes Dryers (total)	**3,177**	**4,160**	**6,249**	**1,567**
Electric Dryers	2,494	3,190	4,805	N.A.
Gas Dryers	682	970	1,444	N.A.
Water Heaters (total)	**N.A.**	**N.A.**	**10,408**	**1,441**
Electric (1,2)	N.A.	N.A.	4,429	580
Gas and Oil (2)	N.A.	N.A.	5,954	843
Solar (3)	N.A.	N.A.	24	18
Office Equipment				
Personal Computers (4)	N.A.	N.A.	43,834	36,590
Host Computers (5)	N.A.	N.A.	2,913	17,178
Copiers	N.A.	N.A.	1,968	N.A.
Facsimile Machines	N.A.	N.A.	6,630	N.A.
Printers	N.A.	N.A.	22,185	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.

Source(s): AHAM, 1990/1991 Major Home Appliance Industry Fact Book, Table 7, p. 10-11 for 1980 data except water heaters; AHAM, 2000 Major Home Appliance Industry Fact Book, 2000, Tables 7 and 8, for 1990 and 1999 data except water heaters; DOC, Current Industrial Reports: Major Household Appliances, MA335F(99)-1, Aug. 2000, for value of water heater shipments; EIA, Renewable Energy Annual 2000, Mar. 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(99)-1, Aug. 2000, for computer data; and Appliance, A Portrait of the U.S. Appliance Industry 2000, Sept. 2000, p. 85 for 1999 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 1990	2001	Typical Maximum Electricity Use (kWh) (4) 1990	2001
Less than 6,000 Btu/h	8.0	9.7	563	464
6,000 to 7,999 Btu/h	8.5	9.7	618	541
8,000 to 13,999 Btu/h	9.0	9.8	917	842
14,000 to 19,999 Btu/h	8.8	9.7	1449	1314
20,000 Btu/h or more	8.2	8.5	1829	1765

Clothes Dryers (3)	Minimum EF (lbs./kWh)	Typical Maximum Energy Use (5)
Electric, Standard	3.01	835
Gas	2.67	32

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) (6)
Top Loading, Standard	1.18	1.04	1.26	1265
Front Loading	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 (7)	Minimum EF (8) 1990	1991	2004	Typical Maximum Energy Use 1990	1991	2004
Gas-Fired	0.54	0.54	0.59	208	208	191
Oil-Fired	0.51	0.51	0.51	214	214	214
Electric Resistance	0.90	0.88	0.92	3456	3534	3380

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) Electric use in kWh. Gas use in therms. 6) Assumed electric water heating. 7) DOE regulations mandate minimum efficiency for appliance based on its size. 8) 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 Efficiency Standards for Consumer Products: Clothes Washers, Dec. 2000, p. 10-8; LBNL, Energy Data Sourcebook for the U.S. Residential Sector, May 1997, p. 102-103 for clothes dryers and p. 94 for dishwashers; and DOE/EE, Technical Support Document: Energy Efficiency Standards for Consumer Products: Water Heaters, April 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

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

Source(s): AHAM, 2000 Major Home Appliance Industry Fact Book, 2000, Table 25, p. 30 for volume and average consumption/unit; 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; and EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table CE5-2c, p. 205 for 1997 portion of note.

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	8.99	11.7

Source(s): AHAM, 1993 Major Home Appliance Industry Factbook, 1993, Table 24, p. 30 for 1972; AHAM, 2000 Major Appliance Industry Fact Book, Nov. 2000, Table 27, p. 32 for 1980-1999 average capacity and EER; and AHAM, 1994-1999 Directory of Certified Room Air Conditioners, Mar. 2000 for best-available.

5.10.6 Water Heater Efficiencies

Residential Appliance Type	Efficiency Parameter (1)	1999 Stock Efficiency	Minimum New Efficiency (2)	2001 Best-Available New Efficiency
Electric Water Heaters	EF	0.87	0.88	0.95
Gas Water Heaters	EF	0.54	0.54	0.65
Oil Water Heaters	EF	0.53	0.51	0.68
Solar Water Heaters	SEF	N.A.	0.80	4.80

Commercial Appliance Type	Efficiency Parameter (1)	1992 Stock Efficiency	Minimum New Efficiency	1998 Best-Available New Efficiency
Electric Water Heaters	EF	0.75	None (3)	0.95
Gas Water Heaters	EF	0.65	0.78 (4)	0.86

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) For tanks greater than 120 gallons or an input greater than 12 kW. 4) Thermal efficiency.

