2011 BUILDINGS ENERGY DATA BOOK

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

2011 Buildings Energy Data Book

March 2012

Prepared for the
Buildings Technologies Program
Energy Efficiency and Renewable Energy
U.S. Department of Energy

by
D&R International, Ltd.

under contract to
Pacific Northwest National Laboratory

This version is dated: March 2012

Table of Contents

Table of Contents

Foreword

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

Data is organized into nine chapters; Chapter 1 – Buildings Sector, Chapter 2 – Residential Sector, Chapter 3 – Commercial Sector, Chapter 4 – Federal Sector, Chapter 5 – Envelope and Equipment, Chapter 6– Energy Supply, Chapter 7 – Energy Codes, Standards, and Laws, Chapter 8 – Water Data, and Chapter 9 – Market Transformation. New data tables on commercial building energy benchmarks were added to their relevant sections. New data tables were also developed from an updated report on commercial refrigeration. You will also find updated market transformation data from the ENERGY STAR program and the U.S. Green Building Council. We continue to refine and provide water data.

We hope you find the *2011 Buildings Energy Data Book* useful. You are encouraged to comment on errors, omissions, emphases, and organization of this report to the person listed below. Requests for additional copies of this report, additional data, or information on an existing table should be referred to D&R International.

Jordan D. Kelso, PE
D&R International, Ltd.
1300 Spring Street
Suite 500
Silver Spring, Maryland 20910
Telephone: (301) 588-9387
Fax: (301) 588-0854
E-mail: jkelso@drintl.com

The *2010 Buildings Energy Data Book* can be found on the web at:

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

Introduction

The *2010 Buildings Energy Data Book* is a statistical compendium prepared and published under contract with the Pacific Northwest National Laboratory (PNNL) with support from the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE). PNNL first published the predecessor to the annual *Buildings Energy Data Book* in 1986. PNNL published these through 2004; Oak Ridge National Laboratory 2005-2006, and National Energy Technology Laboratory 2007-2009.

The Department of Energy's Office of Energy Efficiency and Renewable Energy has developed this *2010 Buildings Energy Data Book* to provide a current and accurate set of comprehensive buildings-related data and to promote the use of such data for consistency throughout DOE programs. Additional data (e.g., more current, widely accepted, and/or better documented data) and suggested changes should be submitted to D&R International. Please provide full source references along with all data.

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

List of Tables

Glossary

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
BTS	DOE's Office of Building Technology, State and Community Programs
CBECS	EIA's Commercial Building Energy Consumption Survey
CDD	Cooling Degree Days
CF	Cubic feet
CFC	Chlorofluorocarbon
CHP	Combined Heat and Power
CO	Carbon monoxide
CO2	Carbon dioxide (CO_2)
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)
DG	Distributed Generation
DOC	U.S. Department of Commerce
DOE	U.S. Department of Energy
EER	Energy Efficiency Ratio (Btu/watt-hour)
EERE	DOE’s Energy Efficiency and Renewable Energy Office
EF	Energy Factor
EIA	DOE's Energy Information Administration
EPA	U.S. Environmental Protection Agency
FEMP	DOE's Federal Energy Management Program
FT2	Square Feet
FY	Fiscal Year
GAMA	Gas Appliance Manufacturers Association

Glossary

GDP	Gross Domestic Product
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 CO2	Million metric tons of carbon dioxide (includes only energy consumption effects, unless otherwise noted)
N.A.	Not Available
N/A	Not Applicable
NAHB	National Association of Home Builders
NCES	National Center for Educational Statistics
NEMS	National Energy Modeling System
NIST	National Institute of Standards and Technology
NWWDA	National Wood Window and Door Association
NOx	Nitrogen oxide (NO_x)
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
OWIP	Office of Weatherization and Intergovernmental Program
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

Glossary

Primary	Refers to energy used at the source (including fuel input to electric power plants)
PV	Photovoltaic
PY	Program Year
Quad	Quadrillion Btu (10^15 Btu)
R-value	Thermal resistance measured in (Btu/Hr-SF-^{o}F)$^{-1}$
RECS	EIA's Residential Energy Consumption Survey
SEDS	State Energy Data System
SEER	Seasonal Energy Efficiency Ratio (Btu/watt-hour)
SEF	Solar Energy Factor
SF	Square feet
SHGC	Solar heat gain coefficient
SIC	Standard Industrial Classification
Site	Refers to energy used on site (i.e., delivered)
SO2	Sulfur dioxide (SO_2)
SRCC	Solar Rating and Certification Corporation
U-Factor	Thermal conductance measured in (Btu/Hr-SF-^{o}F)
VOC	Volatile organic compounds

Chapter 1: Buildings Sector

Chapter 1 provides an overview of energy use in the U.S. buildings sector, which includes single- and multi-family residences and commercial buildings. Commercial buildings include offices, stores, restaurants, warehouses, other buildings used for commercial purposes, and government buildings. Section 1.1 presents data on primary energy consumption, as well as energy consumption by end use. Section 1.2 focuses on energy and fuel expenditures in U.S. buildings. Section 1.3 provides estimates of construction spending, R&D, and construction industry employment. Section 1.4 covers emissions from energy use in buildings, construction waste, and other environmental impacts. Section 1.5 discusses key measures used throughout the Data Book, such as a quad, primary vs. delivered energy, and carbon emissions. Section 1.6 provides estimates of embodied energy for various building assemblies. The main points from this chapter are summarized below.

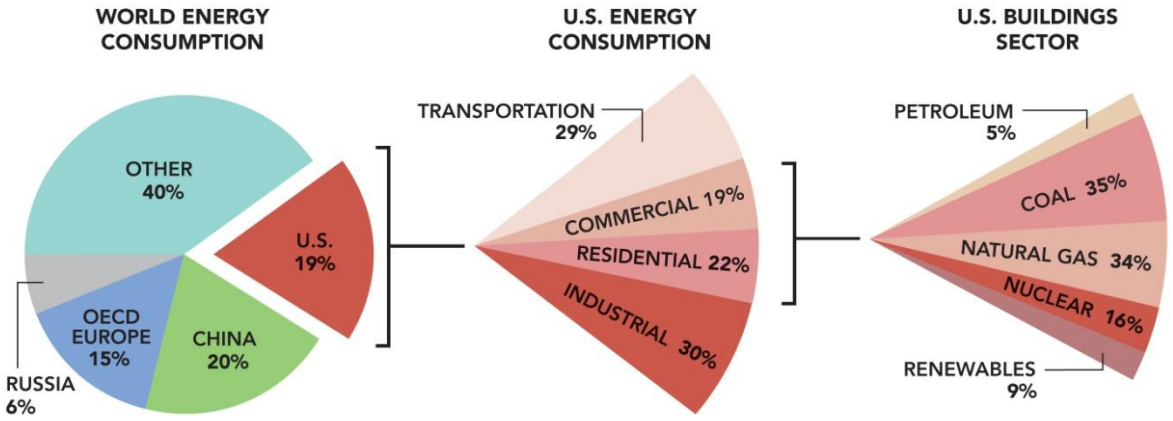
- The 97.8 quads of energy the U.S. consumed in 2010 represented 19% of global consumption—the second largest share of world energy consumption by any country; only China consumed more. (1.1.13) The U.S. buildings sector alone accounted for 7% of global primary energy consumption in 2010. (1.1.3)
- In the United States, the buildings sector accounted for about 41% of primary energy consumption in 2010, 44% more than the transportation sector and 36% more than the industrial sector. (1.1.3)
- Total building primary energy consumption in 2009 was about 48% higher than consumption in 1980. (1.1.8) Space heating, space cooling, and lighting were the dominant end uses in 2010, accounting for close to half of all energy consumed by the buildings sector. (1.1.4)

New building construction also took a big hit in 2010 and was valued at 55% less than at its peak in 2006. (1.3.2) The number of people employed in architecture and construction has decreased 27% from 2006 levels. (1.3.7)

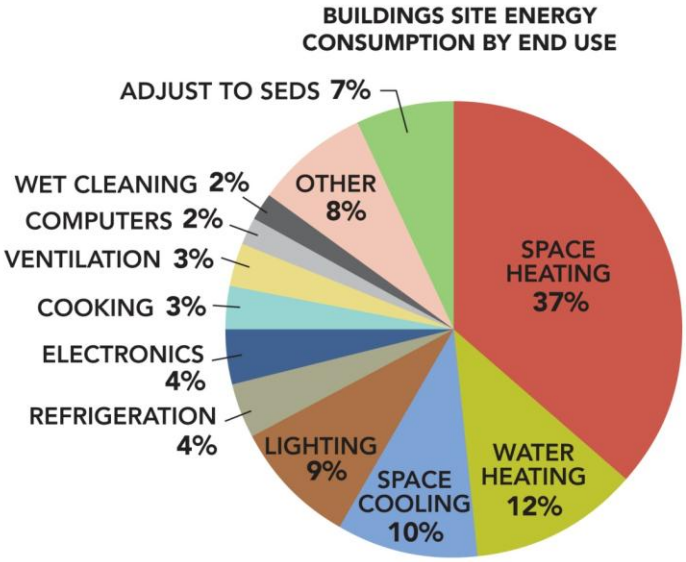
In 2010, China took the United States' place as the largest consumer of energy in the world. Between 2008 and 2010, energy consumption in the U.S. decreased by 2% to 97.8 quads, whereas China's energy consumption increased by 22.9% to 104.6 quads. (1.1.13) Meanwhile, China's carbon dioxide emissions continued to rise at a notable rate, 21% between 2008 and 2010. The U.S.'s carbon dioxide emissions decreased 3% over the same period. U.S. buildings have come to represent an increasing portion of the country's carbon dioxide emissions—40% in 2009, compared to 33% in 1980; yet, the fast growth rate of global emissions means that emissions from U.S. buildings have become a declining percentage of the global total—8.5% in 1980, compared to 7.1% in 2009. (1.4.1)

The decline in U.S. energy consumption can be attributed to the economic recession, which has had a particularly hard impact on the building sector. Total energy expenditures in the building sector decreased 8% to 417.8 billion from 2008 to 2009, the largest percent drop in the last 30 years. (1.2.3) The value of new building construction dropped again for the fourth year in a row and was valued at 377.4 billion, 55% less than at its peak in 2006, where new building construction was valued at 843.6 billion. (1.3.2) As expected, the number of people employed in architecture and construction has also decreased since 2006. More than 7.9 million people were employed in the two industries then, compared to 5.7 million in 2010, a 27% drop. (1.3.7)

Forty-one percent of U.S. primary energy was consumed by the buildings sector, compared to 30% by the industrial sector and 29% by the transportation sector. Of the 39 quads consumed in the buildings sector, homes accounted for 54% and commercial buildings accounted for 46% (1.1.3). Of the energy sources used by the U.S. buildings sector, 75% came from fossil fuels, 16% from nuclear generation, and 9% from renewables. (1.1.8)

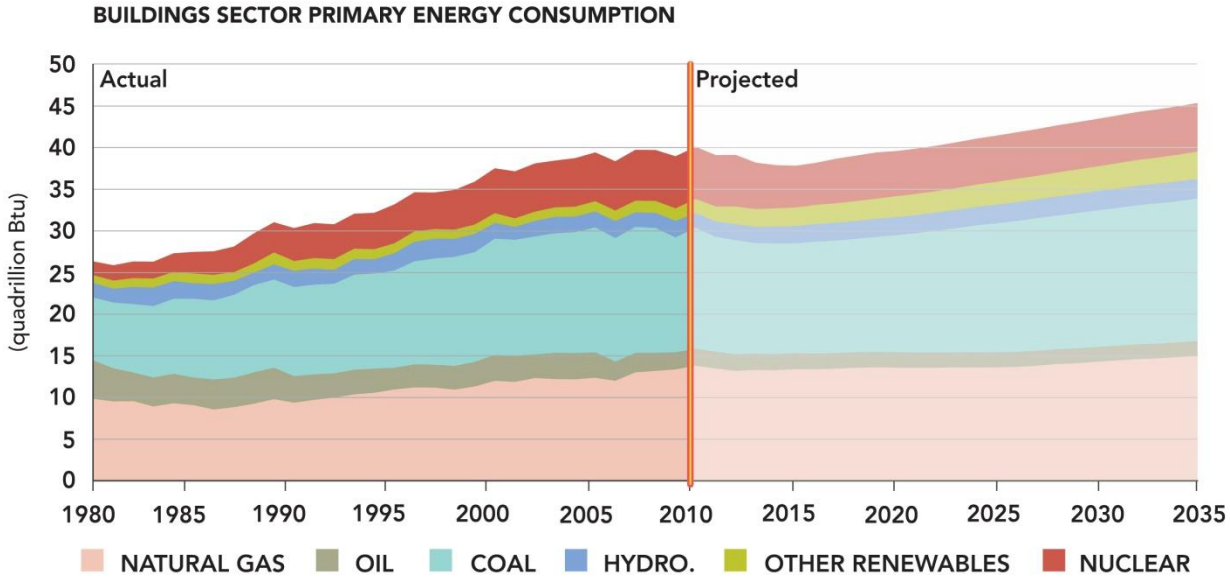


The buildings sector consumed 20 quads of delivered (site) energy in 2010. Delivered energy does not include energy lost during production, transmission, or distribution to customers. The top four end uses—space heating, space cooling, water heating, and lighting—accounted for close to 70% of site energy consumption. Other end uses, such as consumer electronics, kitchen appliances, and ventilation, made up the remainder. (1.1.4)



U.S. building primary energy consumption increased by 48% between 1980 and 2009. The Energy Information Administration (EIA) projects that this growth will stagnate due to the recession until 2016, when steady growth is predicted through 2035. Total primary energy consumption is expected to reach more than 45 quads by 2035, an 17% increase over 2009 levels.

This growth in buildings sector energy consumption is fueled primarily by the growth in population, households, and commercial floorspace, which are expected to increase 27% (2.2.1), 31% (2.1.4), and 28% (3.2.1), respectively, between 2009 and 2035. The use of coal is projected to increase by 11% over the same period, while natural gas consumption will increase by 17%. Use of non-hydroelectric renewable resources, including wind, solar, and biofuels, is expected to increase 109%. (1.1.8)


BUILDINGS SECTOR PRIMARY ENERGY CONSUMPTION
(quadrillion Btu)
50
45
40
35
30
25
20
15
10
5
0
Actual
Projected
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
NATURAL GAS
OIL
COAL
HYDRO.
OTHER RENEWABLES
NUCLEAR

1.1.1 U.S. Residential and Commercial Buildings Total Primary Energy Consumption (Quadrillion Btu and Percent of Total)

	Natural Gas		Petroleum (1)		Coal		Renewable(2)		Electricity Sales	Electricity Losses	Electricity Total		TOTAL (2)		Growth Rate 2010-Year
1980	7.42	28.2%	3.04	11.5%	0.15	0.6%	0.87	3.3%	4.35	10.47	14.82	56.4%	26.29	100%	-
1990	7.14	23.6%	2.36	7.8%	0.15	0.5%	0.74	2.5%	6.01	13.81	19.82	65.6%	30.22	100%	-
2000	8.30	22.1%	2.32	6.2%	0.10	0.3%	0.63	1.7%	8.02	18.15	26.17	69.8%	37.52	100%	-
2005	8.01	20.3%	2.18	5.5%	0.10	0.3%	0.62	1.6%	8.99	19.55	28.53	72.3%	39.44	100%	-
2010	**8.35**	**20.7%**	**1.94**	**4.8%**	**0.07**	**0.2%**	**0.59**	**1.5%**	**9.49**	**19.90 (3)**	**29.39**	**72.9%**	**40.33**	**100%**	**-**
2015	8.40	21.4%	1.71	4.3%	0.06	0.2%	0.66	1.7%	9.43	19.03	28.46	72.4%	39.29	100%	-0.5%
2020	8.43	20.6%	1.63	4.0%	0.06	0.2%	0.69	1.7%	9.95	20.10	30.05	73.6%	40.86	100%	0.1%
2025	8.39	19.7%	1.57	3.7%	0.06	0.2%	0.69	1.6%	10.53	21.24	31.77	74.8%	42.48	100%	0.3%
2030	8.42	19.1%	1.53	3.5%	0.06	0.1%	0.70	1.6%	11.20	22.11	33.31	75.7%	44.03	100%	0.4%
2035	8.41	18.5%	1.50	3.3%	0.06	0.1%	0.71	1.6%	11.83	23.00	34.83	76.5%	45.52	100%	0.5%

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) 2010 site-to-source electricity conversion = 3.10.

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for 2010-2035 and Table A17, p. 34-35 for non-marketed renewable energy.

1.1.2 U.S. Buildings Site Renewable Energy Consumption (Quadrillion Btu) (1)

	Wood (2)	Solar Thermal (3)	Solar PV (3)	GSHP (4)	Total	Growth Rate 2010-Year
1980	0.867	0.000	N.A.	0.000	0.867	-
1990	0.675	0.056	N.A.	0.008	0.739	-
2000	0.549	0.060	N.A.	0.016	0.625	-
2005	0.532	0.058	N.A.	0.029	0.620	-
2010	**0.534**	**0.038**	**0.016**	**0.006**	**0.593**	**-**
2015	0.536	0.049	0.052	0.012	0.648	1.8%
2020	0.542	0.051	0.064	0.019	0.675	1.3%
2025	0.543	0.052	0.066	0.022	0.684	1.0%
2030	0.545	0.053	0.069	0.024	0.692	0.8%
2035	0.546	0.057	0.074	0.027	0.703	0.7%

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-

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables,Table A17, p. 34-35 for 2010-2035.

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

	Buildings Residential	Buildings Commercial	Buildings **Total**	Industry	Transportation	Total	Total Consumption (quads)
1980(1)	20.1%	13.5%	**33.7%**	41.1%	25.2%	100%	78.1
1990	20.0%	15.7%	**35.8%**	37.7%	26.5%	100%	84.5
2000	20.6%	17.4%	**38.0%**	35.1%	26.9%	100%	98.7
2005	21.5%	17.8%	**39.3%**	32.4%	28.3%	100%	100.3
2010	**22.5%**	**18.6%**	**41.1%**	**30.8%**	**28.1%**	**100%**	**98.2**
2015	21.5%	18.6%	**40.2%**	31.4%	28.4%	100%	97.8
2020	21.4%	19.0%	**40.4%**	32.0%	27.6%	100%	101.1
2025	21.7%	19.5%	**41.2%**	31.8%	27.0%	100%	103.1
2030	21.9%	19.9%	**41.8%**	31.5%	26.8%	100%	105.4
2035	21.9%	20.2%	**42.1%**	31.1%	26.8%	100%	108.1

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

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for 2010-2035 and Table A17, p. 34-35 for non-marketed renewable energy.