Source(s): EIA, Supplement to the AEO 2001, Dec. 2000, Table 21 for residential stock efficiencies; BTS/OBE, Characterization of Commercial Building Appliances, Aug. 1993 for commercial efficiencies; BTS/OBE, Market Disposition of High-Efficiency Water Heating Equipment, Nov. 1996, Appendix A, p. A-1 for minimum efficiencies; GAMA, Consumer's Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment, Oct. 2000 for best-available efficiencies; and SRCC, Summary of SRCC Certified Solar Collector and Water Heating System Ratings, Apr. 2000, p. S-16 - S-20 for SEFs.

5.10.7 Other Major Appliance Efficiencies

Residential Appliance Type	Efficiency Parameter (1)	1999 U.S. Average New Efficiency	2001 Best Available New Efficiency
Dishwashers	EF	0.51	1.50
Clothes Washers (2)	EF & MEF	1.47 EF	2.2 MEF

Commercial Appliance Type	Efficiency Parameter (1)	1999 U.S. Average New Efficiency	1992 Best Available New Efficiency
Cooking Equipment:			
Electric Appliances	EF	0.70	0.60 - 0.80
Gas Appliances	EF	0.51	0.30 - 0.65
Laundry Equipment:			
Electric Drying	EF/COP	0.98 (3)	3.30
Gas Drying	EF	0.36 (3)	0.55
Motors	EF	0.65 (3)	0.75
Office Equipment:			
Linear Power Supplies	EF	0.30 - 0.60 (3)	0.60
Switching Power Supplies	EF	0.80 - 0.95 (3)	0.95
Motors	EF	0.60 - 0.70 (3)	0.70

Note(s): 1) EF = Energy Factor. COP = Coeffiecient 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 2001, Dec. 2000, Table 22 for average cooking efficiency; and BTS/OBE, Characterization of Commercial Building Appliances, Aug. 1993 for commercial efficiencies.

5.10.8 1999 Room Air Conditioner Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
Fedders	23%
Electrolux (Frigidaire)	20%
Whirlpool	17%
LG Electronics/Goldstar	13%
Goodman/Amana	7%
Matsushita	4%
Sharp	4%
Others	12%
	100%

Total Units Shipped: 6,113,600

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2000, p. 84.

5.10.9 1999 Refrigerator Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
GE	33%
Whirlpool	25%
Electrolux (Frigidaire)	20%
Maytag (Admiral)	14%
Goodman (Amana)	6%
Others	2%
	100%

Total Units Shipped: 9,098,600

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2000, p. 85.

5.10.10 1999 Range Manufacturer Market Shares (by percentage of products produced)

Company	Electric Market Share (%)	Gas Market Share (%)
GE	43%	30%
Whirlpool	22%	9%
Maytag	19%	27%
Electrolux (Frigidaire)	11%	19%
Goodman (Caloric)	2%	8%
Others	3%	7%
	100%	100%

Total Electric Units Shipped: 4,982,400

Total Gas Units Shipped: 3,136,200

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2000, p. 85.

5.10.11 1999 Microwave Oven Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
Sharp	31%
Samsung	21%
Matsushita	11%
Whirlpool	10%
Sanyo	9%
LG Electronics/Goldstar	8%
Daewoo	5%
Others	5%
	100%

Total Units Shipped: 11,662,085

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2000, p. 85.

5.10.12 1999 Clothes Washer Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
Whirlpool	53%
Maytag	21%
GE	15%
Electrolux (Frigidaire)	7%
Goodman (Speed Queen)	4%
	100%

Total Units Shipped: 7,508,200

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2000, p. 85.

5.10.13 1999 Clothes Dryer Manufacturer Market Shares (by percentage of products produced)

Company	Electric Market Share (%)	Gas Market Share (%)
Whirlpool	53%	55%
GE	19%	17%
Maytag	17%	19%
Electrolux (Frigidaire)	6%	8%
Goodman (Speed Queen)	5%	1%
	100%	100%

Total Electric Units Shipped: 4,864,700

Total Gas Units Shipped: 1,443,000

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2000, p. 85.

5.10.14 1999 Water Heater Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)
Rheem Manufacturing	37%
State Industries	22%
Southcorp	14%
A.O. Smith	14%
Bradford-White	13%
	100%

Total Units Shipped: 9,215,318

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2000, p. 85.

5.10.15 1999 Facsimile and Copier Machine Manufacturer Market Shares (by percentage of products produced)

Company	Facsimile Machine Market Share (%)	Copier Market Share (%)
Brother	23%	-
Sharp	23%	10%
Panasonic	20%	-
Hewlett-Packard	18%	-
Cannon	12%	30%
Xerox	2%	28%
Mita	-	5%
Minolta	-	4%
Ricoh	-	5%
Others	1%	19%
	100%	100%

Total Facsimile Machine Units Shipped: 6,630,200

Total Copier Units Shipped: 1,968,000

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2000, p. 85.

5.10.16 1999 Personal Computer Manufacturer Market Shares (by percentage of products produced)

Company	Market Share (%)	Market Share (%)
Dell	16%	17%
Compaq	15%	15%
Gateway	10%	5%
Hewlett-Packard	10%	2%
IBM	6%	14%
Apple	5%	4%
eMachines	5%	-
NEC	4%	3%
Acer America	3%	-
Toshiba	-	14%
Sony	-	4%
Others	26%	22%
	100%	100%

Total Desktop Computer Units Shipped: 35,919,728

Total Portable Computer Units Shipped: 7,914,350

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 200, p. 85.

5.10.17 1999 Printer Manufacturer Market Shares (by percentage of products produced)

Company	Ink Jet Printer Market Share (%)	Laser Printer Market Share (%)	Other Printers Market Share (%)
Hewlett-Packard	46%	69%	-
Canon	17%	-	-
Epson	14%	-	22%
Lexmark	13%	7%	11%
Brother	-	7%	-
NEC	-	6%	-
Okidata	-	2%	45%
Panasonic	-	-	11%
Others	6%	8%	12%
	96%	100%	100%

Total Ink Jet Units Shipped: 19,259,914

Total Laser Units Shipped: 2,070,431

Total Dot Matrix Units Shipped: 854,728

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2000, p. 85.

5.10.18 Major Residential and Small Commercial Appliance Lifetimes, Ages, and Replacement Picture

Appliance Type	Typical Service Lifetime Range (years)	Average Lifetime (years)	1997 Average Stock Age (years)	Units to be Replaced During 2001
Refrigerators (1)	10-18	14	8	6,972,100
Freezers	12-20	16	12	1,472,800
Room Air Conditioners	7-16	12	9	5,091,100
Microwave Ovens	5-10	8	N.A.	8,132,300
Ranges (2)				
Electric	13-20	16	N.A.	3,227,700
Gas	15-23	19	N.A.	1,367,400
Clothes Washers	8-16	12	N.A.	6,607,500
Clothes Dryers (electric and gas)	11-18	14	N.A.	4,431,000
Water Heaters				
Electric	7-21	14	9	3,396,395
Gas	5-13	9	9	4,241,354
Facsimile Machines	4-6	5	N.A.	4,345,000
Personal Computers (3)	2-5	4	N.A.	28,134,269
Potable Computers	3-5	4	N.A.	6,485,000

Note(s): 1) Excluding compact refrigerators. 2) Ranges include free-standing, built-in, high-oven and cooktop/oven combination units. 3) 2000.
Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sep. 2000, p. 87-88 for service and average lifetimes and units to be replaced; Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sep. 1999, p. 80 for personal computers; EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999 for 1997 average stock lifetimes, Table HC4-4a for room air-conditioners, and Table HC5-2a, for freezers, refrigerators, and water heaters.

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

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

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 total 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.)
- the coal input to 31 coal plants (600-MW each) in one year
- 975 billion cubic feet natural gas
- 8 billion gallons of gasoline = 23 days of U.S. gasoline use
  - - 17.0 million new passenger cars and light-duty trucks each driven 11,700 miles
  - - all new passenger cars and light-duty trucks sold each driven 11,700 miles
  - - 15.0 million stock passenger cars each driven 11,700 miles = 12% of all passenger cars each driven 11,700 miles
  - - all new passenger cars each making 5 round trips from New York to Los Angeles
  - - 7.0 million stock passenger cars driven once around the Equator
- 172 million barrels of crude oil = 17 days of U.S. imports = 153 days of oil flow in the Alaska pipeline at full capacity
  - - the amount of crude oil transported by 498 double-hulled supertankers
- 23 hours of world energy use
- average annual output *delivered* from 42 1,000-MW nuclear power plants
- the energy released in 12,500 WW II-era nuclear bombs (20 kiloton each)
- average annual per capita consumption of 2.8 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 (1999)

Source(s): EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130, Table A7, p. 138, Table A8, p. 139, Table A11, p. 143 for consumption, Table H1, p. 251 for heat rates; EIA, State Energy Data Report 1999, May 2001, Table 9-10, p. 17-18; EIA, Inventory of Electric Utility Power Plants in the U.S. 1999, Nov. 1999, Table 1, p. 10; EIA, Inventory of Nonutility Electric Power Plants in the U.S. 1999, Nov. 2000, Table 1, p. 7; EIA, International Energy Outlook 2001, March 2001, Table A1, p. 175; DOC, Statistical Abstract of the United States 2000, Dec. 2000, No. 1023, p. 626, No. 1031, p. 629, and No. 1050, p. 641; and Newport News Shipbuilding Website.