1.1.4 2010 U.S. Buildings Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas	Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (4)	Primary Total	Primary Percent
Space Heating (5)	5.14	0.76	0.30	0.10	0.54	0.72	7.56	37.0%	2.24	9.07	22.5%
Space Cooling	0.04					1.92	1.96	9.6%	5.94	5.98	14.8%
Lighting						1.88	1.88	9.2%	5.82	5.82	14.4%
Water Heating	1.73	0.13	0.07		0.04	0.54	2.51	12.3%	1.67	3.63	9.0%
Refrigeration (6)						0.84	0.84	4.1%	2.62	2.62	6.5%
Electronics (7)						0.81	0.81	3.9%	2.49	2.49	6.2%
Ventilation (8)						0.54	0.54	2.6%	1.66	1.66	4.1%
Computers						0.38	0.38	1.9%	1.19	1.19	2.9%
Cooking	0.39		0.03			0.21	0.63	3.1%	0.64	1.06	2.6%
Wet Cleaning (9)	0.06					0.33	0.38	1.9%	1.01	1.06	2.6%
Other (10)	0.30	0.01	0.30	0.05	0.02	0.89	1.58	7.7%	2.76	3.45	8.6%
Adjust to SEDS (11)	0.68	0.25				0.44	1.37	6.7%	1.35	2.28	5.7%
Total	**8.35**	**1.14**	**0.70**	**0.15**	**0.59**	**9.49**	**20.43**	100%	**29.39**	**40.33**	100%

Note(s): 1) Includes distillate fuel oil (1.06 quad) and residual fuel oil (0.08 quad). 2) Kerosene (0.04 quad) and coal (0.07 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of wood space heating (0.42 quad), biomass (0.11), solar water heating (0.04 quad), geothermal space heating (less than 0.01 quad), solar photovoltaics (PV) less than 0.02 quad), and wind (less than 0.01 quad). 4) Site-to-source electricity conversion (due to generation and transmission losses) = 3.10. 5) Includes furnace fans (0.42 quad). 6) Includes refrigerators (2.36 quad) and freezers (0.26 quad). Includes commercial refrigeration. 7) Includes color television (1.02 quad) and other office equipment (0.81 quad). 8) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 9) Includes clothes washers (0.10 quad), natural gas clothes dryers (0.06 quad), electric clothes dryers (0.60 quad) and dishwashers (0.31 quad). Does not include water heating energy. 10) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 11) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential and commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Tables A2, Table A4, Table A5, and Table A17; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, Supplement to the Annual Energy Outlook 2012 Early Release, Jan. 2012, Table 32; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses; BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2 and 5-25 - 5-26; EIA, Annual Energy Outlook 1998, Dec. 1997, Table A5, p. 108-109 for 1995 ventilation; and BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, Sept. 2002, Table 8-2, p. 63.

1.1.5 2015 U.S. Buildings Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas	Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (4)	Primary Total	Primary Percent
Space Heating (5)	5.10	0.68	0.26	0.09	0.55	0.59	7.27	35.9%	1.77	8.45	21.5%
Lighting						1.52	1.52	7.5%	4.65	4.65	11.8%
Space Cooling	0.04					0.54	0.57	2.8%	4.60	4.63	11.8%
Water Heating	1.79	0.10	0.05		0.05	0.57	2.55	12.6%	1.71	3.70	9.4%
Refrigeration (6)						0.81	0.81	4.0%	2.43	2.43	6.2%
Electronics (7)						1.54	1.54	7.6%	1.94	1.94	4.9%
Ventilation (8)						0.14	0.14	0.7%	1.62	1.62	4.1%
Computers						0.38	0.38	1.9%	1.14	1.14	2.9%
Wet Cleaning (9)	0.06					0.64	0.70	3.5%	0.98	1.04	2.7%
Cooking	0.41		0.03			0.33	0.76	3.8%	0.41	0.85	2.2%
Other (10)	0.33	0.01	0.31	0.05	0.06	1.76	2.52	12.4%	5.30	6.06	15.4%
Adjust to SEDS (11)	0.68	0.19				0.63	1.50	7.4%	1.90	2.77	7.1%
Total	**8.40**	**0.98**	**0.65**	**0.14**	**0.66**	**9.43**	**20.26**	100%	**28.46**	**39.29**	100%

Note(s): 1) Includes distillate fuel oil (0.90 quad) and residual fuel oil (0.08 quad). 2) Kerosene (0.03 quad) and coal (0.06 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of wood space heating (0.43 quad), biomass (0.11), solar water heating (0.05 quad), geothermal space heating (0.01 quad), solar photovoltaics (PV) (0.05 quad), and wind (less than 0.01 quad). 4) Site-to-source electricity conversion (due to generation and transmission losses) = 3.02. 5) Includes furnace fans (0.14 quad). 6) Includes refrigerators (2.18 quad) and freezers (0.25 quad). Includes commercial refrigeration. 7) Includes color television (0.99 quad). 8) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 9) Includes clothes washers (0.10 quad), natural gas clothes dryers (0.06 quad), electric clothes dryers (0.59 quad) and dishwashers (0.30 quad). Does not include water heating energy. 10) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 11) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential and commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Tables A2, p. 3-5, Table A4, p. 9-10, Table A5, p. 11-12, and Table A17, p. 34-35; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; and EIA, Supplement to the AEO 2012 Early Release, Jan. 2012, Table 32.

1.1.6 2025 U.S. Buildings Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas	Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (4)	Primary Total	Primary Percent
Space Heating (5)	4.96	0.57	0.24	0.09	0.57	0.63	7.05	33.2%	1.89	8.31	19.6%
Space Cooling	0.03					1.64	1.67	7.9%	4.94	4.97	11.7%
Lighting						1.55	1.55	7.3%	4.68	4.68	11.0%
Water Heating	1.84	0.08	0.04		0.05	0.62	2.63	12.4%	1.86	3.88	9.1%
Refrigeration (6)						0.82	0.82	3.9%	2.47	2.47	5.8%
Electronics (7)						0.78	0.78	3.7%	2.34	2.34	5.5%
Ventilation (8)						0.60	0.60	2.8%	1.80	1.80	4.2%
Computers						0.44	0.44	2.0%	1.31	1.31	3.1%
Wet Cleaning (9)	0.06					0.30	0.37	1.7%	0.91	0.98	2.3%
Cooking	0.43		0.03			0.15	0.61	2.9%	0.46	0.92	2.2%
Other (10)	0.48	0.01	0.34	0.05	0.08	2.32	3.28	15.5%	7.00	7.96	18.7%
Adjust to SEDS (11)	0.58	0.18				0.69	1.46	6.9%	2.09	2.85	6.7%
Total	**8.39**	**0.84**	**0.65**	**0.15**	**0.69**	**10.53**	**21.25**	100%	**31.77**	**42.48**	100%

Note(s): 1) Includes distillate fuel oil (0.76 quad) and residual fuel oil (0.08 quad). 2) Kerosene (0.03 quad) and coal (0.06 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of wood space heating (0.443quad), biomass (0.11 quad), solar water heating (0.05 quad), geothermal space heating (0.02 quad), solar photovoltaics (PV) (0.07 quad), and wind (0.01 quad). 4) Site-to-source electricity conversion (due to generation and transmission losses) = 3.02. 5) Includes furnace fans (0.44 quad). 6) Includes refrigerators (2.21 quad) and freezers (0.26 quad). Includes commercial refrigeration. 7) Includes color television (1.12 quad). 8) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 9) Includes clothes washers (0.08 quad), natural gas clothes dryers (0.06 quad), electric clothes dryers (0.54 quad) and dishwashers (0.30 quad). Does not include water heating energy. 10) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 11) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential and commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Tables A2, p. 3-5, Table A4, p. 9-10, Table A5, p. 11-12, and Table A17, p. 34-35; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012,and EIA, Supplement to the AEO 2012 Early Release, Jan. 2012, Table 32.

1.1.7 2035 U.S. Buildings Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas	Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (4)	Primary Total	Primary Percent
Space Heating (5)	4.84	0.49	0.22	0.09	0.57	0.66	6.87	30.5%	1.93	8.15	17.9%
Space Cooling	0.03					1.79	1.82	8.1%	5.27	5.30	11.7%
Lighting						1.63	1.63	7.3%	4.81	4.81	10.6%
Water Heating	1.81	0.07	0.03		0.06	0.63	2.60	11.6%	1.86	3.83	8.4%
Electronics (6)						0.90	0.90	4.0%	2.66	2.66	5.8%
Refrigeration (7)						0.88	0.88	3.9%	2.60	2.60	5.7%
Ventilation (8)						0.65	0.65	2.9%	1.91	1.91	4.2%
Computers						0.49	0.49	2.2%	1.43	1.43	3.1%
Wet Cleaning (9)	0.07					0.32	0.39	1.7%	0.95	1.01	2.2%
Cooking	0.45		0.02			0.17	0.65	2.9%	0.50	0.98	2.2%
Other (10)	0.81	0.01	0.38	0.06	0.08	2.94	4.28	19.0%	8.65	9.99	21.9%
Adjust to SEDS (11)	0.40	0.18				0.77	1.36	6.0%	2.28	2.86	6.3%
Total	**8.41**	**0.75**	**0.66**	**0.15**	**0.71**	**11.83**	**22.52**	100%	**34.83**	**45.52**	100%

Note(s): 1) Includes distillate fuel oil (0.67 quad) and residual fuel oil (0.08 quad). 2) Kerosene (0.03 quad) and coal (0.06 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of wood space heating (0.44 quad), biomass (0.11 quad), solar water heating (0.06 quad), geothermal space heating (0.03 quad), solar photovoltaics (PV) (0.07 quad), and wind (0.01 quad). 4) Site-to-source electricity conversion (due to generation and transmission losses) = 2.94. 5) Includes furnace fans (0.45 quad). 6) Includes color television (1.29 quad) and other office equipment (1.37 quad). 7) Includes refrigerators (2.33 quad) and freezers (0.26 quad). Includes commercial refrigeration. 8) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 9) Includes clothes washers (0.07 quad), natural gas clothes dryers (0.07 quad), electric clothes dryers (0.55 quad) and dishwashers (0.33 quad). Does not include water heating energy. 10) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 11) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the residential and commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Tables A2, p. 3-5, Table A4, p. 9-10, Table A5, p. 11-12, and Table A17, p. 34-35; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012,and EIA, Supplement to the AEO 2012 Early Release, Jan. 2012, Table 32.

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

				Renewables (2)				
	Natural Gas	Petroleum	Coal	Hydroelectric	Other	Total	Nuclear	Total
1980	37%	18%	29%	7%	3%	10%	6%	100%
1990	31%	11%	36%	6%	4%	10%	13%	100%
2000	32%	8%	37%	5%	3%	8%	14%	100%
2005	31%	8%	38%	5%	3%	8%	15%	100%
2010	**35%**	**6%**	**36%**	**5%**	**4%**	**9%**	**16%**	**100%**
2015	37%	5%	31%	5%	5%	11%	16%	100%
2020	35%	5%	32%	5%	6%	11%	17%	100%
2025	34%	4%	33%	5%	7%	12%	17%	100%
2030	34%	4%	33%	5%	7%	12%	17%	100%
2035	34%	4%	33%	5%	7%	13%	16%	100%

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

Source(s): EEIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for 2010-2035 and Table A17, p. 34-35 for non-marketed renewable energy.

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

	Buildings						*Delivered Total*
	Residential	Commercial	**Total**	Industry	Transportation	Total	(quads)
1980	34%	27%	**61%**	39%	0%	100%	7.15
1990	34%	31%	**65%**	35%	0%	100%	9.26
2000	35%	34%	**69%**	31%	0%	100%	11.67
2005	37%	35%	**72%**	28%	0%	100%	12.49
2010 (1)	**39%**	**35%**	**74%**	**26%**	**0%**	**100%**	**12.79**
2015	37%	36%	**73%**	27%	0%	100%	12.88
2020	37%	36%	**73%**	26%	0%	100%	13.58
2025	38%	37%	**74%**	25%	0%	100%	14.13
2030	38%	38%	**76%**	24%	0%	100%	14.75
2035	39%	38%	**77%**	22%	1%	100%	15.32

Note(s): 1) Buildings accounted for 73.6% (or $301.6 billion) of total U.S. electricity expenditures.

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for 2010-2035 and Table A17, p. 34-35 for non-marketed renewable energy.

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

	Site Consumption				Primary Consumption			U.S. Natural Gas Total
	Buildings	Industry	Electric Gen.	Transportation	**Buildings**	Industry	Transportation	(quads)
1980	**37%**	41%	19%	3%	**48%**	49%	3%	20.22
1990	**36%**	43%	17%	3%	**47%**	49%	4%	19.57
2000	**35%**	40%	22%	3%	**50%**	47%	3%	23.66
2005	**36%**	35%	27%	3%	**55%**	42%	3%	22.49
2010 (1)	**34%**	**33%**	**31%**	**3%**	**56%**	**41%**	**3%**	**24.71**
2015	**32%**	33%	32%	3%	**56%**	41%	3%	25.99
2020	**32%**	34%	31%	3%	**55%**	42%	3%	26.13
2025	**33%**	34%	30%	3%	**55%**	42%	3%	25.80
2030	**32%**	33%	32%	3%	**56%**	40%	3%	26.49
2035	**31%**	32%	34%	3%	**57%**	40%	3%	27.11

Note(s): 1) Buildings accounted for 64.2% (or $86.0 billion) of total U.S. natural gas expenditures.

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for 2010-2035 and Table A17, p. 34-35 for non-marketed renewable energy.

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

	Site Consumption				Primary Consumption			U.S. Petroleum Total
	Buildings	Industry	Electric Gen.	Transportation	**Buildings**	Industry	Transportation	(quads)
1980	**9%**	28%	8%	56%	**14%**	31%	56%	34.2
1990	**7%**	25%	4%	64%	**10%**	26%	64%	33.6
2000	**6%**	24%	3%	67%	**8%**	25%	67%	38.4
2005	**5%**	24%	3%	68%	**8%**	25%	68%	40.7
2010 (1)	**5%**	**22%**	**1%**	**72%**	**6%**	**22%**	**72%**	**37.2**
2015	**5%**	21%	1%	73%	**5%**	22%	73%	36.9
2020	**4%**	22%	1%	73%	**5%**	22%	73%	37.1
2025	**4%**	22%	1%	73%	**5%**	22%	73%	37.0
2030	**4%**	22%	1%	73%	**5%**	22%	73%	37.3
2035	**4%**	22%	1%	73%	**5%**	22%	73%	38.0

Note(s): 1) Buildings accounted for an estimated 5.4% (or $39.1 billion) of total U.S. petroleum expenditures.

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for 2010-2035 and Table A17, p. 34-35 for non-marketed renewable energy.

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

	Buildings					
	Residential	Commercial	**Total**	Industry	Transportation	Total
1980	2.62	2.01	**4.63**	10.55	19.01	34.19
1990	1.81	1.38	**3.20**	8.73	21.63	33.55
2000	1.92	1.19	**3.11**	9.47	25.82	38.40
2005	1.88	1.18	**3.07**	10.02	27.65	40.73
2010	**1.37**	**0.85**	**2.22**	**8.15**	**26.88**	**37.25**
2015	1.20	0.73	**1.93**	8.00	26.96	36.89
2020	1.13	0.73	**1.86**	8.29	27.00	37.15
2025	1.08	0.74	**1.82**	8.30	26.92	37.04
2030	1.04	0.74	**1.78**	8.29	27.24	37.31
2035	1.01	0.75	**1.76**	8.34	27.90	38.00

Source(s): EIA, Annual Energy Review 2010, Oct. 2011, Table 5.13a for 1980-2009 buildings, Table 5.13b for 1980 to 2009 industry, Table 5.13c for 1980-2009 transportation, and Table 5.13d for 1980-2009 electricity generators; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for 2010-2035 consumption; EIA, State Energy Consumption Database, June 2011 for 1980-2009

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

	Energy Consumption (Quad)				Population (million)				Annual Growth Rate 1990-2000		Annual Growth Rate 2000-2010	
Region/Country	1990	2000	2010		1990	2000	2010		Energy	Pop.	Energy	Pop.
United States	85.0	99.8	97.8	18.7%	250	282	311	4.6%	1.6%	1.2%	-0.2%	1.0%
China	27.0	36.4	104.6	20.0%	1,148	1,264	1,343	20.0%	3.0%	1.0%	11.1%	0.6%
OECD Europe	69.9	76.8	79.6	15.2%	402	522	550	8.2%	0.9%	2.6%	0.4%	0.5%
Other Non-OECD Asia	12.5	20.6	31.3	6.0%	781	1,014	1,086	16.2%	5.1%	2.6%	4.2%	0.7%
Russia (1)	61.0	27.2	29.9	5.7%	288	147	140	2.1%	-7.7%	-6.5%	0.9%	-0.5%
Central & S. America	14.5	20.8	28.1	5.4%	359	422	462	6.9%	3.7%	1.6%	3.0%	0.9%
Middle East	11.2	17.3	27.6	5.3%	135	173	213	3.2%	4.5%	2.5%	4.8%	2.1%
Japan	18.8	22.4	20.8	4.0%	124	127	127	1.9%	1.8%	0.3%	-0.8%	0.0%
India	7.9	13.5	23.8	4.6%	838	1,006	1,214	18.1%	5.5%	1.8%	5.9%	1.9%
Canada	11.0	13.1	14.3	2.7%	28	31	34	0.5%	1.8%	1.1%	0.9%	0.9%
Oth. Non-OECD Europe	6.4	17.6	19.4	3.7%	154	128	199	3.0%	10.7%	-1.8%	1.0%	4.5%
Africa	9.5	12.0	19.5	3.7%	631	804	1,001	14.9%	2.4%	2.4%	4.9%	2.2%
South Korea	3.8	7.8	10.2	2.0%	43	47	49	0.7%	7.4%	0.9%	2.7%	0.5%
Mexico/Chile (2)	4.7	6.4	8.5	1.6%	85	100	128	1.9%	3.1%	1.6%	2.9%	2.5%
Australia & N. Zealand	4.4	5.7	6.9	1.3%	20	23	26	0.4%	2.5%	1.2%	2.0%	1.3%
Total World	**348.4**	**397.4**	**522.0**	100%	**5,287**	**6,089**	**6,701**	100%	1.3%	1.4%	2.8%	1.0%

Note(s): 1) 1990 Values for Russia approximated by Former USSR. 2) Before 2010, Mexico/Chile category only included Mexico.
Source(s): EIA, International Energy Outlook 2011, Sept. 2011, Table A1, p.157; EIA, Country Profiles http://www.eia.gov/country/index.cfm

1.2.1 Building Energy Prices, by Year and Major Fuel Type ($2010 per Million Btu)

	Residential Buildings				Commercial Buildings				Building
	Electricity	Natural Gas	Petroleum (1)	Avg.	Electricity	Natural Gas	Petroleum (2)	Avg.	Avg. (3)
1980	36.40	8.35	16.77	17.64	37.22	7.70	13.06	18.52	17.99
1990	35.19	8.63	13.27	18.64	32.49	7.20	9.31	18.62	18.63
2000	30.13	9.54	14.18	18.06	26.86	8.19	10.44	17.66	17.89
2005	30.64	13.66	18.93	21.50	28.11	12.15	15.14	20.92	21.25
2010	**33.69**	**11.08**	**23.75**	**22.42**	**29.73**	**9.10**	**20.28**	**20.99**	**21.80**
2015	33.22	10.28	28.73	22.24	28.07	8.59	24.07	20.11	21.30
2020	32.46	11.06	29.90	22.58	27.78	9.21	25.46	20.46	21.62
2025	32.31	12.11	31.22	23.36	27.74	10.12	26.73	21.07	22.32
2030	31.76	12.66	32.40	23.69	26.98	10.53	27.97	21.01	22.45
2035	32.47	13.86	33.86	24.92	27.99	11.55	28.94	22.14	23.62

Note(s): 1) Residential petroleum products include distillate fuel, LPG, and kerosene. 2) Commercial petroleum products include distillate fuel, LPG, kerosene, motor gasoline, and residual fuel. 3) In 2010, buildings average electricity price was $30.47/MMBtu or ($0.10/kWh), average natural gas price was $10.611/MMBtu ($1.06/therm), and petroleum was $22.66/ MMBtu ($3.14/gal.). Averages do not include wood or coal

Source(s): EIA, State Energy Data 2009: Prices and Expenditures, June 2011, for 1980-2009 and prices for note, Tables ET3-ET4, p. 27-28 for 1980-2009 consumption; EIA, Annual Energy Outlook 20112 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A3, p. 6-8, Table A12, p. 25-26, and Table A13, p. 27-28 for 2010-2035 consumption and prices; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for price deflators.