6.1.3 Carbon Emission Comparisons

One million metric ton of carbon equivalent equals:

- 1.85 million short tons of coal
- the coal input to 1 coal plant (600-MW) in one year
- 67 billion cubic feet natural gas
- 425 million gallons of gasoline = 28 hours of U.S. gasoline use
  - - 1.0 million new cars each driven 11,700 miles
  - - 756 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
- 9 million barrels of crude oil
- 86 minutes of world energy emissions
- 6 hours of U.S energy emissions
- 16 hours of U.S Buildings energy emissions
- 30 hours of U.S Residential energy emissions
- 36 hours of U.S Commercial energy emissions
- 5 days of U.S Buildings lighting energy emissions
- average annual per capita emissions of 181 thousand people in the U.S.
- the approximate emissions from cities approximately the size of any one of the following cities: Arlington, VA, Columbus, GA, Fort Wayne, IN, Grand Rapids, MI, Huntsville, AL, Irving, TX, Jackson, MS, Little Rock, AR, Newport News, VA, Orlando, FL, Salt Lake City, UT, San Bernardino, CA, Tacoma, WA

Source(s): EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130, Table A7, p. 138 for consumption, Table A19, p. 151 for emissions, and Table H1, p. 251 for heat rates; EIA, Inventory of Electric Utility Power Plants in the U.S. 1999, Sept. 2000, Table 1, p. 9; EIA, Inventory of Nonutility Electric Power Plants in the U.S. 1999, Nov. 2000, Table 1, p. 7; EIA, International Energy Outlook 2001, March 2001, Table A10, p. 185; EIA, Emissions of Greenhouse Gases in the U.S. 1999, Oct. 2000, Table B1; and DOC, Statistical Abstract of the United States 2000, Dec. 2000, No. 2, p. 7, No. 39, p. 39-42 for populations, and No. 1050, p. 641.

6.1.4 Average Annual Carbon Dioxide Emission for Various Functions

	Annual Unit Energy Consumption		Carbon Emissions (lb CO2)
Stock Refrigerator	1148	kWh - Electricity	1,600
Stock Electric Water Heater	2879	kWh - Electricity	4,000
Stock Gas Water Heater	24.5	million Btu - Natural Gas	2,900
Stock Oil Water Heater	31.4	million Btu - Fuel Oil	5,000
Single-Family Home	114.7	million Btu	25,300
Mobile Home	79.5	million Btu	17,500
Multi-Family Unit in Large Building	48.6	million Btu	10,700
Multi-Family Unit in Small Building	91.5	million Btu	20,200
School Building	1986	million Btu	514,800
Office Building	1445	million Btu	374,500
Passenger Car	444	gallons - Gasoline	8,600
Standard Pickup Truck	635	gallons - Gasoline	12,300
SUV- Small	513	gallons - Gasoline	9,900
SUV - Medium	660	gallons - Gasoline	12,700
SUV- Large	866	gallons - Gasoline	16,700
CAFE Car	842	gallons - Gasoline	16,300
CAFE Light Truck	921	gallons - Gasoline	17,800

Source(s): EIA, AEO 2001, Dec. 2001, Table A2, p. 128-130 and Table A19, p. 151 for electricity emissions, and Table H1, p. 251 for gasoline heat rate; EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table CE4-2C, p. 181 for water heater energy consumption, Table HC5-2A, p. 74 for refrigerators and Table CE5-2C, p. 205 for refrigerator energy, and Table CE1-4c, p. 116 for household consumption; EIA, A Look at Commercial Buildings in 1995, Oct. 1998, Table CE-3, p. 214 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 20, 2000, Table 10.4, p. 10-4 and Figure 10.1, p. 10-2 for mileage and Table 7.16, p. 7-18 for efficiencies; and EIA, Assumptions to the Annual Energy Outlook 2001, Dec. 2000, Table 2, p. 9 for carbon emissions.

6.2.1 1999 Utility Impacts of Saving an Electric Quad (1)

Plant fuel type	Utility Fuel Input Shares (%)	Average-sized Utility Unit (MW) in 1999	Aggregate Number of Units to Provide the Fuel's Share of the Electric Quad (2)
Natural Gas	10.9%	55	87
Petroleum	3.1%	20	97
Coal	53.0%	245	37
Nuclear	22.0%	1013	3
Renewable (3)	11.1%	24	122
Total	100%		346

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 1999. 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 1999, Sept. 2000, Table 1, p. 10; EIA, Inventory of Nonutility Electric Utility Power Plants in the United States 1999, Nov. 2000, Table 1, p. 7; and EIA, Annual Energy Outlook 2001, Dec. 2000, Table A2, p. 128-130 for consumption and Table A8, p. 139 for electricity supply.