1.2.2 Building Energy Prices, by Year and Fuel Type ($2010)

	Residential Buildings				Commercial Buildings			
	Electricity (¢/kWh)	Natural Gas (¢/therm)	Distillate Oil ($/gal)	LPG ($/gal)	Electricity (¢/kWh)	Natural Gas (¢/therm)	Distillate Oil ($/gal)	Residual Oil ($/gal)
1980	12.42	83.51	1.53	2.24	12.70	77.01	1.43	2.05
1990	12.01	86.28	1.40	1.69	11.08	72.04	0.78	1.26
2000	10.28	95.36	1.51	1.70	9.17	81.85	0.84	1.28
2005	10.45	136.59	1.90	2.36	9.59	121.45	1.24	2.07
2010	**11.50**	**110.79**	**2.29**	**2.92**	**10.14**	**90.95**	**1.66**	**2.86**
2015	11.33	102.80	2.60	3.74	9.58	85.91	2.41	3.28
2020	11.08	110.57	2.64	3.96	9.48	92.13	2.63	3.49
2025	11.02	121.07	2.74	4.15	9.47	101.25	2.73	3.69
2030	10.84	126.62	2.82	4.34	9.20	105.25	2.85	3.89
2035	11.08	138.62	2.93	4.55	9.55	115.50	2.82	4.06

Source(s): EIA, State Energy Data 2009: Prices and Expenditures, June 2011, p. Tables ET3-ET4, p. 27-28 for 1980-2009; EIA, Annual Energy Outlook 2011, April 2011, Table G1, p. 225 for fuels' heat content; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A3, p. 6-8 for 2010-2035; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for price deflators.

1.2.3 Buildings Aggregate Energy Expenditures, by Year and Major Fuel Type ($2010 Billion) (1)

	Residential Buildings				Commercial Buildings				Total Building
	Electricity	Natural Gas	Petroleum (2)	Total	Electricity	Natural Gas	Petroleum (3)	Total	Expenditures
1980	89.1	40.5	28.9	158.5	70.9	20.5	17.2	108.6	267.2
1990	110.9	39.0	18.2	168.2	92.9	19.4	9.2	121.5	289.7
2000	122.6	48.6	21.6	192.8	106.3	26.6	8.3	141.2	334.0
2005	142.1	67.7	26.9	236.7	122.3	37.4	11.4	171.2	407.9
2010	**166.8**	**56.1**	**29.0**	**251.8**	**134.8**	**29.9**	**14.5**	**179.2**	**431.1**
2015	159.3	51.3	31.1	241.7	130.0	29.3	15.0	174.4	416.0
2020	163.1	54.7	30.1	247.9	136.9	32.1	15.7	184.8	432.7
2025	171.3	59.1	29.8	260.3	145.0	35.5	16.6	197.0	457.3
2030	178.9	61.3	29.5	269.7	150.1	37.7	17.3	205.1	474.9
2035	193.0	66.0	29.6	288.6	164.8	42.2	18.0	225.0	513.6

Note(s): 1) Expenditures exclude wood and coal. 2009 U.S. energy expenditures were 1.06 trillion. 2) Residential petroleum products include distillate fuel oil, LPG, and kerosene. 3) Commercial petroleum products include distillate fuel oil, LPG, kerosene, motor gasoline, and residual fuel.

Source(s): EIA, State Energy Data Prices and Expenditures Database, June 2011 for 1980-2009; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 and Table A3, p. 6-8 for 2010-2035; and EIA, Annual Energy Review 2011, Oct. 2011, Appendix D, p. 353 for price deflators.

1.2.4 FY 2007 Federal Buildings Energy Prices and Expenditures, by Fuel Type ($2010)

Fuel Type	Average Fuel Prices ($/million BTU)		Total Expenditures ($ million) (2)
Electricity	23.68 (1)		4009.39
Natural Gas	9.37		1138.21
Fuel Oil	15.25		419.30
Coal	3.62		62.87
Purchased Steam	24.30		318.35
LPG/Propane	17.06		43.87
Other	16.19		36.64
Average	17.05	**Total**	6028.63

Note(s): Prices and expenditures are for Goal-Subject buildings. 1) $0.0776/kWh. 2) Energy used in Goal-Subject buildings in FY 2007 accounted for 33.8% of the total Federal energy bill.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP FY 2007, Jan. 2010, Table A-4, p. 93 for prices and expenditures, and Table A-9, p. 97 for total energy expenditures; EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators.

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

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity	Total	Percent
Space Heating (3)	53.7	14.2	0.9	8.0	0.6	23.7	0.1	23.2	100.7	23.4%
Space Cooling	0.4							61.3	61.7	14.3%
Lighting								59.3	59.3	13.8%
Water Heating	18.3	2.6		2.0		4.6		17.8	40.7	9.4%
Refrigeration (4)								26.9	26.9	6.2%
Electronics (5)								26.1	26.1	6.1%
Ventilation (6)								15.9	15.9	3.7%
Cooking	4.0			0.8		0.8		8.8	13.6	3.2%
Computers								12.1	12.1	2.8%
Wet Cleaning (7)	0.6							11.0	11.6	2.7%
Other (8)	2.7	0.3		7.7	1.2	9.2		27.3	39.2	9.1%
Adjust to SEDS (9)	6.2	5.2				5.2		11.9	23.4	5.4%
Total	**86.0**	**22.3**	**0.9**	**18.5**	**1.8**	**43.5**	**0.1**	**301.6**	**431.2**	100%

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating ($0.6 billion) and motor gasoline other uses ($1.2 billion). 3) Includes furnace fans ($4.5 billion). 4) Includes refrigerators ($24.1 billion) and freezers ($2.8 billion). 5) Includes color televisions ($11.0 billion) and other electronics ($15.0 billion). 6) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 7) Includes clothes washers ($1.1 billion), natural gas clothes dryers ($0.6 billion), electric clothes dryers ($6.5 billion) and dishwashers ($3.4 billion). 8) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial services station equipment, ATMs, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, manufacturing performed in commercial buildings. 9) Expenditures related to an energy adjustment that EIA uses to relieve discrepancies between data sources. Refers to energy attributable to the residential and commercial buildings sectors, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A3, p. 6-8 for prices, Table A4, p. 9-10 for residential energy consumption, and Table A5, p. 11-12 for commercial energy consumption; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, State Energy Data 2009: Prices and Expenditures, June 2011, p. 24-25 for coal prices; EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for price deflators; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2, 5-25 and 5-26 for commercial ventilation; and BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, Sept. 2002, Table 8-2, p. 63 for commercial lighting.

1.2.6 2015 Buildings Energy End-Use Expenditure Splits, by Fuel Type ($2010 Billion) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity	Total	Percent
Space Heating (3)	49.5	15.9	1.3	8.1	0.7	25.9	0.2	18.7	94.3	22.7%
Space Cooling	0.3							48.0	48.3	11.6%
Lighting								45.9	45.9	11.0%
Water Heating	17.6	2.6		1.5		4.1		18.3	40.0	9.6%
Refrigeration (4)								24.9	24.9	6.0%
Electronics (5)								19.8	19.8	4.7%
Ventilation (6)								15.1	15.1	3.6%
Computers								11.6	11.6	2.8%
Wet Cleaning (7)	0.6							10.8	11.4	2.7%
Cooking	3.9			0.9		0.9		4.4	9.1	2.2%
Other (8)	2.9	0.3		8.9	1.4	10.6		54.1	67.6	16.3%
Adjust to SEDS (9)	5.8	4.5				4.5		17.7	28.1	6.7%
Total	**80.6**	**23.3**	**1.3**	**19.4**	**2.1**	**46.1**	**0.2**	**289.3**	**416.2**	100%

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating ($0.7 billion) and motor gasoline other uses ($1.4 billion). 3) Includes furnace fans ($4.6 billion). 4) Includes refrigerators ($22.6 billion) and freezers ($2.8 billion). 5) Includes color televisions ($10.9 billion). 6) Commercial only; residential fan proportionately in space heating and cooling. 7) Includes clothes washers ($1.1 billion), natural gas clothes dryers ($0.6 billion), electric clothes dryers ($6.5 billion) and dishwashers ($3.3 billion). 8) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial services station equipment, ATMs, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 9) Expenditures related to an energy adjustment that EIA uses to relieve discrepancies between data sources. Refers to energy attributable to the residential and commercial buildings sectors, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A3, p. 6-8 for prices, Table A4, p. 9-10 for residential energy consumption, and Table A5, p. 11-12 for commercial energy consumption; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, State Energy Data 2009: Prices and Expenditures database.

1.2.7 2025 Buildings Energy End-Use Expenditure Splits, by Fuel Type ($2010 Billion) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity	Total	Percent
Space Heating (3)	56.7	14.3	1.5	7.8	0.7	24.3	0.2	19.5	100.7	22.0%
Space Cooling	0.3							50.5	50.9	11.1%
Lighting								45.2	45.2	9.9%
Water Heating	21.3	2.3		1.3		3.6		19.6	44.4	9.7%
Refrigeration (4)								24.9	24.9	5.4%
Electronics (5)								23.2	23.2	5.1%
Computers								13.2	13.2	2.9%
Wet Clean (6)	0.8							9.8	10.5	2.3%
Cooking	4.8			0.8		0.8		4.9	10.5	2.3%
Ventilation (7)								16.6	16.6	3.6%
Other (8)	4.8	0.4		10.6	1.7	12.7		69.8	87.4	19.1%
Adjust to SEDS (9)	5.9	4.9				4.9		19.2	30.0	6.6%
Total	**94.6**	**21.9**	**1.5**	**20.6**	**2.5**	**46.4**	**0.2**	**316.3**	**457.4**	100%

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating ($0.7 billion) and motor gasoline other uses ($1.7 billion). 3) Includes furnace fans ($4.7 billion). 4) Includes refrigerators ($22.3 billion) and freezers ($2.6 billion). 5) Includes color televisions ($12.0 billion). 6) Includes clothes washers ($0.8 billion), natural gas clothes dryers ($0.8 billion), electric clothes dryers ($5.8 billion) and dishwashers ($3.2 billion). 7) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 8) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial services station equipment, ATMs, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 9) Expenditures related to an energy adjustment that EIA uses to relieve discrepancies between data sources. Refers to energy attributable to the residential and commercial buildings sectors, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A3, p. 6-8 for prices, Table A4, p. 9-10 for residential energy consumption, and Table A5, p. 11-12 for commercial energy consumption; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, State Energy Data 2009: Prices and Expenditures database.

1.2.8 2035 Buildings Energy End-Use Expenditure Splits, by Fuel Type ($2010 Billion) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity	Total	Percent
Space Heating (3)	63.4	13.0	1.6	7.7	0.8	23.1	0.2	20.6	107.2	20.9%
Water Heating	23.8	2.2		1.2		3.4		35.8	63.0	12.3%
Space Cooling	0.4							55.7	56.1	10.9%
Lighting								47.8	47.8	9.3%
Electronics (4)								27.2	27.2	5.3%
Refrigeration (5)								27.0	27.0	5.3%
Computers								14.8	14.8	2.9%
Cooking	5.8			0.8		0.8		5.4	12.1	2.3%
Wet Clean (6)	0.9							10.4	11.3	2.2%
Ventilation (7)								2.4	2.4	0.5%
Other (8)	9.3	0.4		12.6	2.0	15.0		88.8	113.2	22.0%
Adjust to SEDS (9)	4.6	5.3				5.3		21.7	31.6	6.2%
Total	**108.2**	**21.0**	**1.6**	**22.3**	**2.8**	**47.6**	**0.2**	**357.8**	**513.8**	100%

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating ($0.8 billion) and motor gasoline other uses ($2.0 billion). 3) Includes furnace fans ($4.8 billion). 4) Includes color televisions ($14.2 billion). 5) Includes refrigerators ($24.1 billion) and freezers ($3.0 billion). 6) Includes clothes washers ($0.8 billion), natural gas clothes dryers ($0.9 billion), electric clothes dryers ($6.0 billion) and dishwashers ($3.6 billion). 7) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 8) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial services station equipment, ATMs, telecommunications equipment, medical equipment, pumps, lighting, emergency electric generators, manufacturing performed in commercial buildings. 9) Expenditures related to an energy adjustment that EIA uses to relieve discrepancies between data sources. Refers to energy attributable to the residential and commercial buildings sectors, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A3, p. 6-8 for prices, Table A4, p. 9-10 for residential energy consumption, and Table A5, p. 11-12 for commercial energy consumption; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, State Energy Data 2009: Prices and Expenditures database.

1.2.9 Implicit Price Deflators (2005 = 1.00)

Year	Implicit Price Deflator	Year	Implicit Price Deflator	Year	Implicit Price Deflator
1980	0.48	1990	0.72	2000	0.89
1981	0.52	1991	0.75	2001	0.91
1982	0.55	1992	0.77	2002	0.92
1983	0.58	1993	0.78	2003	0.94
1984	0.60	1994	0.80	2004	0.97
1985	0.62	1995	0.82	2005	1.00
1986	0.63	1996	0.83	2006	1.03
1987	0.65	1997	0.85	2007	1.06
1988	0.67	1998	0.86	2008	1.09
1989	0.70	1999	0.87	2009	1.10
				2010	1.11

Source(s): EIA, Annual Energy Review 2010, August 2011, Appendix D, p. 353.

1.3.1 Estimated Value of All U.S. Construction Relative to the GDP ($2010)

- 2007 estimated value of all U.S. construction was $1.82 trillion (including renovation; heavy construction; public works; residential, commercial, and industrial new construction; and non-contract work).
- Compared to the $14.6 trillion 2007 U.S. gross domestic product (GDP), all construction held a 12.4% share.
- In 2007, residential and commercial building renovation (valued at $496 billion) and new building construction (valued at $759 billion) was estimated to account for 69% (approximately $1.26 trillion) of the $1.81 trillion.

Source(s): National Science and Technology Council, Construction & Building: Interagency Program for Technical Advancement in Construction and Building, 1999, p. 5; DOC, 1997 Census of Construction Industries: Industry Summary, Jan. 2000, Table 7, p. 15; DOC, Annual Value of Construction Put in Place, August 2010; DOC, Expenditures for Residential Improvements and Repairs by Property Type, Table S2, May 2008; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators and GDP.

1.3.2 Value of New Building Construction Relative to GDP, by Year ($2010 Billion)

	Value of New Construction Put in Place				Bldgs. Percent of
	Residential	Commercial (1)	All Bldgs. (1)	GDP	Total U.S. GDP
1980	166.0	159.8	325.8	6,461	5.0%
1985	213.5	226.3	439.8	7,579	5.8%
1990	208.4	227.2	435.6	8,890	4.9%
1995	238.0	203.8	441.8	10,063	4.4%
2000	334.6	312.7	647.3	12,423	5.2%
2005	538.3	302.2	840.4	13,986	6.0%
2006	508.9	334.7	843.6	14,359	5.9%
2007	376.2	383.3	759.5	14,639	5.2%
2008	242.1	399.6	641.7	14,639	4.4%
2009	143.2	328.5	471.8	14,254	3.3%
2010	129.8	247.7	377.4	14,660	2.6%

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

Source(s): DOC, Current Construction Reports: Value of New Construction Put in Place, C30, Aug. 2003, Table 1 for 1980-1990; DOC, Annual Value of Private Construction Put in Place, August 2008 for 1995-2000; DOC, Annual Value of Private Construction Put in Place, February 2012 for 2002-2010; DOC, Annual Value of Public Construction Put in Place, August 2008 for 1995-2000; DOC, Annual Value of Public Construction Put in Place, February 2012 for 2002-2010; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for GDP and price deflators.

1.3.3 Value of Building Improvements and Repairs Relative to GDP, by Year ($2010 Billion) (1)

	Value of Improvements and Repairs				Bldgs. Percent of
	Residential	Commercial	All Bldgs.	GDP	Total U.S. GDP
1980	107.4	N.A.	N.A.	5,894.6	N.A.
1985	147.6	140.2 (2)	287.8	6,914.5	4.2%
1990	176.9	142.3 (3)	319.2	8,110.4	3.9%
1995	169.6	150.9	320.5	9,180.3	3.5%
2000	198.0	136.4	334.4	11,332.9	3.0%
2006	244.6	224.6	469.2	13,099.8	3.6%
2007	235.7	259.8	495.5	13,354.9	3.7%

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

Source(s): DOC, Expenditures for Residential Improvements and Repairs by Property Type, Quarterly, May 2005 for 1980-1990; DOC, Expenditures for Residential Improvements and Repairs by Property Type, Table S2, May 2008 for 1994-2007; DOC, Current Construction Reports: Expenditures for Nonresidential Improvements and Repairs: 1992, CSS/92, Sept. 1994, Table A, p. 2 for 1986-1990 expenditures; DOC, 1997 Census of Construction Industries: Industry Summary, Jan. 2000, Table 7, p. 15; DOC, Annual Value of Private Construction Put in Place, July 2008 and DOC, Annual Value of Public Construction Put in place, July 2008 for 1995-2000; DOC, Annual Value of Private Construction Put in Place, August 2010 and DOC, Annual Value of Public Construction Put in Place, August 2010 for 2003-2007; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for GDP and price deflators.

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

Sector	Percent of Sales
Average Construction R&D (1)	**1.2**
Heavy Construction	2.0
Special Trade Construction	0.2
U.S. Average of All Private R&D (2)	**3.2**
Manufacturing Average	3.1
Service Industry Average	3.3

Building Technology	Percent of Sales
Appliances	2.0
Lighting	1.2
HVAC	1.5
Fans, Blowers, & Air Cleaning Equipment	1.6
Lumber and Wood Products	0.3
Commercial Building Operations	2.2

Note(s): 1) Includes all construction (e.g., bridges, roads, dams, buildings, etc.).
Source(s): National Science Foundation, Research and Development in Industry: 2003, Table 27, p. 76-77; and Schonfeld & Associates, R&D Ratios & Budgets, June 2003, p. 219-222.

1.3.5 2007-2010 Investment into Construction and Energy R&D, by Selected Country

	Year	Construction Percent of Private R&D to Total Private R&D	Electricity, Gas, and Water Percent of Private R&D to Total Private R&D
United States	2007	0.1	0.6
Australia	2010	5.2	1.8
China	2009	1.3	2.5
France	2007	0.4	1.6
Germany	2008	0.1	0.3
Italy	2010	0.9	0.8
Japan	2009	1.0	0.5
Norway	2008	1.4	2.2
Portugal	2008	1.7	6.0
South Africa	2007	0.1	16.2
South Korea	2008	2.5	1.0
United Kingdom	2008	0.1	0.2

Note(s): Includes all construction (e.g., bridges, roads, dams, buildings, etc.).
Source(s): National Science Board, Science and Engineering Indicators 2012, Volume 1, Jan. 2012, Appendix Table 4-46; National Science Board, Science and Engineering Indicators: 2010, Volume 1, Jan. 2010, Appendix Table 4-53.

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

Budget Function	Percent of U.S. Federal Budget
National Defense	57.2%
Health	23.1%
Other energy, general science, natural resources, and environment	**8.0%**
Space research and technology	6.3%
Transportation	1.5%
Agriculture	1.5%
Veterans' benefits and services research	0.7%
Green building	**0.2%**
Other functions (2)	1.6%
Total	100%

Organization	Average Annual Funding ($1,000s)
DOE	123,170
EPA	25,317
NSF	22,940
PIER (1)	11,100
DOC-NIST	7,500
NYSERDA	5,800
HUD	5,000
GSA	3,000
ASHRAE	2,400

Note(s): 1) PIER = Public Interest Energy Research. 2) Includes education, training, employment, and social services; income security; and commerce.
Source(s): U.S. Green Building Council, Green Building Research Funding: An Assessment of Current Activity in the United States, 2006, Chart 1, p. 3, Chart 2, p. 3.

1.3.7 Buildings Design and Construction Trades, by Year

		Employees, in thousands			Number of Residential Builder Establishments with Payrolls, in thousands (2)			
		Architects	Construction (1)		New Construction	Remodeling	Both	Total (3)
1980		N.A.	3,065	1982	14.4	21.7	57.5	93.6
1990		N.A.	3,861	1987	38.4	32.8	48.1	119.3
2000	(4)	215	5,183	1992	36.3	43.3	51.0	130.6
2005		235	7,336	1997	46.6	33.6	52.1	134.1
2006		221	7,691	2002	95.4	28.0	47.7	167.4
2007		240	7,630	2007	52.4	49.8	69.8	163.1
2008		233	7,162					
2009		204	6,016					
2010		184	5,526					

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

Source(s): DOC, Statistical Abstract of the U.S. 2001, May 2002, Table 593, p. 380 for 2000 architect employment, Table 609, p. 393 for construction employment; Statistical Abstract of the U.S. 2007, 2006, Table 602, p. 388 for 2005 architect employment; DOC, Statistical Abstract of the U.S. 2008, 2007, Table 598, p. 388 for 2006 architect employment; DOC, Statistical Abstract of the U.S. 2009, 2008, Table 596, p. 384 for 2007 architect employment; DOC, Statistical Abstract of the U.S. 2010, 2009, Table 603 for 2008 architect employment; DOC, Statistical Abstract of the U.S. 2011, 2010, Table 629 for 2005-2008 construction employment and Table 615, p. 393 for architect employment; DOC, Statistical Abstract of the U.S. 2012, 2011, Table 632 for 2009-2010 construction employment; DOC, 1992 Census of Construction Activities: U.S. Summary, CC92-I-27, Jan. 1996, p. 27-5 for construction employees; DOC, 1997 Economic Census: Construction - Industry Summary, EC97C23IS, Jan. 2000, Table 2, p. 8 for industrial builders; DOC, 1997 Economic Census: Construction - Single-Family Housing Construction, EC97C-2332A, Nov. 1999, Table 10, p. 14 for 1997 builder establishments; DOC, 2002 Economic Census: Construction - New Single-Family Housing Construction, EC02-231-236115, Dec. 2004, New Housing Operatives, ECO2-231-236118, Dec. 2004, Residential Remodelers, EC02-231-236119, Dec. 2004, Industrial Building Construction, 231-236210, Dec. 2004; DOC, 2007 Economic Census: Construction – New Single-Family Housing Construction, EC0723SG08, Oct. 2010, for 2007 number of residential 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.

1.3.8 Number of Construction Employees and Total Employees for Select Building Envolope Industries (Thousand Employees)

	2002	2004	2006	2008	2010
Poured Concrete Foundation and Structure Contractors (NAICS 238110)					
-Total Employment	197.5	221.5	254.0	236.2	154.3
-Construction/Extraction Occupations	165.5	187.3	213.1	198.2	127.3
-Construction/Extraction % of Total	83.8%	84.5%	83.9%	83.9%	82.5%
Masonry Contractors (NAICS 238140)					
-Total Employment	228.9	238.4	255.1	229.4	145.2
-Construction/Extraction Occupations	199	208	224	198	123
-Construction/Extraction % of Total	87.0%	87.1%	87.8%	86.4%	84.9%
Roofing Contractors (NAICS 238160)					
-Total Employment	183.2	188.0	201.5	196.1	166.8
-Construction/Extraction Occupations	145.2	152.7	161.9	155.9	130.4
-Construction/Extraction % of Total	79.2%	81.2%	80.4%	79.5%	78.2%
Drywall and Insulation Contractors (NAICS 238310)					
-Total Employment	321.4	342.8	367.7	329.9	213.9
-Construction/Extraction Occupations	279.5	299.2	322.0	286.1	182.4
-Construction/Extraction % of Total	87.0%	87.3%	87.6%	86.7%	85.3%
Painting and Wall Covering Contractors (NAICS 238320)					
-Total Employment	223.1	224.6	245.1	233.6	171.5
-Construction/Extraction Occupations	191.0	193.7	213.0	202.4	146.2
-Construction/Extraction % of Total	85.8%	86.2%	86.9%	86.7%	85.8%

Source(s): Bureau of Labor Statistics, Occupational Employment and Wage Estimates: 2002 OES Estimates for 2002 Data, November 2004 OES Estimates for 2004 Data, May 2006 Estimates for 2006 Data, May 2008 Estimates for 2008 Data, May 2010 Estimates for 2010 Data. Available at http://www.bls.gov/oes/oes_data.htm.

1.3.9 Number of Construction Employees and Total Employees for Select Building Equipment Industries (Thousand Employees)

	2002	2004	2006	2008	2010
Electrical Contractors and Other Wiring Installation Contractors (NAICS 238210)					
-Total Employment	894.3	852.7	890.4	915.2	724.9
-Construction/Extraction Occupations	585.7	562.1	601.1	620.7	478.5
-Construction/Extraction % of Total	65.5%	65.9%	67.5%	67.8%	66.0%
Plumbing, Heating, and Air-Conditioning Contractors (NAICS 238220)					
-Total Employment	837.7	896.8	977.7	996.2	806.4
-Construction/Extraction Occupations	495.6	505.1	542.6	543.0	422.4
-Construction/Extraction % of Total	59.2%	56.3%	55.5%	54.5%	52.4%
Other Building Equipment Contractors (NAICS 238290)					
-Total Employment	107.0	106.8	119.4	132.2	119.8
-Construction/Extraction Occupations	46.4	49.0	54.0	59.7	55.0
-Construction/Extraction % of Total	43.3%	45.8%	45.2%	45.2%	45.9%

Source(s): Bureau of Labor Statistics, Occupational Employment and Wage Estimates: 2002 OES Estimates for 2002 Data, November 2004 OES Estimates for 2004 Data, May 2006 Estimates for 2006 Data, May 2008 Estimates for 2008 Data, May 2010 Estimates for 2010 Data. Available at http://www.bls.gov/oes/oes_data.htm.

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

	Buildings				U.S.			
	Site Fossil	Electricity	Total	Growth Rate 2010-Year	Total	Growth Rate 2010-Year	Buildings % of Total U.S.	Buildings % of Total Global
1980	630	933	1562	-	4723	-	33%	8.5%
1990	566	1190	1756	-	5039	-	35%	8.1%
2000	619	1588	2207	-	5867	-	38%	9.3%
2005	591	1739	2330	-	5996	-	39%	8.2%
2010 (3)	**584**	**1684**	**2268**	**-**	**5634**	**-**	**40%**	**7.4%**
2015	570	1493	2063	-1.3%	5434	-0.5%	38%	6.5%
2020	566	1566	2132	-0.5%	5549	-0.1%	38%	6.3%
2025	560	1664	2224	-0.1%	5618	0.0%	40%	6.1%
2030	558	1755	2313	0.1%	5695	0.0%	41%	5.9%
2035	556	1840	2396	0.1%	5806	0.1%	41%	5.7%

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) Carbon emissions calculated from EIA, Assumptions to the AEO 2010 and difffers from EIA, AEO 2012 Early Release, Table A18. Buildings sector total varies by -0.7% from EIA, AEO 2012 Early Release. 3) U.S. buildings emissions approximately equal the combined carbon emissions of Russia and Canada.

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 2009, Feb. 2011, Tables 8-11 for 1990-2009 greenhouse gas emissions; EIA, Assumptions to the Annual Energy Outlook 2010, May 2010, Table 1.2, p. 12 for carbon coefficients; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2011, Summary Reference Case Tables, Table A2, p. 3-5 for 2010-2035 energy consumption and Table A18, p. 36 for 2010-2035 emissions; EIA, International Energy Outlook 2011, Sept. 2011, Table A10 for 2010-2035 global emissions; and EIA, Country Energy Profiles for global emissions (1980-2009), available at http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm, accessed 2/10/2012 for 1980-2009 global emissions.

1.4.2 2010 Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Space Heating (4)	272.9	49.0	6.7	18.7	2.6	77.0	6.2	128.2	484.3	21.3%
Space Cooling	2.3							340.5	342.8	15.1%
Lighting								334.1	334.1	14.7%
Water Heating	91.9	9.2		4.6		13.7		98.5	204.1	9.0%
Refrigeration (5)								149.8	149.8	6.6%
Electronics (6)								143.0	143.0	6.3%
Ventilation (7)								95.2	95.2	4.2%
Computers								68.2	68.2	3.0%
Wet Cleaning (8)	2.9							57.8	60.8	2.7%
Cooking	20.9			1.9		1.9		36.5	59.4	2.6%
Other (9)	15.8	0.9		19.1	3.8	23.9		158.4	198.1	8.7%
Adjust to SEDS (10)	36.2	18.4				18.4		75.4	129.9	5.7%
Total	**442.9**	**77.5**	**6.7**	**44.3**	**6.4**	**134.8**	**6.2**	**1685.7**	**2269.6**	100%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. Carbon emissions calculated from EIA, Assumptions to the AEO 2011 and differs from EIA, AEO 2012 Early Release, Table A18. Buildings sector total varies by 0.1% from EIA, AEO 2012 Early Release. 2) Includes kerosene space heating (2.6 MMT) and motor gasoline other uses (3.8 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (23.9 MMT). 5) Includes refrigerators (135.2 MMT) and freezers (14.6 MMT). 6) Includes color television (58.2 MMT) and other office equipment. 7) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 8) Includes clothes washers (5.8 MMT), natural gas clothes dryers (2.9 MMT), electric clothes dryers (34.3 MMT), and dishwashers (17.8 MMT). Does not include water heating energy. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 10) Emissions related to a discrepancy between data sources and that results from energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A4, p. 9-10 and Table A5, p. 11-12 for energy consumption, and Table A18, p. 36 for emissions; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, Assumptions to the Annual Energy Outlook 2011, July 2011, Table 1.2, p. 14 for carbon coefficients; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses; BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2; BTP/Navigant Consulting, U.S. Lighting Market Characterization, Volume I, Sept. 2002, Table 8-2, p.63; and EIA, AEO 1999, Dec. 1998, Table A4, p. 118-119 and Table A5, p. 120-121 for 1996 data.

1.4.3 2015 Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Space Heating (4)	270.4	43.9	6.2	16.6	2.1	68.8	6.2	93.0	438.4	21.3%
Lighting								243.7	243.7	11.8%
Space Cooling	1.9							241.0	242.9	11.8%
Water Heating	95.0	7.2		3.1		10.3		89.6	194.9	9.4%
Refrigeration (5)								127.5	127.5	6.2%
Electronics (6)								101.9	101.9	4.9%
Ventilation (7)								85.0	85.0	4.1%
Computers								59.9	59.9	2.9%
Wet Cleaning (8)	3.2							51.6	54.7	2.7%
Cooking	21.7			1.8		1.8		21.4	44.9	2.2%
Other (9)	17.6	0.9		19.2	3.5	23.6		277.9	319.1	15.5%
Adjust to SEDS (10)	36.0	13.9				13.9		99.8	149.8	7.3%
Total	**445.8**	**65.8**	**6.2**	**40.8**	**5.5**	**118.4**	**6.2**	**1492.5**	**2062.9**	100%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (2.1 MMT) and motor gasoline other uses (3.5 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (22.1 MMT). 5) Includes refrigerators (114.3 MMT) and freezers (13.3 MMT). 6) Includes color television (52.2 MMT) and other office equipment (49.9 MMT). 7) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 8) Includes clothes washers (5.0 MMT), natural gas clothes dryers (3.2 MMT), electric clothes dryers (31.0 MMT), and dishwashers (15.6 MMT). Does not include water heating energy. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 10) Emissions related to a discrepancy between data sources and that results from energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A4, p. 9-10 and Table A5, p. 11-12 for energy consumption, and Table A18, p. 36 for emissions; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, Assumptions to the Annual Energy Outlook 2011, July 2011, Table 1.2, p. 14 for carbon coefficients.

1.4.4 2025 Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Space Heating (4)	263.3	35.5	6.3	15.2	2.0	59.0	6.1	98.9	427.3	19.2%
Space Cooling	1.8							258.7	260.5	11.7%
Lighting								245.4	245.4	11.0%
Water Heating	97.7	5.7		2.5		8.3		97.6	203.7	9.2%
Refrigeration (5)								129.5	129.5	5.8%
Electronics (6)								122.6	122.6	5.5%
Ventilation (7)								94.4	94.4	4.2%
Computers								68.8	68.8	3.1%
Wet Cleaning (8)	3.3							47.9	51.2	2.3%
Cooking	22.7			1.6		1.6		24.3	48.7	2.2%
Other (9)	25.3	0.9		21.7	3.8	26.4		366.6	418.3	18.8%
Adjust to SEDS (10)	30.9	13.4				13.4		109.4	153.7	6.9%
Total	**445.0**	**55.6**	**6.3**	**41.1**	**5.8**	**108.7**	**6.1**	**1664.0**	**2223.8**	100%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (2.0 MMT) and motor gasoline other uses (3.8 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (22.9 MMT). 5) Includes refrigerators (115.8 MMT) and freezers (13.6 MMT). 6) Includes color television (58.7 MMT) and other office equipment (63.8 MMT). 7) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 8) Includes clothes washers (3.9 MMT), natural gas clothes dryers (3.3 MMT), electric clothes dryers (28.5 MMT), and dishwashers (15.5 MMT). Does not include water heating energy. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 10) Emissions related to a discrepancy between data sources and that results from energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A4, p. 9-10 and Table A5, p. 11-12 for energy consumption, and Table A18, p. 36 for emissions; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, Assumptions to the Annual Energy Outlook 2011, July 2011, Table 1.2, p. 14 for carbon coefficients.

1.4.5 2035 Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Space Heating (4)	257.1	29.5	6.6	14.1	1.9	52.1	6.0	102.1	417.3	17.4%
Space Cooling	1.7							278.5	280.3	11.7%
Lighting								253.9	253.9	10.6%
Water Heating	96.0	5.1		2.1		7.3		98.1	201.4	8.4%
Electronics (5)								140.4	140.4	5.9%
Refrigeration (6)								137.1	137.1	5.7%
Ventilation (7)								100.7	100.7	4.2%
Computers								75.5	75.5	3.1%
Wet Cleaning (8)	3.5							50.0	53.4	2.2%
Cooking	24.1			1.5		1.5		26.5	52.2	2.2%
Other (9)	42.8	1.0		23.9	4.2	29.0		456.9	528.7	22.1%
Adjust to SEDS (10)	21.3	13.1				13.1		120.5	154.9	6.5%
Total	**446.5**	**48.7**	**6.6**	**41.6**	**6.0**	**103.0**	**6.0**	**1840.3**	**2395.8**	100%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (1.9 MMT) and motor gasoline other uses (4.2 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (23.1 MMT). 5) Includes color television (68.1 MMT) and other office equipment (72.3 MMT). 6) Includes refrigerators (123.2 MMT) and freezers (13.9 MMT). 7) Commercial only; residential fan and pump energy use included proportionately in space heating and cooling. 8) Includes clothes washers (3.8 MMT), natural gas clothes dryers (3.5 MMT), electric clothes dryers (28.8 MMT), and dishwashers (17.4 MMT). Does not include water heating energy. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 10) Emissions related to a discrepancy between data sources and that results from energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A4, p. 9-10 and Table A5, p. 11-12 for energy consumption, and Table A18, p. 36 for emissions; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, Assumptions to the Annual Energy Outlook 2011, July 2011, Table 1.2, p. 14 for carbon coefficients.

1.4.6 World Carbon Dioxide Emissions

	Emissions (million metric tons)				Annual Growth Rate	
Nation/Region	1990	2000	2010		1990-2000	2000-2010
China	2270	2850	8262	26%	2.3%	11.2%
United States	5041	5862	5644	18%	1.5%	-0.4%
OECD Europe	4128	4191	4094	13%	0.2%	-0.2%
Other Non-OECD Asia	827	1339	1872	6%	4.9%	3.4%
Russia (1)	3821	1556	1632	5%	-8.6%	0.5%
Middle East	730	1094	1692	5%	4.1%	4.5%
India	579	1003	1602	5%	5.7%	4.8%
Central & S. America	716	992	1150	4%	3.3%	1.5%
Japan	1047	1201	1090	3%	1.4%	-1.0%
Africa	726	887	1107	4%	2.0%	2.2%
Oth. Non-OECD Europe	417	1038	1127	4%	9.5%	0.8%
Canada	471	573	569	2%	2.0%	-0.1%
South Korea	242	439	528	2%	6.1%	1.9%
Australia & N. Zealand	296	391	456	1%	0.0%	0.0%
Mexico/Chile (2)	302	383	480	2%	2.4%	2.3%
Total World	**21616**	**23804**	**31305**	**100%**	**1.0%**	**2.8%**

Note(s): 1) 1990 value is for the former USSR. 2) Values before 2010 do not include Chile.

Source(s): EIA, Country Energy Profiles, available at http://www.eia.gov/country/index.cfm, accessed 2/3/2012; EIA, International Energy Outlook 2011, September 2011, Table A10, p. 167

1.4.7 2009 Methane Emissions for U.S. Buildings Energy Production, by Fuel Type (MMT CO2 Equivalent) (1)

Fuel Type	Residential	Commercial	Buildings Total
Petroleum	1.0	0.5	1.6
Natural Gas	41.0	26.8	67.8
Coal	0.0	0.3	0.3
Wood	2.6	0.4	3.0
Electricity (2)	52.8	50.5	103.3
Total	**97.4**	**78.5**	**176.0**

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

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 2009, Mar. 2011, Table 18, p. 37 for energy production emissions; EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2009, April 2011, Table 3-10, p. 3-9 for stationary combustion emissions; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for energy consumption.