6.2.2 Cost of an Electric Quad Used in the Buildings Sector ($1999 billion)

	1999	2000	2010	2020
Residential	7.45	7.48	7.32	7.87
Commercial	6.80	7.04	5.90	6.43
Buildings Sector	7.13	7.27	6.62	7.16

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 2001, Dec. 2000, Table A2, p. 128-130 and Table A3, p. 131-132.

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

New Plant Type	Installed Capital Costs (1999 thousand dollars per MW)	2000 Net Generation Heat Rate (Btu/kWh)	2010 Net Generation Heat Rate (Btu/kWh)	2000 Installed Capital Costs of a 500-MW Power Plant ($1999 million)
Pulverized Coal	1,092	9,419	9,087	546
Advanced Coal	1,306	7,969	6,968	653
Combined Cycle	445	7,687	7,000	223
Advanced Combined-Cycle	576	6,927	6,350	288
Combustion Turbine	331	11,467	10,600	166
Advanced Combustion Turbine	462	9,133	8,000	231
Fuel Cell	2,041	5,787	5,361	1021

Stock Plant Type	1999	2000	2010	2020
Fossil Fuel Steam Heat Rate (Btu/kWh)	10,293	10,273	9,524	9,014
Nuclear Energy Heat Rate (Btu/kWh)	10,678	10,678	10,678	10,678

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 for AEO 2001, Dec. 2000, Table 43, p. 69; and EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130, and Table A8, p. 139.

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

	1999	2000	2010	2020
Average Utility Delivery Efficiency (1, 2)	31.6%	31.7%	33.5%	35.5%
Average Utility Delivery Ratio (Btu/kWh) (2, 3)	10,813	10,768	10,195	9,617

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 2001, Dec. 2000, Table A2, p. 128-130 for generator consumption and Table A8, p. 139 for electricity sales; and EIA, Annual Energy Review 1999, July 2000, Diagram 5, p. 209.

6.3.1 Cost of a Generic Quad Used in the Buildings Sector ($1999 billion) (1)

	1999	2000	2010	2020
Residential	7.20	7.62	7.22	7.59
Commercial	6.40	6.73	5.80	6.25
Buildings Sector	6.81	7.21	6.55	6.96

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, Annual Energy Outlook 2001, Dec. 2000, Table A2, p. 128-130 and Table A18, p. 150 for energy consumption and Table A3, p. 131-132 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
1999	**(2)**	**30%**	**8%**	**37%**	**6%**	**3%**	**9%**	**15%**	**1%**	**100%**
2000		31%	7%	37%	6%	3%	9%	15%	1%	100%
2010		35%	5%	38%	5%	4%	9%	13%	1%	100%
2020		41%	4%	36%	5%	4%	8%	9%	0%	100%

Note(s): 1) See Table 6.1.1 for generic quad definition. The total 1999 Buildings sector primary energy consumption was 34.75 quads. Excludes buildings-related energy consumption in the industrial sector.
Source(s): EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for energy consumption and Table A18, p. 150 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
1999	**(2)**	**32%**	**9%**	**34%**	**6%**	**4%**	**9%**	**14%**	**1%**	**100%**
2000		33%	9%	35%	5%	4%	9%	14%	1%	100%
2010		37%	6%	35%	5%	5%	9%	12%	0%	100%
2020		43%	5%	34%	4%	4%	9%	9%	0%	100%

Note(s): 1) See Table 6.1.1 for generic quad definition. 2) The total 1999 Residential buildings sector primary energy consumption was 19.12 quads.
Source(s): EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for energy consumption and Table A18, p. 150 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
1999	**(2)**	**28%**	**6%**	**40%**	**7%**	**2%**	**9%**	**16%**	**1%**	**100%**
2000		29%	5%	41%	6%	2%	8%	16%	1%	100%
2010		33%	4%	40%	5%	3%	9%	14%	1%	100%
2020		39%	3%	39%	5%	3%	8%	10%	0%	100%

Note(s): 1) See Table 6.1.1 for generic quad definition. 2) The total 1999 Commercial buildings sector primary energy consumption was 15.63 quads. Excludes buildings-related energy consumption in the industrial sector.
Source(s): EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130 for energy consumption and Table A18, p. 150 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		
	1999	2000	2010	2020
Petroleum	0.56	0.00	0.00	0.00
Natural Gas	1.29	11.62	7.41	9.20
Coal	13.84	7.01	11.05	8.47
Nuclear	0.00	0.00	0.00	0.00
Renewable Energy (2)	0.00	0.00	0.00	0.00
Total	15.70	18.63	18.46	17.67

Note(s): 1) This table provides estimates of the carbon emissions resulting from consumption of a primary quad at electric utilities. Projected (2000-2020) new marginal capacity 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). 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 2001, Dec. 2000, Table A2, p. 128-130 and Table A19, p. 151.

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								
	1999			2000			2010			2020		
	Resid.	Comm.	Bldgs.	Resid.	Comm.	Bldgs.	Resid.	Comm.	Bldgs.	Resid.	Comm.	Bldgs.
Electricity (2)	10.13	11.73	10.85	15.46	11.47	13.00	13.79	13.89	13.97	13.27	14.08	13.73
Petroleum	1.37	0.89	1.15	3.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	3.66	2.93	3.33	5.52	2.58	3.66	3.33	2.53	2.94	3.27	2.27	2.79
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	0.06	0.11	0.08	0.00	0.00	0.00	0.05	0.03	0.04	0.00	0.04	0.03
Total	15.22	15.66	15.42	24.23	14.05	16.66	17.17	16.45	16.95	16.54	16.39	16.56

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, renewable energy, and coal. 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 2001, Dec. 2000, Table A2, p. 128-130 and Table A18, p. 150 for energy consumption and Table A19, p. 151 for carbon emissions.

7.1.1 Weatherization Population Facts

- Roughly 25% of Federally eligible households move in and out of poverty each year.
- The average income of Federally eligible households in FY 1998 was $12,880, 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 1998, the energy burden on Federally eligible households was slightly less than four times the burden on Federally ineligible households (12.5% versus 3.2%).
- DOE Weatherization saves an average of 13-34% on home energy bills (depending on main heating fuel). This equates to $2.10 in energy benefits being produced for every $1.00 invested; an additional $0.60 are produced in non-energy (societal) benefits.

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 1998, Oct. 2000, Table A-2a, p. 75 for Federally eligible average income Federally eligible and Federally ineligible 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 ORNL, Weatherization Plus Progress Report: Poised to Move Forward, June 2001 for DOE weatherization savings; and BTS for remaining data.

7.1.2 Weatherization Program Facts

- In FY 2000, DOE contributed 31% to all Federal weatherization funding, LIHEAP 49%, and others 20%.
- 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 of about 30 million eligible households. LIHEAP's budget for FY 1995 was $1.5 billion, FY 1997 is $1.0 billion.

Source(s): DOE/BTS, Weatherization Program Notice 00-2, Dec. 16, 1999 for agency weatherization funding and HUD data; 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 EIA, Housing Characteristics 1993, June 1995, Table 3.1a, p. 26 for Federally eligible.

7.1.3 Weatherization Costs and Savings

- Legislation enacted in 2000 for the DOE Weatherization program requires that states spend no more than an average of $2,500 per household. 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 2.1 and a societal benefit-cost ratio of 2.7. 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): BTS, Weatherization Program Notice 00-1, Nov. 23, 1999 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 PY 1989; and 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 ORNL, Weatherization Plus Progress Report: Poised to Move Forward, June 2001 for DOE weatherization savings.

7.1.4 Residential Energy Burdens, by Weatherization Eligibility and Year

	1987	1990			FY 1998 (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%	6.3%	3.9%	2.6%
Federally Eligible	**13.0%**	**14.4%**	**N.A.**	**10.1%**	**12.5%**	**8.3%**	**8.4%**
Federally Ineligible	4.0%	3.5%	N.A.	N.A.	3.2%	2.8%	2.1%
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 1997, adjusted to reflect FY 1998 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, FY1998, Oct. 2000, Tables A-2a, A-2b, and A-2c, p. 75-77.

7.1.5 FY 1998 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	6.8%	4.3%	2.8%	6.8%	4.5%	2.8%	6.4%	3.7%	2.7%	5.0%	3.1%	1.9%
Federally Eligible	**13.5%**	**9.2%**	**8.8%**	**13.3%**	**9.2%**	**9.4%**	**14.1%**	**8.3%**	**8.6%**	**9.2%**	**6.3%**	**6.2%**
Federally Ineligible	3.5%	3.1%	2.3%	3.4%	3.1%	2.3%	3.1%	2.8%	2.2%	2.5%	2.2%	1.6%

Note(s): 1) Data are derived from RECS 1997, adjusted to reflect FY 1998 HDD, CDD, and fuel prices. See Table 7.1.4 for totals and Table 7.1.11 for definitions.

Source(s): HHS, LIHEAP Home Energy Notebook, FY1998, Oct. 2000, Tables A-2a, A-2b, and A-2c, p. 75-77.