1.4.8 2010 Carbon Dioxide Emission Coefficients for Buildings (MMT CO2 per Quadrillion Btu) (1)

	All Buildings	Residential Buildings	Commercial Buildings
Coal			
Average (2)	95.35	95.35	95.35
Natural Gas			
Average (2)	53.06	53.06	53.06
Petroleum Products			
Distillate Fuel Oil/Diesel	73.15	-	-
Kerosene	72.31	-	-
Motor Gasoline	70.88	-	-
Liquefied Petroleum Gas	62.97	-	-
Residual Fuel Oil	78.80	-	-
Average (2)	69.62	68.45	71.62
Electricity Consumption (3)			
Average - Primary (4)	57.43	57.43	57.43
Average - Site (5)	178.3	179.1	177.9
New Generation			
Gas Combined Cycle - Site (6)	112.5	112.5	112.5
Gas Combustion Turbine - Site (6)	171.4	171.4	171.4
Stock Gas Generator - Site (7)	133.9	133.9	133.9
All Fuels (3)			
Average - Primary	56.23	55.79	56.77
Average - Site	111.4	105.6	118.7

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 2011 Early Release and were adjusted using Assumptions to the AEO 2010. 3) Excludes electricity imports from utility consumption. Includes nuclear and renewable (including hydroelectric) generated electricity. 4) This coefficient is used to estimate CO2 emissions resulting from the consumption of energy by electric generators. 5) This coefficient is used to estimate CO2 emissions resulting from the consumption of electricity by end-users. 6) This coefficient is used to estimate emissions of the next-built (2010) natural gas-fired, electric generator resulting from the consumption of electricity by end-users. 7) This coefficient is used to estimate emissions of existing natural gas-fired, electric generators resulting from the consumption of electricity by end-users.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A8, p. 18-19, Table A17, p. 34-35 for consumption and Table A18, p. 36 for emissions; EIA, Assumptions to the AEO 2011, July 2011, Table 1.2, p. 14 for coefficients and Table 8.2, p. 97 for generator efficiencies; EIA, Annual Energy Review 2010, Oct. 2011, Diagram 8.0, p. 233 for Transmission and Distribution (T&D) losses.

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

	Stock 2010		
	Resid.	Comm.	Bldgs.
Electricity (2)	39.81	44.10	41.75
Petroleum	3.78	2.81	3.34
Natural Gas	12.17	9.55	10.98
Renew. En. (3)	0.00	0.00	0.00
Coal	0.03	0.30	0.15
Total	**55.79**	**56.77**	**56.23**

Note(s): 1) Electricity imports from utility consumption were not included since this energy was produced outside of the U.S. "Average" means the weighted average of different fuels (e.g., petroleum is the average of residual and distillate fuel oils, LPG, kerosene, and motor gasoline). The combustion of fossil fuels produces carbon in the form of carbon dioxide and carbon monoxide; however, carbon monoxide emissions oxidize in a relatively short time to form carbon dioxide. 2) Includes renewables. 3) Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 and Table A17, p. 34-35 for energy consumption and Table A18, p. 36 for carbon emissions; and EIA, Assumptions to the AEO 2011, June 2011, Table 1.2, p. 14.

1.4.10 2010 Emissions Summary Table for U.S. Buildings Energy Consumption (Thousand Short Tons) (1)

	Buildings				Buildings Percent
	Wood/SiteFossil	Electricity	Total	U.S. Total	of U.S. Total
SO2	433	3,814 (2)	4,247	7,938	54%
NOx	656	1,554	2,210	12,914	17%
CO	2,926	540	3,466	67,790	5%
VOCs	219	34	253	13,443	2%
PM-2.5	378	294	672	4,495	15%
PM-10	383	318	701	10,778	7%

Note(s): 1) VOCs = volatile organic compounds; PM-10 = particulate matter less than 10 micrometers in aerodynamic diameter. PM-2.5 = particulate matter less than 2.5 micrometers in aerodynamic diameter. CO and VOCs site fossil emissions mostly from wood burning. 2) Emissions of SO2 are 28% lower for 2002 than 1994 estimates since Phase II of the 1990 Clean Air Act Amendments began in 2000. Buildings Energy Consumption related to SO2 emissions dropped 27% from 1994 to 2002.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5; and EPA, 1970-2010 National Emissions Inventory, Average Annual Emissions, All Criteria Pollutants, October 2011.

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

All Buildings

	Electricity (1)	*Site Fossil Fuel (2)*	Electricity (per primary quad) (1)
SO2	0.402	0.041	0.130
NOx	0.164	0.062	0.053
CO	0.057	0.275	0.018

Note(s): 1) Emissions of SO2 are 28% lower for 2002 than 1994 estimates since Phase II of the 1990 Clean Air Act Amendments began in 2000. Buildings energy consumption related SO2 emissions dropped 65% from 1994 to 2011. 2) Includes natural gas, petroleum liquid fuels, coal, and wood.

Source(s): EPA, 1970-2010 National Emissions Inventory, Average Annual Emissions, All Criteria Pollutants, October 2012; and EIA, Annual Energy Outlook 2011 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for energy consumption.

1.4.12 Characteristics of U.S. Construction Waste

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

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

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

Material	Weight (pounds)		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 (5)	**8,000**	100%	**50**

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

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

1.4.14 2003 Construction and Demolition Debris Generated from Construction Activities

	Debris (million tons)			Debris (percent of total buildings sector)		
	Residential	Commercial	Buildings	Residential	Commercial	Buildings
Construction	10.0	5.0	15.0	6%	3%	9%
Demolition	38.0	33.0	71.0	22%	19%	42%
Renovation	19.0	65.0	84.0	11%	38%	49%
Total	**67.0**	**103.0**	**170.0**	**39%**	**61%**	**100%**

Note(s): 170 million tons of construction and demolition debris represents approximately 3.2 pounds of debris per person per day in the U.S.

Source(s): EPA/OSW, Estimating 2003 Building-Related Construction and Demolition Materials Amounts, March 2009, Table 2-7, p. 17.

1.4.15 Disposal and Recovery of Construction and Demolition (C&D) Materials in 2003

Reporting State (1)	Tons of C&D Materials Disposed	Tons of C&D Materials Recovered (2) (3)	Recovery Rate
Florida	5,277,259	1,998,256	27%
Maryland	1,913,774	2,270,100	54%
Massachusetts	720,000	3,360,000	82%
New Jersey	1,519,783	5,582,336	79%
North Carolina	1,844,409	20,002	1%
Utah	1,054,296	46,461	4%
Virginia	3,465,548	95,131	3%
Washington	1,780,356	2,640,560	60%
Total	17,575,425	16,012,846	48%

Note(s): 1) Only eight states reported recovery and disposal amounts 2003, representing approximately 21% of the US population. 2) State definitions vary regarding what constitutes C&D materials. Some states may include concrete, asphalt pavement, and metals from non-building sources. 3) Recovered materials may include those used for purposes that do not meet state definitions for recycling, such as landfill cover and energy generation.

Source(s): EPA, Estimating 2003 Building-Related Construction and Demolition Materials Amounts, Table 3-1

1.5.1 Key Definitions

Quad: Quadrillion Btu (10^15 or 1,000,000,000,000,000 Btu)

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

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

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

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

1.5.2 Consumption Comparisons in 2010

One quad equals:

- 50.2 million short tons of coal
  - = enough coal to fill a train of railroad cars 4,123 miles long (about one and a half times across the U.S.)
- 974.7 billion cubic feet natural gas
- 8.2 billion gallons of gasoline = 21.2 days of U.S. gasoline use
  - = 22.89 million passenger cars each driven 12,400 miles
  - = 20.12 million light-duty vehicles each driven 12,200 miles
  - = all new passenger cars sold, each driven 50,000 miles
  - = 13.69 million stock passenger cars, each driven 11,500 miles = 10% of all passenger cars, each driven 11,500 miles
  - = all new passenger cars each making 9 round-trips from New York to Los Angeles
- 172.4 million barrels of crude oil = 14.45 days of U.S. imports = 245 days of oil flow in the Alaska pipeline at full capacity
  - = the amount of crude oil transported by 483 supertankers
- 16.8 hours of world energy use
- the electricity delivered from 258 coal-fired power plants (200-MW each) in one year
- the electricity delivered from 37 nuclear power plants (1000-MW each) in one year
- average annual per capita consumption of 3.17 million people in the U.S.
- the approximate annual primary consumption of any one of the following states: Arkansas, Mississippi, Kansas, Oregon (1)

Note(s): 1) All states listed have annual energy consumption that is within 20% of one quad. Consumption numbers for states are from 2009.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A1, p. 1-2, Table A2, p. 3-5, Table A7, p. 34-35, Table A8, p. 18-19, Table A9, p. 20-21, and Table A11, p. 23-24 for consumption; EIA, Annual Energy Outlook 2011, April 2011, Table G1, p. 235 for heat rates; EIA, State Energy Consumption Database, June 2011; EIA, Electric Power Annual 2010, Nov. 2011, Table 1.1, p. 14; DOC, Statistical Abstract of the United States 2008, May 2008, No. 1080, p. 690; DOC, Statistical Abstract of the United States 2012, 2011, No. 1060, p. 666, and No. 1096, p. 688; and Newport News Shipbuilding Web site.

1.5.3 Carbon Emission Comparisons

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

- the combustion of 530 thousand short tons of coal
- the coal input to 1 coal plant (200-MW) in about 1 year
- the combustion of 18 billion cubic feet of natural gas
- the combustion of 119 million gallons of gasoline = the combustion of gasoline for 7 hours in the U.S.
  - = 323 thousand new cars, each driven 12,400 miles
  - = 282 thousand new light-duty vehicles, each driven 12,200 miles
  - = 274 thousand new light trucks, each driven 11,000 miles
  - = 0.14 million new passenger cars, each making 5 round trips from New York to Los Angeles
- the combustion of 192 million gallons of LPG
- the combustion of 107 million gallons of kerosene
- the combustion of 102 million gallons of distillate fuel
- the combustion of 87 million gallons of residual fuel
- 17 minutes of world energy emissions
- 90 minutes of U.S energy emissions
- 3.9 hours of U.S. buildings energy emissions
- 7 hours of U.S. residential energy emissions
- 8 hours of U.S. commercial energy emissions
- 1.2 days of U.S. buildings lighting energy emissions
- average annual per capita emissions of 53,000 people in the U.S.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2010, Summary Reference Case Tables, Table A2, p. 3-5, Table A7, p. 16-17 for consumption and Table A18, p. 36 for emissions; EIA, Annual Energy Outlook 2011, Apr. 2011, Table G1, p. 235 for heat rates; EIA, Electric Power Annual 2010, Feb. 2012, Table 1.2; EIA, International Energy Outlook 2011, Table A10; EIA, Assumptions to the Annual Energy Outlook 2011, July 2010, Table 1.2, p. 14 for carbon coefficients; DOC, Statistical Abstract of the United States 2012, Jan. 2012, No. 1, p. 8; and Statistical Abstract of the United States 2008, Jan. 2008, No. 1084, p. 715

1.5.4 Average Annual Carbon Dioxide Emissions for Various Functions

	Annual Unit Energy Consumption		Carbon Emissions (MMT CO2)	Carbon Emissions (lb CO2)
Stock Refrigerator (1)	1,359	kWh - Electricity	0.8	1,800
Stock Electric Water Heater	2,814	kWh - Electricity	1.7	3,800
Stock Gas Water Heater	24	million Btu - Natural Gas	1.3	2,800
Stock Oil Water Heater	32	million Btu - Fuel Oil	2.3	5,100
Single-Family Home	108	million Btu	11.4	25,200
Mobile Home	70	million Btu	7.4	16,400
Multi-Family Unit in Large Building	54	million Btu	5.7	12,700
Multi-Family Unit in Small Building	85	million Btu	9.0	19,800
School Building	2,125	million Btu	252.2	556,200
Office Building	1,376	million Btu	163.3	360,200
Hospital, In-Patient	60,152	million Btu	7,140.2	15,744,200
Stock Vehicles				
Passenger Car	530	gallons - Gasoline	4.6	10,094
Van, Pickup Truck, or SUV	615	gallons - Gasoline	5.3	11,718
Heavy Truck	1,956	gallons - Diesel Fuel	17.4	38,447
Tractor Trailer Truck	10,749	gallons - Diesel Fuel	95.8	211,312

Note(s): 1) Stock refrigerator consumption is per household refrigerator consumption, not per refrigerator.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for consumption and Table A18, p. 36 for emissions; EIA, Annual Energy Outlook 2010, Apr. 2011, Table G1, p. 235 for gasoline heat rate; EIA, A Look at Residential Energy Consumption in 2005, Jan. 2009, Tables WH6 and WH7 for water heater energy consumption, Table AP2 for refrigerator energy, and Table US9 for household consumption; EIA, 2003 Commercial Buildings Energy Consumption Survey, June 2006, Table C3, p. 247 for commercial buildings; ORNL, Transportation Energy Data Book: Edition 30, 2011, Table 4.1, p. 4-2, Table 4.2, p. 4-3, Table 5.1, p. 5-2 and Table 5.2, p. 5-3 for vehicles; and EIA, Assumptions to the AEO 2011, July 2011, Table 1.2, p. 14 for carbon coefficients.

1.5.5 Cost of a Generic Quad Used in the Buildings Sector ($2010 Billion) (1)

	Residential	Commercial	**Buildings**
1980	10.45	10.30	**10.39**
1990	10.12	9.17	**9.70**
2000	9.57	8.26	**8.97**
2005	11.10	9.62	**10.43**
2010	**9.98**	**9.84**	**9.94**
2015	9.88	9.60	**9.78**
2020	9.91	9.66	**9.82**
2025	10.09	9.84	**10.00**
2030	10.06	9.82	**9.97**
2035	10.57	10.35	**10.49**

Note(s): 1) See Table 1.5.1 for generic quad definition. This table provides the consumer cost of a generic quad in the buildings sector. This table may be used 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 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 and Table A17, p. 34-35 for energy consumption and Table A3, p. 6-8 for 2010-2035 energy prices; EIA, State Energy Consumption Estimates 1960-2009, June 2011, Tables C5-C6, p. 8-9 for 1980-2009; EIA, State Energy Data 2009: Prices and Expenditures, June 2011, Tables CT4 and CT5 (1980-2009); and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators.

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

				Renewables				
	Natural Gas	Petroleum	Coal	Hydro.	Other	Total	Nuclear	Total
1980	39%	12%	31%	7%	4%	11%	7%	100%
1990	32%	8%	36%	7%	4%	10%	13%	100%
2000	32%	6%	38%	5%	3%	8%	15%	100%
2005	32%	6%	39%	5%	3%	8%	15%	100%
2010	**32%**	**5%**	**38%**	**5%**	**4%**	**9%**	**17%**	**100%**
2015	34%	4%	33%	6%	5%	11%	18%	100%
2020	32%	4%	34%	6%	6%	12%	18%	100%
2025	31%	4%	35%	6%	7%	12%	18%	100%
2030	31%	3%	35%	6%	7%	12%	18%	100%

Note(s): 1) See Table 1.5.1 for generic quad definition. 2) The total 2010 Buildings sector primary energy consumption was 40.33 quads.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 and Table A17, p. 34-35 for energy consumption; and EIA, State Energy Data 2009 Consumption Database

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

Window Type	Embodied Energy (MMBtu/SF) (1)	CO2 Equivalent Emissions (lbs/SF)
Aluminium	0.973	190.1
PVC-clad Wood	0.447	88.3
Wood	0.435	90.9
Vinyl (PVC)	0.557	111.7
Curtainwall Viewable Glazing	0.233	66.1

Note(s): 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material. Assumptions: Low rise building. Values are general estimations for the U.S. 60 year building lifetime. Low-e, double-pane, argon-filled glazing. All assemblies are insulated to IECC 2009 minimums for zones 3 and 6.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v3.5.2. 2010. Available at www.athenasmi.org/tools/ecoCalculator/index.html

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

Exterior Wall Type	Embodied Energy (MMBtu/SF) (1)		CO2 Equivalent Emissions (lbs/SF)	
	U.S. North (2)	U.S. South (3)	U.S. North (2)	U.S. South (3)
2x4 Steel Stud Wall (4)				
16" OC with brick cladding	0.10	0.10	14.46	14.04
24" OC with brick cladding	0.10	0.09	13.47	13.03
16" OC with wood cladding	0.07	0.07	8.71	8.27
24" OC with wood cladding	0.06	0.06	7.69	7.28
16" OC with steel cladding (26 ga)	0.24	0.24	38.65	38.23
2x6 Wood Stud Wall (5)				
16" OC with brick cladding	0.09	0.09	11.29	10.91
16" OC with PVC cladding	0.09	0.08	7.98	7.61
24" OC with steel cladding	0.23	0.23	36.29	35.91
24" OC with stucco cladding	0.07	0.07	8.66	8.29
24" OC with wood cladding	0.05	0.05	5.34	4.96
Structural Insulated Panel (SIP) (6)				
with brick cladding	0.15	0.14	15.98	15.06
with steel cladding	0.30	0.29	41.18	40.23
with stucco cladding	0.14	0.13	13.58	12.63
with PVC cladding	0.14	0.13	12.70	11.75
with wood cladding	0.12	0.11	10.23	9.30

Note(s): Assumptions: Low rise building. 60 year building lifetime. All assemblies are insulated to IECC 2009 minimums for zones 3 and 6. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material. 2) Northern values represent ASHRAE climate zone 6. 3) Southern Values represent ASHRAE climate zone 3. 4) Includes cladding, continuous insulation sheathing, cavity insulation, polyethylene membrane, gypsum board, and latex paint. 5) Includes cladding, wood structural panel (WSP) sheathing, cavity insulation, polyethylene membrane, gypsum board, and latex paint. 6) Includes cladding, builder's paper, gypsum board, and latex paint.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.3.5.2. 2010. Available at www.athenasmi.org/tools/ecoCalculator/index.html

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

	Embodied Energy (MMBtu/SF) (1)		CO2 Equivalent Emissions (lbs/SF)	
	U.S. North (2)	U.S. South (3)	U.S. North (2)	U.S. South (3)
8" Concrete Block (4)				
Brick Cladding	0.26	0.26	42.59	42.37
Stucco Cladding	0.25	0.25	40.17	39.95
Steel Cladding	0.41	0.41	67.77	67.57
2x4 Steel Stud Wall (16" OC)	0.24	0.24	39.46	39.24
6" Cast-In-Place Concrete (3)				
Brick Cladding	0.13	0.13	24.43	24.21
Stucco Cladding	0.11	0.11	22.00	21.78
Steel Cladding	0.28	0.27	49.60	49.41
2x4 Steel Stud Wall (16" OC)	0.11	0.11	21.30	21.08
8" Concrete Tilt-Up (4)				
Brick Cladding	0.14	0.14	28.26	28.04
Stucco Cladding	0.12	0.12	25.84	25.62
Steel Cladding	0.29	0.28	53.44	53.24
2x4 Steel Stud Wall (16" OC)	0.12	0.12	25.13	24.91
Insulated Concrete Forms (5)				
Brick Cladding	0.16	0.16	29.45	29.45
Stucco Cladding	0.14	0.14	27.03	27.03
Steel Cladding	0.30	0.30	54.63	54.63

Note(s): Assumptions: 60 year building lifetime. Low rise building. Values are general estimations for the U.S. All assemblies are insulated to IECC 2009 minimums for zones 3 and 6. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material. 2) Northern values represent ASHRAE climate zone 6. 3) Southern Values represent ASHRAE climate zone 3. 4) Includes continuous insulation, polyethylene membrane, gypsum board, and latex paint. 5) Includes gypsum board and latex paint.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.3.5.2. 2010. Available at www.athenasmi.org/tools/ecoCalculator/index.html