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	0.16	N.A.	N.A.	N.A.	101.0
1997	0.17	34.1	67.4	19.7	101.5
1998	0.17	N.A.	N.A.	N.A.	102.8
1999	0.19	N.A.	N.A.	N.A.	104.1
2000	0.21	N.A.	N.A.	N.A.	105.3
Total 1977-2000	5.16	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/BTS 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, Apr. 1996, Table B-1, for 1986, 1988, 1989, and 1991 households.

7.1.7 1997 Households, Square Footage, by Income Level, Weatherization Eligibility, Household Type, and Ownership (million)

1997 Family Income	Total	**Federally Eligible**	Federally Ineligible	Below 125% Poverty Line	Single-Family	Multi-Family	Mobile Home	Own	Rent
Less than $5,000	3.8	**3.8**	0.0	3.8	1.9	1.5	0.4	1.2	2.5
$5,000 to $7,499	5.1	**5.1**	0.0	5.1	2.3	2.3	0.4	1.9	3.2
$7,500 to $9,999	4.5	**4.5**	0.0	4.1	2.4	1.8	0.3	2.1	2.4
$10,000 to $14,999	9.8	**9.8**	0.5	4.6	5.8	3.2	0.9	5.1	4.7
$15,000 to $19,999	6.1	**6.1**	4.3	1.5	4.3	1.1	0.6	3.8	2.2
$20,000 to $34,999	4.7	**4.7**	19.3	0.7	3.3	1.0	0.5	3.0	1.8
All Households	101.5	**34.1**	67.4	19.7	73.7	21.4	6.3	68.5	33.0
Federally Eligible					**20.1**	**11.0**	**3.0**	**17.1**	**17.0**
Federally Ineligible					53.7	10.4	3.3	51.3	16.1
Below 125% Poverty Line					10.5	7.3	1.9	8.2	11.5
Square Feet (billion)	168.8	**42.9**	125.9	22.9	143.5	19.1	6.3	134.7	34.1

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

7.1.8 1997 Average Energy Expenditures per Household Member and per Square Foot, by Weatherization Eligibility ($1999)

	Per Household Member	Members/ Hhold	Per Square Foot	Square Feet/ Hhold
Total U.S. Households	531	2.6	0.83	1663
Federally Eligible	**439**	**2.7**	**0.93**	**1259**
Federally Ineligible	580	2.5	0.79	1868
Below 125% Poverty Line	404	2.8	0.97	1164

Source(s): Data taken from EIA, 1997 Residential Energy Consumption Survey; and EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 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 1995, Aug. 1997, 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 1995, Aug. 1997, p. 55 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	15	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 2001, for water heater capacity; and AGA, Gas Facts 1998, Dec. 1999, www.aga.org for range and clothes dryer consumption.

7.3.1 1997 *Delivered* Energy End-Uses for an Average Household, by Region (10^6 Btu/Hhold)

	Northeast	Midwest	South	West	National
Space Heating	76.0	82.3	30.8	30.9	52.0
Space Cooling	2.0	3.3	8.8	5.7	5.7
Water Heating	21.4	22.0	15.7	19.1	19.0
Appliances (1)	22.8	28.3	29.8	24.3	26.9
Total	122.2	135.9	85.1	78.7	103.6

Note(s): 1) Includes refrigerators, freezers, lights, televisions, toaster ovens, electric stove-tops, electric ovens, microwave ovens, gas stove-tops, gas ovens, natural gas grills, clothes washers and dryers, dishwashers, swimming pool and hot tub pumps and heaters, personal computers, laser printers, facsimile machines, photocopiers, waterbed heaters, heated aquariums, evaporative coolers, fans, portable space heater, humidifier, dehumidifier, and air cleaners.

Source(s): EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table CE1-13c, p. 121-122.

7.3.2 1997 End-Use Carbon Dioxide Splits for an Average Household, by Region (pounds of CO2)

	Northeast	Midwest	South	West	National
Space Heating	11,085	9,804	5,125	4,703	7,285
Space Cooling	659	1,297	3,513	1,849	2,327
Water Heating	3,566	3,277	3,486	3,146	3,409
Appliances (1)	8,026	9,933	11,117	8,597	9,683
Total	23,336	24,312	23,241	18,295	22,703

Note(s): 1) Includes refrigerators, freezers, lights, televisions, toaster ovens, electric stove-tops, electric ovens, microwave ovens, gas stove-tops, gas ovens, natural gas grills, clothes washers and dryers, dishwashers, swimming pool and hot tub pumps and heaters, personal computers, laser printers, facsimile machines, photocopiers, waterbed heaters, heated aquariums, evaporative coolers, fans, portable space heater, humidifier, dehumidifier, and air cleaners.

Source(s): EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Tables CE(2-5)-(9-12)c; EIA, AEO 2001, Dec. 2000, Table A2, p. 128-130, Table A18, p. 150 for consumption data, and Table A19, p. 151 for emissions data; EIA, Emissions of Greenhouse Gases in the U.S. 1999, Oct. 2000, Table B1, www.eia.doe.gov for petroleum carbon emission coefficients; and EIA, Assumptions to the AEO 2001, Dec. 2000, Table 2, p. 9 for selected coefficients.

7.3.3 1997 Energy End-Use Expenditures for an Average Household, by Region ($1999)

	Northeast	Midwest	South	West	National
Space Heating	674	563	322	247	432
Space Cooling	76	83	206	131	144
Water Heating	239	184	208	173	201
Appliances (1)	736	631	648	578	646
Total	1726	1461	1385	1130	1423

Note(s): 1) Includes refrigerators, freezers, lights, televisions, toaster ovens, electric stove-tops, electric ovens, microwave ovens, gas stove-tops, gas ovens, natural gas grills, clothes washers and dryers, dishwashers, swimming pool and hot tub pumps and heaters, personal computers, laser printers, facsimile machines, photocopiers, waterbed heaters, heated aquariums, evaporative coolers, fans, portable space heater, humidifier, dehumidifier, and air cleaners.

Source(s): EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table CE1-13e, p. 130-131; EIA, Annual Energy Review 1999, July 2000, Appendix E, p. 347 for price inflators.

7.3.4 Materials Used in the Construction of a 2,085 Sq. Ft. New Single-Family Home, 1995

13,127 board-feet of lumber	12 interior doors
6,212 square feet of sheathing	7 closet doors
14 tons of concrete	2 garage doors
2,325 square feet of exterior siding material	1 fireplace
3,100 square feet of roofing material	3 toilets; 2 bathtubs; 1 shower stall
3,061 square feet of insulation	3 bathroom sinks
6,144 square feet of interior wall material	13 kitchen cabinets; 2 other cabinets
2,100 square feet of interior ceiling material	1 kitchen sink
120 linear feet of ducting	1 range; 1 refrigerator; 1 dishwasher; 1 garbage disposer; 1 range hood
15 windows	1 washer; 1 dryer
5 exterior doors (4 hinged, 1 sliding)	1 heating and cooling system
2,085 square feet of flooring material	

Source(s): NAHB, 1997 Housing Facts, Figures and Trends, 1997, p. 8.

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

Year Built		mid-1960s	Space Heating		
Occupants		3		Equipment	Central Warm-Air Furnace
Floorspace				Fuel	Natural Gas
	Heated Floospace	1946		Age (6)	13
	Cooled Floorspace	1692	Space Cooling (7)		Yes
	Garage	2-Car	Water Heating		
Stories		1		Size (8)	48
Foundation		Basement		Fuel	Natural Gas
Total Rooms (2)		6		Age (6)	9
	Bedrooms	3	Refrigerator		
	Other Rooms	3		Number	1
Full Bathroom		2		Size (9)	19
Half Bathroom		0		Age (6)	9
Window			Freezer		No
	Area (3)	224	Electric Clothes Dryer		Yes
	Number (4)	14	Electric Clothes Washer		Yes
	Type	Single-Pane	Dishwasher		Yes
	Frame	Nonmetal	Range/Oven		Electric
Insulation (5)			Microwave Oven		Yes
	Ceiling/Roof	Yes	Ceiling Fans		3
	Walls	Yes	Computer		No (10)
Lighting		N.A.	Television		
				Type	Color
				Number	2

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) Typical insulation levels are "well" or "adequate." Levels of insulation will vary depending on climate. 6) Years. 7) Approximately 75% of single-family homes were air-conditioned with either central air-conditioning, room air-conditioning, or a heat pump. 8) Gallons. 9) Cubic Feet. 10) In 1997, 40% (29.2 million) households had a computer.

Source(s): EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table HC1-4a, p. 42-44, Table HC2-4a, p. 52, Table HC3-4a, p. 59-60, Table HC4-4a, p. 68-69, Table HC5-4a, p. 81-84, HC7-4a, p. 109; EIA, RECS 1997, Nov. 1999; and EIA, Housing Characteristics 1993, June 1995, Table 3.29a, p. 168-173.

7.4.1 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 judgement.

Source(s): LBNL, Commercial Heating and Cooling Loads Component Analysis, June 1998, Table 10, p. 31.

7.4.3 Typical School Building (1)

		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 judgement.

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 judgement.

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 judgement.

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

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- Works with State and local regulatory groups to improve building codes, appliance standards, and guidelines for efficient energy use
- Provides support and grants to States and communities for deployment of energy-efficient technologies and practices