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

	Embodied Energy (MMBtu/SF) (1)	CO2 Equivalent Emissions (lbs/SF)
Glulam Joist with Plank Decking		
with EPDM membrane	0.16	11.05
with PVC membrane	0.25	20.70
with Modified bitumen membrane	0.25	21.78
with 4-Ply built-up roofing	0.43	41.49
with Steel Roofing	0.10	10.05
Wood I-Joist with WSP Decking		
with EPDM membrane	0.14	10.10
with PVC membrane	0.23	19.75
with Modified bitumen membrane	0.24	20.81
with 4-Ply built-up roofing	0.42	40.54
with Steel Roofing	0.09	9.11
Solid Wood Joist with WSP Decking		
with EPDM membrane	0.15	10.36
with PVC membrane	0.24	20.02
with Modified bitumen membrane	0.24	21.10
with 4-Ply built-up roofing	0.43	40.81
with Steel Roofing	0.10	9.39
Wood Chord/Steel Web Truss with WSP Decking		
with EPDM membrane	0.17	14.09
with PVC membrane	0.26	23.74
with Modified bitumen membrane	0.26	24.80
with 4-Ply built-up roofing	0.44	44.53
with Steel Roofing	0.11	13.10
Wood Truss (Flat) with WSP Decking		
with EPDM membrane	0.15	10.71
with PVC membrane	0.24	20.37
with Modified bitumen membrane	0.24	21.43
with 4-Ply built-up roofing	0.42	41.16
with Steel Roofing	0.09	9.72
Wood Truss (4:12 Pitch) with WSP Decking		
with 30-yr. fiberglass shingles	0.11	7.80
with 30-yr. organic shingles	0.12	8.38
with Clay tile roof	0.16	19.36
with Steel roof	0.09	9.19

Note(s): Assumptions: 60 year building lifetime. Low rise building. Values are general estimations for the U.S. All roof assemblies include R-20 continuous insulation, polyethylene membrane, latex paint, and gypsum board. All assemplies are insulated to IECC 2009 minimums for zones 3 and 6. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.3.5.2. 2010. Available at www.athenasmi.org/tools/ecoCalculator/index.html

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

	Embodied Energy (MMBtu/SF) (1)	CO2 Equivalent Emissions (lbs/SF)
Precast Hollow-Core Concrete		
EPDM Membrane	0.17	21.23
PVC Membrane	0.26	30.89
Modified Bitumen Membrane	0.26	31.94
4-Ply Built-Up Roofing System	0.44	51.68
Steel Roofing System	0.11	20.24
Precast Double-T		
EPDM Membrane	0.15	17.42
PVC Membrane	0.24	27.05
Modified Bitumen Membrane	0.25	28.13
4-Ply Built-Up Roofing System	0.43	47.86
Steel Roofing System	0.10	16.42
Suspended Concrete Slab		
EPDM Membrane	0.24	37.32
PVC Membrane	0.33	46.96
Modified Bitumen Membrane	0.33	48.04
4-Ply Built-Up Roofing System	0.51	67.75
Steel Roofing System	0.18	36.33
Open-Web Steel Joist, Steel Decking (2)		
EPDM Membrane	0.17	15.28
PVC Membrane	0.26	24.93
Modified Bitumen Membrane	0.26	26.01
4-Ply Built-Up Roofing System	0.45	45.72
Steel Roofing System	0.12	14.29

Note(s): Assumptions: 60 year building lifetime. Low rise building. Values are general estimations for the U.S. All roof assemblies include R-20 continuous insulation, polyethylene membrane, and latex paint. All assemblies are insulated to IECC 2009 minimums for zones 3 and 6. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material. 2) Includes

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.3.5.2. 2010. Available at www.athenasmi.org/tools/ecoCalculator/index.html

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

Interior Wall Type (2)	Embodied Energy (MMBtu/SF) (1)	CO2 Equivalent Emissions (lbs/SF)
2x4 wood stud (16" OC) + gypsum board (3)	0.03	2.84
2x4 wood stud (24" OC) + gypsum board (3)	0.03	2.78
2x4 wood stud (24" OC) + 2 gypsum boards (4)	0.04	4.45
Steel stud (16" OC) + gypsum board (4)	0.04	3.99
Steel stud (24" OC) + gypsum board (4)	0.04	3.64
Steel stud (24" OC) + 2 gypsum boards	0.05	5.31
6" Concrete block + gypsum board	0.21	34.02
6" Concrete block	0.19	32.34
Clay brick (4") unpainted	0.05	6.97

Note(s): Assumptions: Values are general estimations for the U.S. 60 year building lifetime. Low rise building. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material. 2) All interior walls include two coats of latex paint unless noted otherwise. 3) Rounding obscures difference in embodied energy figures: wood stud with 16" OC is 3.6% higher than wood stud with 24" OC. 4) Rounding obscures difference in embodied energy figure: wood stud wall is 19.9% higher than steel stud wall with 16" OC and 27.6% higher than steel stud wall with 24" OC.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.3.5.2. 2010. Available at www.athenasmi.org/tools/ecoCalculator/index.html

1.6.7 Embodied Energy of Floor Structures in the U.S.

Floor Structure with Interior Ceiling Finish of Gypsum Board, Latex Paint	Embodied Energy (MMBtu/SF) (1)	CO2 Equivalent Emissions (lbs/SF)
Glulam joist and plank decking	0.04	3.06
Precast Hollowcore	0.05	13.43
Wood I-joist	0.02	2.03
Open-web Steel Joist	0.06	7.94
Open-web Steel Joist with concrete topping	0.07	12.30
Precast Double-T	0.04	11.38
Precast Double-T with concrete topping	0.06	16.45
Steel Joist	0.06	8.82
Steel Joist with plywood decking	0.06	9.28
Suspended Concrete Slab	0.12	29.19
Wood Joist	0.02	1.65
Wood Joist with plywood decking	0.03	2.38
Wood Chord and Steel Web truss	0.05	5.91
Wood Truss	0.03	2.71
Floor Structure without Interior Ceiling Finish		
Glulam joist and plank decking	0.05	4.32
Precast Hollowcore	0.06	14.68
Wood I-joist	0.04	3.26
Open-web Steel Joist	0.07	9.19
Open-web Steel Joist with concrete topping	0.09	13.54
Precast Double-T	0.05	12.61
Precast Double-T with concrete topping	0.07	17.70
Steel Joist	0.07	10.08
Steel Joist with plywood decking	0.08	10.54
Suspended Concrete Slab	0.13	30.42
Wood Joist	0.04	2.91
Wood Joist with plywood decking	0.05	3.64
Wood Chord and Steel Web truss	0.06	7.17
Wood Truss	0.04	3.95

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

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.3.5.2. 2010. Available at www.athenasmi.org/tools/ecoCalculator/index.html

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

Assumes Non-Load-Bearing Exterior Wall:		Embodied Energy (MMBtu SF) (1)	CO2 Equivalent Emissions (lbs/SF)
Column Type	Beam Type		
Concrete	Concrete	0.101	17.57
Concrete	Steel I-beam	0.091	11.24
Hollow structural steel	Glulam	0.022	2.07
Hollow structural steel	Laminated veneer lumber	0.019	1.81
Glulam	Glulam	0.019	1.68
Glulam	Laminated veneer lumber	0.016	1.39
Steel I-beam	Steel I-beam	0.054	5.51
Steel I-beam	Laminated veneer lumber	0.018	1.61
Built-up softwood	Glulam	0.019	0.62
Built-up softwood	Laminated veneer lumber	0.016	0.49

Assumes Load-Bearing Exterior Wall:			
Column Type	Beam Type		
Concrete	Concrete	0.076	13.49
Concrete	Steel I-beam	0.069	8.31
Hollow structural steel	Glulam	0.017	1.63
Hollow structural steel	Laminated veneer lumber	0.015	1.41
Glulam	Glulam	0.015	1.34
Glulam	Laminated veneer lumber	0.013	1.15
Steel I-beam	Steel I-beam	0.044	4.48
Steel I-beam	Laminated veneer lumber	0.014	1.28
Built-up softwood	Glulam	0.015	1.34
Built-up softwood	Laminated veneer lumber	0.013	1.12

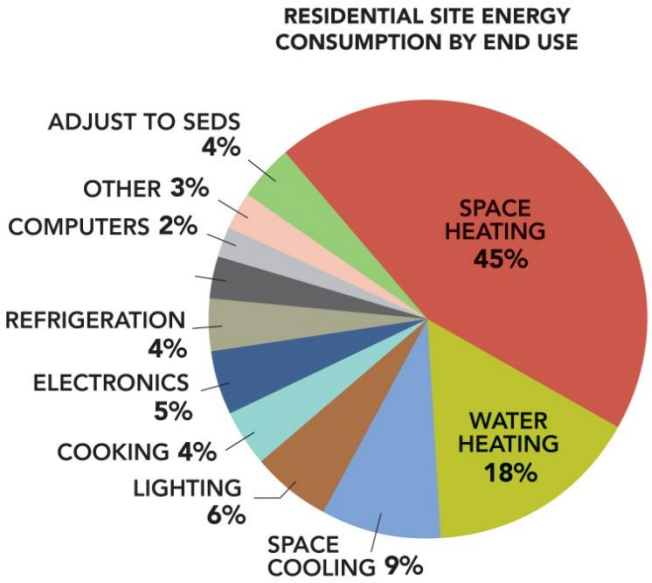
Note(s): Assumptions: Values are general estimations for the U.S. Low rise building. 60 year building lifetime. Bay size: 30 by 30 feet. Column Height: 10 feet. 1) Embodied Energy: Energy use includes extraction, processing, transportation, construction, and disposal of each material.

Source(s): Athena Institute. Athena EcoCalculator for Assemblies v.3.5.2. 2010. Available at www.athenasmi.org/tools/ecoCalculator/index.html

Chapter 2: Residential Sector

Chapter 2 focuses on energy use in the U.S. residential buildings sector. Section 2.1 provides data on energy consumption by fuel type and end use, as well as energy consumption intensities for different housing categories. Section 2.2 presents characteristics of average households and changes in the U.S. housing stock over time. Sections 2.3 and 2.4 address energy-related expenditures and residential sector emissions, respectively. Section 2.5 contains statistics on housing construction, existing home sales, and mortgages. Section 2.6 presents data on home improvement spending and trends. Section 2.7 describes the industrialized housing industry, including the top manufacturers of various manufactured home products. Section 2.8 presents information on low-income housing and Federal weatherization programs. The main points from this chapter are summarized below:

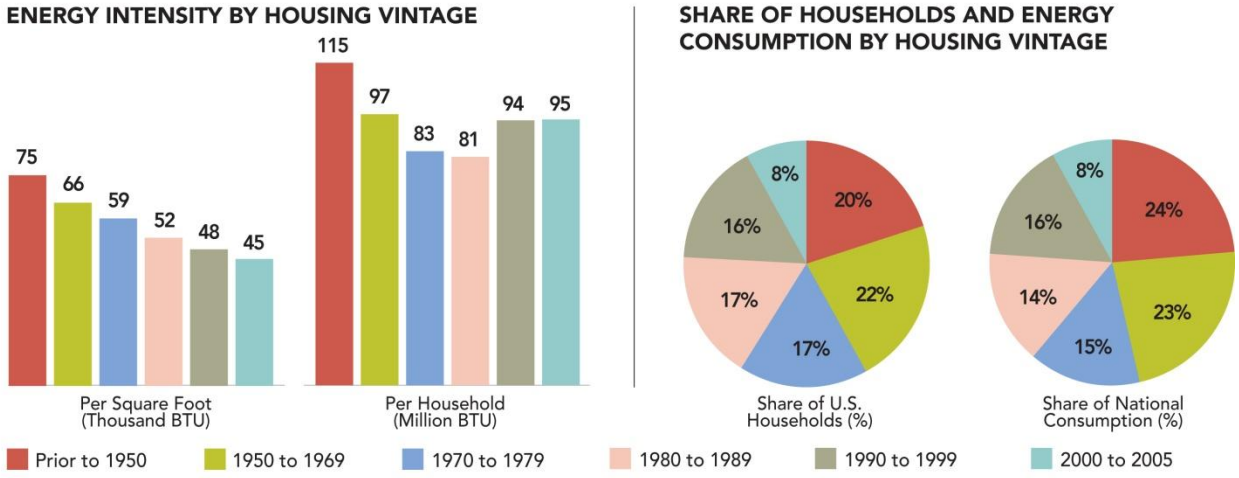
- The recession continues to affect the construction and real estate industry. About 700,000 new residential units were constructed in 2010, representing a 66% drop from 2006. Housing prices have also continued to decrease since 2007.
- Residential energy expenditures decreased 7%, or $18 billion, from 2008 to 2009, the largest percent decrease in the last 30 years. At the same time, carbon dioxide emissions from residential buildings decreased 5%.
- Space heating and cooling – which combined account for 54% of site energy consumption and 43% of primary energy consumption – drive residential energy demand.
- Homes built between 2000 and 2005 used 14% less energy per square foot than homes built in the 1980s and 40% less energy per square foot than homes built before 1950. However, larger home sizes have offset these efficiency improvements.



Primary energy consumption in the residential sector totaled 20.99 quadrillion Btu (quads) in 2009, equal to 54% of consumption in the buildings sector and 22% of total primary energy consumption in the U.S. Nearly half (49%) of this primary energy was lost during transmission and distribution (T&D). Energy consumption increased 24% from 1990 to 2009. However, because of projected improvements in building and appliance efficiency, the Energy Information Administration's 2012 Annual Energy Outlook forecast a 13% increase from 2009 to 2035. (2.1.1)

As illustrated above, space heating demanded the greatest share of on-site energy consumption at 5.23 quads, or 45%. Forty-three percent of site energy was consumed as natural gas. All the energy used for space cooling, lighting, electronics, and refrigeration was consumed as electricity. Electricity accounted for 70% of total primary energy consumption, but only 4.95 quads of electricity were actually delivered to U.S. households due to T&D losses. (2.1.5)

There is a clear trend toward increasing efficiency in residential housing. Homes built between 2000 and 2005 used 44,700 Btu per heated square foot of heated floor space—14% less than homes built in the 1980s and 40% less than homes built before 1950. (2.1.12)



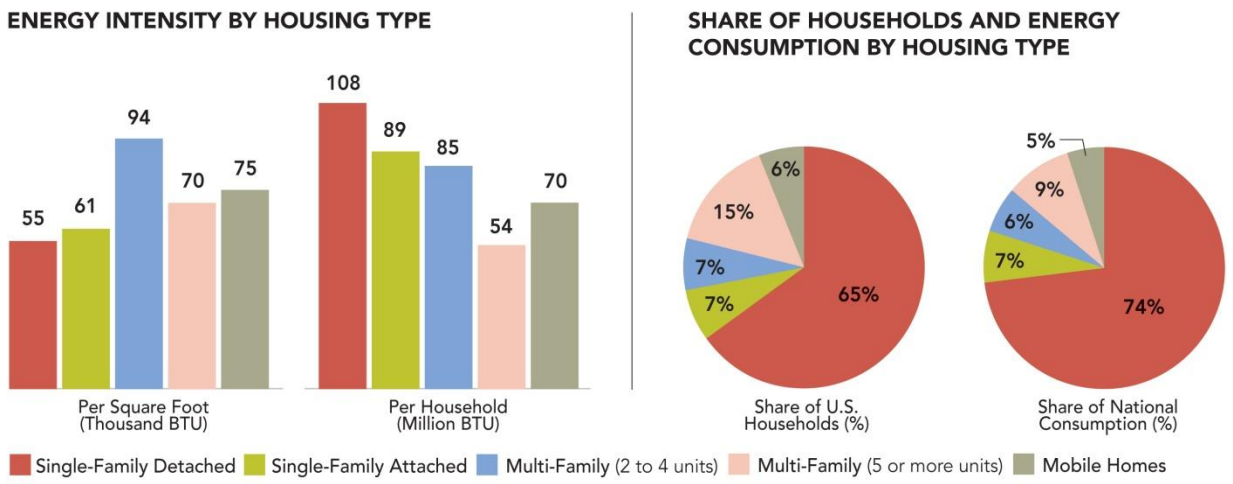
ENERGY INTENSITY BY HOUSING TYPE

SHARE OF HOUSEHOLDS AND ENERGY CONSUMPTION BY HOUSING TYPE

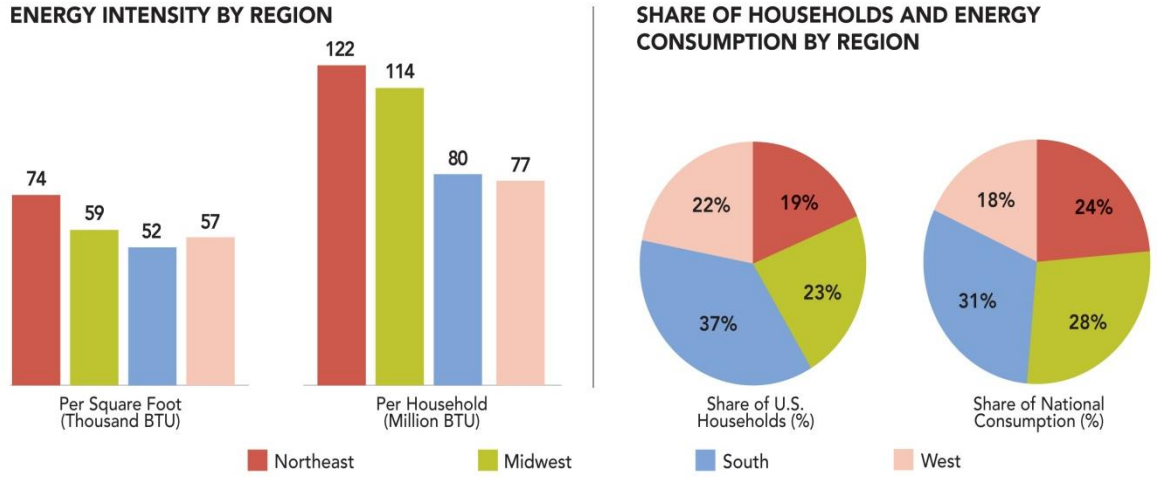
There has also been a trend toward larger home sizes. Specifically, single-family homes built between 2000 and 2005 are 29% larger on average than those built in the 1980s and 38% larger than those built before 1950. However, among all housing types, homes built before 1950 are 11% larger on average than those built between 1950 and 1979. (2.2.5) As shown in the figure above, the oldest homes—which generally have less efficient systems and little or no insulation—have the highest per-household energy consumption of all home vintages. Despite better building practices and newer systems, the greater average floor space of new homes has offset their improved efficiency.

The energy consumption profiles of single-family homes and multi-family homes (apartments) are very different. On average, multi-family homes used 64.1 million Btu per household, which was 9% less than mobile homes and 40% less than single-family homes. The difference was most pronounced for multi-family homes in buildings with 5 or more units, which consumed about half as much energy as the average single-family home. One reason is that new multi-family homes built since 1990 have about half the floor space, on average, as new single-family homes. (2.5.1)

Although multi-family homes used the least energy per household, they consumed the most energy per square foot of heated floor space, at 78,300 Btu. Mobile homes used 5% less energy per square foot than multi-family homes, and the average single-family home used 26% less. (2.1.11) Energy demand for water heating, cooking, and refrigeration is mostly independent of floor space, thus leading to higher consumption per square foot in smaller households.



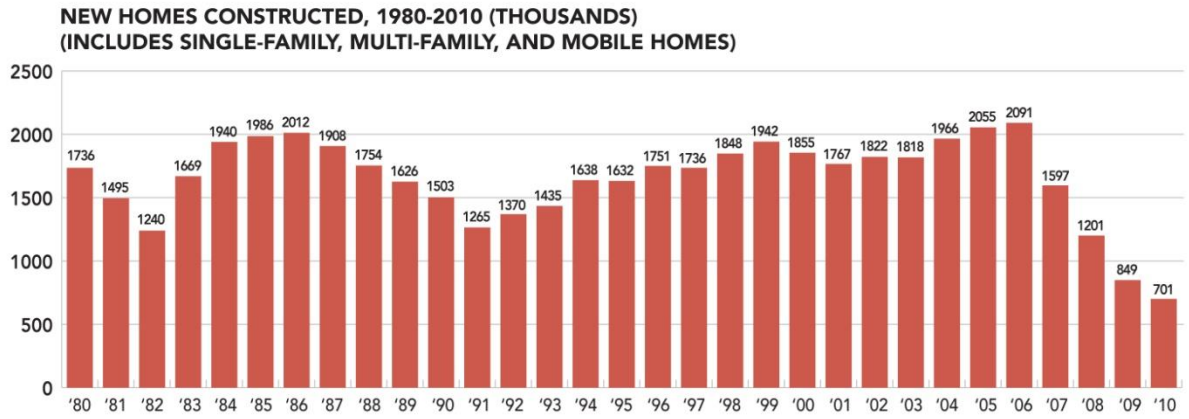
The greatest energy consumption intensities per household were in the Northeast and Midwest. (2.1.10) This is partly because the average household size is largest in the Midwest at 2,566 square feet, while the Northeast has the largest share of homes built before 1950 and the smallest share of homes built between 1990 and 2005. (2.2.3), (2.2.4)



Space heating made up the largest share of delivered energy consumption in both regions. On the other hand, the average household in the South required only 20.4 million Btu for space heating, less than one-third the energy required for space heating in the average household in the Northeast. Households in the West also required less energy for space heating on average—23.8 million Btu per household—and required only 4 million Btu per household for space cooling, compared to 13.9 million Btu per household in the South. Other end uses were fairly consistent across all four regions. (2.1.9)

The characteristics of the residential sector have changed in response to the economy and other factors. For example, new construction grew steadily from 1.8 million homes in 2001 to 2.1 million homes in 2006, but it has declined since, with just over 700,000 new homes built in 2010. (2.5.1) In that year, 52% of single-family homes were constructed and 68% of mobile homes were placed in the South. (2.5.4) In fact, the South has accounted for the largest share of home construction for the past 30 years. (2.2.3) This

trend is significant because of the lower energy consumption intensities associated with homes in that region.



The geographical distribution of new housing has contributed to greater electricity consumption in the residential sector—from 53% of total primary energy in 1980 to 69% in 2009—as more homes come with electricity-intensive heating and cooling equipment installed. (2.1.1) The percentage of new single-family homes with air conditioning has increased from 62% in 1980 to 79% in 1995 and 88% in 2010. Recently, heat pump heating systems have also gained market share, from 23% in 2001 to 38% in 2010. Warm-air furnaces still represent the most common type of heating system—56% of new homes had one in 2010. (2.2.8)

During the recession, sales of existing homes fell from 6.5 million in 2006 to a low of 4.9 million in 2010, the lowest number of sales since 1997. (2.5.9) All regions saw decreased sales in 2010 and home values continued to fall nationwide. Sales prices and appraisal data showed a 14.8% decrease in 3rd quarter Home Price Index (HPI) values between 2007 and 2011 for the country as a whole. (2.5.10)

Reduced home values corresponded with less spending on energy efficiency-related home improvements. In 2009, Americans spent $169 billion on home improvements compared to $237 billion in 2007. Of the $173 billion, $13 billion was for HVAC systems, $12 billion was for doors and windows, and $1.8 billion was for insulation. (2.6.3), (2.6.4)

Aggregate energy expenditures in the residential sector have increased by more than 50% between 1980 and 2009, from $158.5 billion in 1980 to $241.6 billion in 2009, as expressed in 2010 dollars. (2.3.3) This increase is largely due to the growing housing stock, and less caused by rising energy prices which have increased 11% over the same period. (2.3.4) On average, households in the Northeast spent the most on energy in 2005—$2,554 per year; households in the West spent the least—$1,975 per year. (2.3.13) Though regional variation in energy prices exists, much of the difference in energy expenditures among regions can be explained by climate and housing stock characteristics.

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

	Natural Gas		Petroleum (1)		Coal		Renewable(2)		Electricity Sales	Electricity Losses	Electricity Total		TOTAL (2)		Growth Rate 2010-Year
1980	4.79	30%	1.72	11%	0.03	0%	0.85	5%	2.45	5.89	8.33	53%	15.72	100%	-
1990	4.47	26%	1.37	8%	0.03	0%	0.64	4%	3.15	7.24	10.39	61%	16.91	100%	-
2000	5.07	25%	1.52	7%	0.01	0%	0.49	2%	4.07	9.20	13.27	65%	20.36	100%	-
2005	4.94	23%	1.42	7%	0.01	0%	0.49	2%	4.64	10.08	14.72	68%	21.58	100%	-
2010	**5.06**	**23%**	**1.22**	**6%**	**0.01**	**0%**	**0.45**	**2%**	**4.95**	**10.39**	**15.34**	**69%**	**22.07**	**100%**	
2015	4.99	24%	1.08	5%	0.01	0%	0.51	2%	4.79	9.68	14.47	69%	21.06	100%	-0.9%
2020	4.95	23%	1.01	5%	0.01	0%	0.54	2%	5.02	10.15	15.17	70%	21.66	100%	-0.2%
2025	4.88	22%	0.95	4%	0.01	0%	0.54	2%	5.30	10.70	16.00	71%	22.39	100%	0.1%
2030	4.84	21%	0.91	4%	0.01	0%	0.55	2%	5.63	11.12	16.76	73%	23.06	100%	0.2%
2035	4.76	20%	0.87	4%	0.01	0%	0.55	2%	5.94	11.56	17.50	74%	23.69	100%	0.3%

Note(s): 1) Petroleum includes distillate oil, LPG, and kerosene. 2) Includes site-marketed and non-marketed renewable energy. 3) 2008 site-to-source electricity conversion = 3.16.

Source(s): EIA, State Energy Data 2009: Consumption, 2011, Table 8 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables,Table A2, p. 3-5 for 2010-2035 consumption and Table A17, p. 34-35 for non-marketed renewable energy.

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

	Natural Gas	Petroleum	Coal	Renewables Hydro.	Renewables Other	Renewables Total	Nuclear	Total (quad)
1980	41%	12%	28%	7%	6%	13%	6%	14.84
1990	34%	8%	34%	6%	5%	11%	13%	16.54
2000	34%	8%	35%	5%	4%	9%	14%	20.06
2005	34%	7%	36%	5%	4%	9%	14%	21.28
2010	**37%**	**6%**	**33%**	**4%**	**4%**	**9%**	**15%**	**21.52**
2015	39%	6%	28%	5%	6%	11%	15%	19.98
2020	38%	5%	30%	5%	7%	12%	16%	20.59
2025	36%	5%	31%	5%	7%	12%	16%	21.14
2030	36%	5%	31%	5%	7%	12%	16%	21.63
2035	39%	5%	29%	5%	8%	13%	14%	18.87

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

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 3-5 and Table A17, p. 34-35 for energy consumption; and EIA, State Energy Data Report 2009, Jun. 2011, Tables 8 and 12.

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

	Wood	Solar Thermal	Solar PV	GSHP	Total	Growth Rate 2010-Year
1980	0.846	0.000	N.A.	0.000	0.846	-
1990	0.582	0.056	N.A.	0.006	0.643	-
2000	0.430	0.060	N.A.	0.009	0.499	-
2005	0.428	0.058	N.A.	0.016	0.502	-
2010	**0.424**	**0.010**	**0.009**	**0.006**	**0.449**	
2015	0.426	0.017	0.045	0.012	0.500	2.2%
2020	0.432	0.018	0.056	0.019	0.525	1.6%
2025	0.434	0.018	0.058	0.022	0.531	1.1%
2030	0.435	0.018	0.059	0.024	0.537	0.9%
2035	0.436	0.018	0.062	0.027	0.542	0.8%

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

Source(s): EIA, State Energy Data 2009: Consumption, 2011, Table 8 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A17, p. 34-35 for 2010-2035.

2.1.4 Residential Delivered and Primary Energy Consumption Intensities, by Year

	Number of Households (millions)	Percent Post-2000 Households (1)	*Delivered Energy Consumption* Total (10^15 Btu)	*Delivered Energy Consumption* Per Household (10^6 Btu/Hhold)	Primary Energy Consumption Total (10^15 Btu)	Primary Energy Consumption Per Household (million Btu/Hhold)
1980	79.6	N.A.	9.83	123.5	15.72	197.4
1990	94.2	N.A.	9.68	102.7	16.92	179.5
2000	105.7	N.A.	11.17	105.6	20.37	192.7
2005	108.8	9.0%	11.51	105.7	21.59	198.4
2010	**114.2**	**13.6%**	**11.66**	**102.1**	**22.07**	**193.3**
2015	118.8	17.9%	11.30	95.1	21.06	177.3
2020	126.0	24.8%	11.42	90.6	21.66	171.9
2025	132.7	30.7%	11.58	87.3	22.39	168.7
2030	139.3	36.1%	11.83	84.9	23.06	165.6
2035	145.6	40.8%	12.02	82.6	23.69	162.7

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

Source(s): EIA, State Energy Data 2009: Consumption, Jun. 2010, Table 8 for 1980-2009; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 3-5, Table A4, p. 9-10, Table A17, p. 34-35 for 2010-2035, and Table A20, p. 37-38 for households; DOC, Statistical Abstract of the United States 2007, Jan. 2007, Table No. 948, p. 606 for 1980-2004 households; DOC, Statistical Abstract of the United States 2010; 2010, Table 982 for 2005-2009 households.

2.1.5 2010 Residential Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas	Fuel Oil	LPG	Other Fuel(1)	Renw. En.(2)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (3)	Primary Total	Primary Percent
Space Heating (4)	3.50	0.53	0.30	0.04	0.43	0.44	5.23	44.7%	1.35	6.15	27.8%
Water Heating	1.29	0.10	0.07		0.01	0.45	1.92	16.4%	1.38	2.86	12.9%
Space Cooling	0.00					1.08	1.08	9.2%	3.34	3.34	15.1%
Lighting						0.69	0.69	5.9%	2.13	2.13	9.7%
Refrigeration (6)						0.45	0.45	3.9%	1.41	1.41	6.4%
Electronics (5)						0.54	0.54	4.7%	1.68	1.68	7.6%
Wet Cleaning (7)	0.06					0.33	0.38	3.3%	1.01	1.06	4.8%
Cooking	0.22		0.03			0.18	0.43	3.7%	0.57	0.81	3.7%
Computers						0.17	0.17	1.5%	0.53	0.53	2.4%
Other (8)	0.00		0.16		0.01	0.20	0.37	3.2%	0.63	0.80	3.6%
Adjust to SEDS (9)						0.42	0.42	3.6%	1.29	1.29	5.8%
Total	**5.06**	**0.63**	**0.56**	**0.04**	**0.45**	**4.95**	**11.69**	100%	**15.34**	**22.07**	100%

Note(s): 1) Kerosene and coal are assumed attributable to space heating. 2) Comprised of wood space heating (0.42 quad), solar water heating (0.01 quad), geothermal space heating (less than 0.01 quad), and solar PV (0.01 quad). 3) Site-to-source electricity conversion (due to generation and transmission losses) = 3.10. 4) Includes furnace fans (0.13 quad). 5) Includes color television (0.33 quad). 6) Includes refrigerators (0.37 quad) and freezers (0.08 quad). 7) Includes clothes washers (0.03 quad), natural gas clothes dryers (0.06 quad), electric clothes dryers (0.19 quad), and dishwashers (0.10 quad). Does not include water heating energy. 8) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. 9) Energy adjustment that EIA uses to relieve discrepancies between data sources. Refers to energy attributable to the residential buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 2-5 and Table A4, p. 9-12; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A, for residential electric end-uses.

2.1.6 2015 Residential Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas	Fuel Oil	LPG	Other Fuel(1)	Renw. En.(2)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (3)	Primary Total	Primary Percent
Space Heating (4)	3.40	0.48	0.26	0.03	0.44	0.42	5.03	44.2%	1.27	5.88	27.9%
Water Heating	1.31	0.07	0.05		0.02	0.48	1.92	16.9%	1.44	2.88	13.7%
Space Cooling	0.00					1.02	1.02	8.9%	3.07	3.07	14.6%
Lighting						0.53	0.53	4.6%	1.60	1.60	7.6%
Refrigeration (5)						0.45	0.45	4.0%	1.37	1.37	6.5%
Electronics (6)						0.33	0.33	2.9%	0.99	0.99	4.7%
Wet Cleaning (7)	0.06					0.33	0.39	3.4%	0.98	1.04	5.0%
Cooking	0.22		0.03			0.11	0.36	3.1%	0.34	0.59	2.8%
Computers						0.19	0.19	1.7%	0.57	0.57	2.7%
Other (8)	0.00		0.17		0.05	0.94	1.17	10.2%	2.85	3.07	14.6%
Total	**4.99**	**0.55**	**0.51**	**0.03**	**0.51**	**4.79**	**11.38**	100%	**14.47**	**21.06**	100%

Note(s): 1) Kerosene and coal are assumed attributable to space heating. 2) Comprised of wood space heating (0.43 quad), solar water heating (0.02 quad), geothermal space heating (0.01 quad), and solar PV (0.05 quad). 3) Site-to-source electricity conversion (due to generation and transmission losses) = 3.02. 4) Includes furnace fans (0.14 quad). 5) Includes refrigerators (0.37 quad) and freezers (0.08 quad). 6) Includes color television (0.33 quad). 7) Includes clothes washers (0.03 quad), natural gas clothes dryers (0.06 quad), electric clothes dryers (0.20 quad), and dishwashers (0.10 quad). Does not include water heating energy. 8) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 2-5 and Table A4, p. 9-12.

2.1.7 2025 Residential Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas	Fuel Oil	LPG	Other Fuel(1)	Renw. En.(2)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (3)	Primary Total	Primary Percent
Space Heating (4)	3.28	0.38	0.24	0.03	0.46	0.46	4.85	41.5%	1.40	5.78	25.8%
Water Heating	1.32	0.05	0.04		0.02	0.53	1.96	16.8%	1.60	3.03	13.5%
Space Cooling	0.00					1.12	1.12	9.6%	3.38	3.38	15.1%
Lighting						0.47	0.47	4.0%	1.42	1.42	6.3%
Refrigeration (5)						0.48	0.48	4.1%	1.45	1.45	6.5%
Electronics (6)						0.37	0.37	3.2%	1.12	1.12	5.0%
Wet Cleaning (7)	0.06					0.30	0.37	3.1%	0.91	0.98	4.4%
Cooking	0.22		0.03			0.13	0.38	3.2%	0.40	0.64	2.9%
Computers						0.24	0.24	2.0%	0.72	0.72	3.2%
Other (8)	0.00		0.20		0.07	1.20	1.46	12.5%	3.61	3.87	17.3%
Total	**4.88**	**0.43**	**0.50**	**0.03**	**1.00**	**5.30**	**11.69**	100%	**16.00**	**22.39**	100%

Note(s): 1) Kerosene and coal are assumed attributable to space heating. 2) Comprised of wood space heating (0.43 quad), solar water heating (0.02 quad), geothermal space heating (0.02 quad), and solar PV (0.06 quad). 3) Site-to-source electricity conversion (due to generation and transmission losses) = 3.02. 4) Includes furnace fans (0.14 quad). 5) Includes refrigerators (0.39 quad) and freezers (0.09 quad). 6) Includes color television (0.37 quad). 7) Includes clothes washers (0.02 quad), natural gas clothes dryers (0.06 quad), electric clothes dryers (0.18 quad), and dishwashers (0.10 quad). Does not include water heating energy. 8) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 2-5 and Table A4, p. 9-12.

2.1.8 2035 Residential Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas	Fuel Oil	LPG	Other Fuel(1)	Renw. En.(2)	*Site* Electric	*Site* Total	*Site* Percent	Primary Electric (3)	Primary Total	Primary Percent
Space Heating (4)	3.20	0.31	0.22	0.03	0.46	0.49	4.72	38.9%	1.45	5.67	23.9%
Water Heating	1.27	0.04	0.03		0.02	0.54	1.90	15.6%	1.60	2.96	12.5%
Space Cooling	0.00					1.25	1.25	10.3%	3.68	3.68	15.5%
Lighting						0.48	0.48	3.9%	1.41	1.41	5.9%
Refrigeration (5)						0.52	0.52	4.3%	1.54	1.54	6.5%
Electronics (6)						0.44	0.44	3.6%	1.29	1.29	5.4%
Wet Cleaning (7)	0.07					0.32	0.39	3.2%	0.95	1.01	4.3%
Cooking	0.23		0.02			0.15	0.40	3.3%	0.44	0.69	2.9%
Computers						0.27	0.27	2.2%	0.79	0.79	3.3%
Other (8)	0.00		0.22		0.07	1.48	1.77	14.6%	4.35	4.64	19.6%
Total	**4.76**	**0.35**	**0.51**	**0.03**	**0.55**	**5.94**	**12.14**	100%	**17.50**	**23.69**	100%

Note(s): 1) Kerosene and coal are assumed attributable to space heating. 2) Comprised of wood space heating (0.44 quad), solar water heating (0.02 quad), geothermal space heating (0.03 quad), solar PV (0.06 quad), and wind (0.01 quad). 3) Site-to-source electricity conversion (due to generation and transmission losses) = 2.94. 4) Includes furnace fans (0.15 quad). 5) Includes refrigerators (0.43 quad) and freezers (0.09 quad). 6) Includes color television (0.44 quad). 7) Includes clothes washers (0.02 quad), natural gas clothes dryers (0.07 quad), electric clothes dryers (0.19 quad), and dishwashers (0.11 quad). Does not include water heating energy. 8) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 2-5 and Table A4, p. 9-12.

2.1.9 2005 Delivered Energy End-Uses for an Average Household, by Region (Million Btu per Household)

	Northeast	Midwest	South	West	National
Space Heating	70.3	56.6	20.4	23.8	38.7
Space Cooling	3.6	5.6	13.9	4.0	7.9
Water Heating	21.1	20.4	15.8	21.2	19.0
Refrigerator	5.4	7.0	6.6	5.7	6.3
Other Appliances & Lighting	23.0	25.9	25.0	24.1	24.7
Total (1)	**122.2**	**113.5**	**79.9**	**77.4**	**95.0**

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

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

2.1.10 2005 Residential Delivered Energy Consumption Intensities, by Census Region

Region	Per Square Foot (thousand Btu) (1)	Per Household (million Btu)	Per Household Members (million Btu)	Percent of Total Consumption
Northeast	**73.5**	**122.2**	**47.7**	**24%**
New England	77.0	129.4	55.3	7%
Middle Atlantic	72.2	119.7	45.3	17%
Midwest	**58.9**	**113.5**	**46.0**	**28%**
East North Central	61.1	117.7	47.3	20%
West North Central	54.0	104.1	42.9	8%
South	**51.5**	**79.8**	**31.6**	**31%**
South Atlantic	47.4	76.1	30.4	16%
East South Central	56.6	87.3	36.1	6%
West South Central	56.6	82.4	31.4	9%
West	**56.6**	**77.4**	**28.1**	**18%**
Mountain	54.4	89.8	33.7	6%
Pacific	58.0	71.8	25.7	11%
U.S. Average	**58.7**	**94.9**	**37.0**	**100%**

Note(s): 1) Energy consumption per square foot was calculated using estimates of average heated floor space per household. According to the 2005 Residential Energy Consumption Survey (RECS), the average heated floor space per household in the U.S. was 1,618 square feet. Average total floor space, which includes garages, attics and unfinished basements, equaled 2,309 square feet.

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

2.1.11 2005 Residential Delivered Energy Consumption Intensities, by Housing Type

Type	Per Square Foot (thousand Btu) (1)	Per Household (million Btu)	Per Household Members (million Btu)	Percent of Total Consumption
Single-Family:	**55.4**	**106.6**	**39.4**	**80.5%**
Detached	55.0	108.4	39.8	73.9%
Attached	60.5	89.3	36.1	6.6%
Multi-Family:	**78.3**	**64.1**	**29.7**	**14.9%**
2 to 4 units	94.3	85.0	35.2	6.3%
5 or more units	69.8	54.4	26.7	8.6%
Mobile Homes	**74.6**	**70.4**	**28.5**	**4.6%**
All Housing Types	**58.7**	**95.0**	**37.0**	**100%**

Note(s): 1) Energy consumption per square foot was calculated using estimates of average heated floor space per household. According to the 2005 Residential Energy Consumption Survey (RECS), the average heated floor space per household in the U.S. was 1,618 square feet. Average total floor space, which includes garages, attics and unfinished basements, equaled 2,309 square feet.

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

2.1.12 2005 Residential Delivered Energy Consumption Intensities, by Vintage

Year Built	Per Square Foot (thousand Btu) (1)	Per Household (million Btu)	Per Household Member (million Btu)	Percent of Total Consumption
Prior to 1950	74.5	114.9	46.8	24%
1950 to 1969	66.0	96.6	38.1	23%
1970 to 1979	59.4	83.4	33.5	15%
1980 to 1989	51.9	81.4	32.3	14%
1990 to 1999	48.2	94.4	33.7	16%
2000 to 2005	44.7	94.7	34.3	8%
Average	58.7	95.0	40.0	

Note(s): 1) Energy consumption per square foot was calculated using estimates of average heated floor space per household. According to the 2005 Residential Energy Consumption Survey (RECS), the average heated floor space per household in the U.S. was 1,618 square feet. Average total floor space, which includes garages, attics and unfinished basements, equaled 2,309 square feet.

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

2.1.13 2005 Residential Delivered Energy Consumption Intensities, by Principal Building Type and Vintage

Building Type	Per Square Foot (thousand Btu) (1)		Per Household (million Btu)		Per Household Member (million Btu)	
	Pre-1995	1995-2005	Pre-1995	1995-2005	Pre-1995	1995-2005
Single-Family	**38.4**	**44.9**	**102.7**	**106.2**	**38.5**	**35.5**
Detached	37.9	44.7	104.5	107.8	38.8	35.4
Attached	43.8	55.5	86.9	85.1	34.2	37.6
Multi-Family	**63.8**	**58.7**	**58.3**	**49.2**	**27.2**	**24.3**
2 to 4 units	69.0	55.1	70.7	59.4	29.5	25.0
5 or more units	61.5	59.6	53.6	47.2	26.3	24.2
Mobile Homes	**82.4**	**57.1**	**69.6**	**74.5**	**29.7**	**25.2**

Note(s): 1) Energy consumption per square foot was calculated using estimates of average heated floor space per household. According to the 2005 Residential Energy Consumption Survey (RECS), the average heated floor space per household in the U.S. was 1,618 square feet. Average total floor space, which includes garages, attics and unfinished basements, equaled 2,309 square feet.

Source(s): EIA, 2005 Residential Energy Consumption Survey,

2.1.14 2005 Residential Delivered Energy Consumption Intensities, by Ownership of Unit

Ownership	Per Square Foot (thousand Btu) (1)	Per Household (million Btu)	Per Household Members (million Btu)	Percent of Total Consumption
Owned	**54.9**	**104.5**	**40.3**	**78%**
Rented	**77.4**	**71.7**	**28.4**	**22%**
Public Housing	75.7	62.7	28.7	2%
Not Public Housing	77.7	73.0	28.4	19%
				100%

Note(s): 1) Energy consumption per square foot was calculated using estimates of average heated floor space per household. According to the 2005 Residential Energy Consumption Survey (RECS), the average heated floor space per household in the U.S. was 1,618 square feet. Average total floor space, which includes garages, attics and unfinished basements, equaled 2,309 square feet.

Source(s): EIA, 2005 Residential Energy Consumption Survey.

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

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

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

Source(s): LBNL, Residential Heating and Cooling Loads Component Analysis, Nov. 1999, Figure P-1 and Appendix C: Component Loads Data Tables.

2.1.16 Operating Characteristics of Electric Appliances in the Residential Sector

	Power Draw (W) (1)			Annual Usage (hours/year)			Annual Consumption	Annual Cost
	Active	Idle	Off	Active	Idle	Off	(kWh/year)	($) (2)
Kitchen								
Coffee Maker	1,000	70	0	38	229	8,493	58	5.6
Dishwasher (3)				365 (4)			120	11.6
Microwave Oven	1,500		3	70		8,690	131	12.6
Toaster Oven	1,051			37			54	5.2
Refrigerator-Freezer							660	63.1
Freezer							470	45.0
Lighting								
18-W Compact Fluorescent	18			1,189			20	2.1
60-W Incandescent Lamp	60			672			40	3.9
100-W Incandescent Lamp	100			672			70	6.4
Torchiere Lamp-Halogen	300			1,460			440	42.0
Bedroom and Bathroom								
Hair Dryer	710			50			40	3.4
Waterbed Heater	350			3,051			1,070	102.7
Laundry Room								
Clothes Dryer				359 (4)			1,000	96.0
Clothes Washer (3)				392 (4)			110 (3)	10.4
Home Electronics								
Desktop PCs	75	4	2	2,990	330	5,440	237	22.8
Notebook PCs	25	2	2	2,368	935	5,457	72	6.9
Desktop Computer Monitors	42	1	1	1,865	875	6,020	85	8.2
Stereo Systems	33	30	3	1,510	1,810	5,440	119	11.4
Televisions	97		4	1,860		6,900	222 (7)	21.3
Analog, <40"	86			1,095 (5)			184	17.7
Analog, >40"	156			1,825 (5)			312	30.0
Digital, ED/HD TV, <40"	150			1,095 (5)			301	28.9
Digital, ED/HD TV, >40"	234			1,825 (5)			455	43.7
Set-top Boxes	20	0	20	6,450	0	2,310	178	17.1
DVD/VCR	17	13	3	170	5,150	3,430	78	7.5
Video Game Systems	36	36	1	405	560	7,795	41	3.9
Heating and Cooling								
Dehumidifier	600			1,620			970	93.3
Furnace Fan	295			1,350			400	38.2
Ceiling Fan (only fan motor)	35			2,310			81	7.8
Space Heater	1,320	1		584			314	30.1
Water Heating								
Water Heater-Family of 4	4,500			64 (6)			4,770	458.3
Water Heater-Family of 2	4,500			32 (6)			2,340	224.3
Portable Spa	4,350	275		25	8,735		2,525	242.4

Note(s): 1) Power draw will vary due to appliance components and modes of operation. 2) $0.096/kWh. 3) Excludes electricity for water heating and drying. 4) Cycles/year. 5) TVs <40" are estimated on 3 hours/day and TVs >40" are estimated on 5 hours/day. 6) Gallons/day. 7) Power, usage and annual consumption values for televisions are weighted averages of multiple usage types and screen sizes.

Source(s): BTS/A.D. Little, Electricity Consumption by Small End Uses in Residential Buildings, Aug. 1998, Exhibit 6-8, p. 6-10 for clothes washer, computer, dehumidifier, dishwasher, furnace fan, pool pump, torchiere lamp-halogen, waterbed heater, and well pump; LBNL, Energy Data Sourcebook for the U.S. Residential Sector, LBNL-40297, Sept. 1997, p. 100-102 for clothes dryers, Table 10.2, p. 108 for lighting, and p. 62-67 for water heaters; LBNL, Miscellaneous Electricity Use in the U.S. Residential Sector, LBNL-40295, Apr. 1998, Appendix D for hair dryers; EIA, Supplement to AEO 2008, June 2008, Table 21 for refrigerator and freezer; GAMA, Consumers' Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment, Apr. 2000 for water heater power draw; EIA/TIAX, Commercial and Residential Sector Miscellaneous Electricity Consumption: FY2005 and Projections to 2030, Sept. 2006, p. 41-60 for coffee maker, microwave oven, stereo systems, TVs, DVD/VCR, ceiling fan, and portable spa; TIAX, Energy Consumption by Consumer Electronics in U.S. Residences, Final Report to the Consumer Electronics Association, Jan. 2007, p. 69-72 for desktop and notebook PCs, p. 62-63 for monitors, p. 85-90 for TVs, p. 76-81 for set-top boxes, and p. 103-105 for video game systems; and Energy Center of Wisconsin, Electricitiy Savings Opportunities for Home Electronics and Other Plug-In Devices in Minnesota Homes, May 2010, pp. 52-57 for toaster ovens, spaceheaters, power tools, vacuums, lawn sprinklers, and acquarium equipment.

2.1.17 Operating Characteristics of Natural Gas Appliances in the Residential Sector

	Average Capacity (thousand Btu/hr)	Appliance Usage		Annual Consumption (million Btu/year)	Annual Cost ($) (1)
Range	10			4	48
Clothes Dryer		359	(2)	4	49
Water Heating					
Water Heater-Family of 4	40	64	(3)	26	294
Water Heater-Family of 2	40	32	(3)	12	140

Note(s): 1) $1.139/therm. 2) Cycles/year. 3) Gallons/day.

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

2.1.18 2009 Annual Natural Gas Consumption per Appliance by Census Division

Census Division	**Furnaces** million Btu	**Water Heaters** million Btu	**Ranges** million Btu	**Clothes Dryers** million Btu	**Fireplaces** million Btu
New England	72,095	24,853	6,367	4,930	8,216
Middle Atlantic	85,241	24,032	5,238	4,930	9,448
East North Central	72,506	22,902	8,832	8,216	13,248
West North Central	46,831	24,443	4,416	4,622	3,903
South Atlantic	54,226	20,232	4,108	5,135	5,957
East South Central	47,858	20,129	4,416	5,135	9,038
West South Central	33,891	24,648	3,595	3,081	5,135
Mountain	58,334	26,702	3,389	3,389	6,162
Pacific	44,675	20,232	3,286	3,286	29,064
United States					
Average	**61,928**	**23,005**	**5,238**	**5,135**	**10,270**
Total	**515,657**	**208,173**	**43,648**	**42,723**	**90,171**

Source(s): American Gas Association, Residential Natural Gas Market Survey, Table 10-1, January 2011

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

	Site Consumption				Primary Consumption			U.S. Natural Gas Total
	Residential	Industry	Electric Gen.	Transportation	**Residential**	Industry	Transportation	(quads)
1980	**24%**	41%	19%	3%	**30%**	49%	3%	20.22
1990	**23%**	43%	17%	3%	**29%**	49%	4%	19.57
2000	**21%**	40%	22%	3%	**29%**	47%	3%	23.66
2005	**22%**	35%	27%	3%	**32%**	42%	3%	22.49
2010	**20%**	**33%**	**31%**	**3%**	**32%**	**41%**	**3%**	**24.71**
2015	**19%**	33%	32%	3%	**31%**	41%	3%	25.99
2020	**19%**	34%	31%	3%	**30%**	42%	3%	26.13
2025	**19%**	34%	30%	3%	**30%**	42%	3%	25.80
2030	**18%**	33%	32%	3%	**31%**	40%	3%	26.49
2035	**18%**	32%	34%	3%	**31%**	40%	3%	27.11

Note(s): 1) Residential sector accounted for 40% (or $71 billion) of total U.S. natural gas expenditures.

Source(s): EIA, State Energy Data 2009: Consumption, Jun. 2011, Tables 8-12 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 3-5 for 2010-2035.

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

	Site Consumption				Primary Consumption			U.S. Petroleum Total
	Residential	Industry	Electric Gen.	Transportation	**Residential**	Industry	Transportation	(quads)
1980	**5%**	28%	8%	56%	**8%**	31%	56%	34.2
1990	**4%**	25%	4%	64%	**5%**	26%	64%	33.6
2000	**4%**	24%	3%	67%	**5%**	25%	67%	38.4
2005	**3%**	24%	3%	68%	**5%**	25%	68%	40.7
2010	**3%**	**22%**	**1%**	**72%**	**4%**	**22%**	**72%**	**37.2**
2015	**3%**	21%	1%	73%	**3%**	22%	73%	36.9
2020	**3%**	22%	1%	73%	**3%**	22%	73%	37.1
2025	**3%**	22%	1%	73%	**3%**	22%	73%	37.0
2030	**2%**	22%	1%	73%	**3%**	22%	73%	37.3
2035	**2%**	22%	1%	73%	**3%**	22%	73%	38.0

Source(s): EIA, State Energy Data 2009: Consumption, Jun. 2011, Tables 8-12, p. 18-22 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 3-5 for 2010-2035.

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

	Households (millions)	Percent Post-2000 Households (1)	Floorspace (billion SF)	U.S. Population (millions)	Average Household Size (2)
1980	80	N.A.	142	227	2.9
1990	94	N.A.	169	250	2.6
2000	106	N.A.	N.A.	282	2.7
2005	109	9%	256	296	2.7
2010	114	14%	N.A.	310	2.7
2015	119	18%	N.A.	326	2.7
2020	126	25%	N.A.	341	2.7
2025	133	31%	N.A.	357	2.7
2030	139	36%	N.A.	374	2.7
2035	146	41%	N.A.	390	2.7

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

Source(s): DOC, Statistical Abstract of the U.S. 2008, Oct. 2007, No. 948, p. 626 for 1980-2004 households; DOC, Statistical Abstract of the U.S. 2012, 2011, Table 982 for 2005-2009 households, Tables 2-3 for 1980-2035 population; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A4, p. 9-10 for 2010-2035 households and Table A20, p. 37-38 for housing starts; EIA, Buildings and Energy in the 1980's, June 1995, Table 2.1, p. 23 for residential buildings and floorspace in 1980 and 1990; EIA, 1997 Residential Energy Consumption Survey for 1997 buildings and floorspace; EIA, 2001 Residential Energy Consumption Survey for 2001 households and floorspace; and EIA, 2005 Residential Energy Consuption Survey for 2005 floorspace.

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

Housing Type	Owned	Rented	Total
Single-Family:	**61.5%**	**10.3%**	**71.7%**
Detached	57.7%	7.2%	64.9%
Attached	3.8%	3.1%	6.8%
Multi-Family:	**3.7%**	**18.3%**	**22.0%**
2 to 4 units	1.6%	5.3%	6.9%
5 or more units	2.1%	13.0%	15.0%
Mobile Homes	**5.1%**	**1.1%**	**6.2%**
Total	**70.3%**	**29.6%**	**100%**

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

2.2.3 Share of Total U.S. Households, by Census Region, Division, and Vintage, as of 2005

Region	Prior to 1950	1950 to 1969	1970 to 1979	1980 to 1989	1990 to 1999	2000 to 2005	All Vintages
Northeast	**6.7%**	**5.2%**	**2.4%**	**2.1%**	**1.3%**	**0.8%**	**18.5%**
New England	2.1%	1.2%	0.5%	0.5%	0.3%	0.3%	4.9%
Middle Atlantic	4.6%	4.0%	1.9%	1.6%	1.0%	0.5%	13.6%
Midwest	**5.7%**	**5.8%**	**3.6%**	**2.5%**	**3.7%**	**1.7%**	**23.0%**
East North Central	4.3%	3.9%	2.7%	1.8%	2.1%	1.1%	16.0%
West North Central	1.4%	1.9%	0.9%	0.7%	1.6%	0.6%	7.1%
South	**4.0%**	**6.9%**	**6.4%**	**7.5%**	**7.5%**	**4.3%**	**36.6%**
South Atlantic	2.0%	3.4%	3.5%	4.2%	4.3%	2.2%	17.4%
East South Central	0.9%	1.3%	0.9%	1.0%	1.3%	0.7%	6.2%
West South Central	1.2%	2.3%	4.7%	2.2%	1.8%	1.4%	13.6%
West	**3.4%**	**4.6%**	**4.5%**	**4.6%**	**3.1%**	**1.5%**	**21.8%**
Mountain	0.7%	1.2%	1.3%	1.5%	1.3%	0.9%	6.8%
Pacific	2.8%	3.4%	3.3%	3.1%	1.8%	0.6%	15.0%
United States	**19.9%**	**22.5%**	**17.0%**	**16.7%**	**15.6%**	**8.3%**	**100%**

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

2.2.4 Characteristics of U.S. Housing by Census Division and Region, as of 2005

Census Division	Share of U.S. Housing Stock	Average Home Size (1) (total square feet)	Average Home Size (heated square feet)
Northeast	**19%**	**2,423**	**1,664**
New England	5%	2,552	1,680
Middle Atlantic	14%	2,376	1,658
Midwest	**23%**	**2,566**	**1,927**
East North Central	16%	2,628	1,926
West North Central	7%	2,424	1,930
South	**37%**	**2,295**	**1,551**
South Atlantic	20%	2,370	1,607
East South Central	6%	2,254	1,544
West South Central	11%	2,184	1,455
West	**22%**	**1,963**	**1,366**
Mountain	7%	2,149	1,649
Pacific	15%	1,878	1,238
Total	**100%**	**2,309**	**1,618**

Note(s): 1) Total Square footage includes attic, garage, and basement square footage.
Source(s): EIA, A Look at Residential Energy Consumption in 2005, July 2008.

2.2.5 Characteristics of U.S. Housing by Vintage, as of 2005

Vintage	Share of US Housing Stock	Average Home Size (square feet) (1) Single Family	Multi-Family	Mobile Home
Prior to 1950	20%	2,677	1,021	775
1950 to 1969	23%	2,433	927	775
1970 to 1979	17%	2,666	869	948
1980 to 1989	17%	2,853	909	1,008
1990 to 1999	16%	3,366	940	1,245
2000 to 2005	8%	3,680	1,047	1,425
Total U.S. Homes (millions)	111.1	**U.S. Average** 2,838	941	1,062

Note(s): 1) Average home sizes include both heated and unheated floor space, including garages.
Source(s): EIA, A Look at Residential Energy Consumption in 2005, July 2008.

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

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

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

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

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

Note(s): 1) This is a weighted-average house that has combined characteristics of the Nation's stock homes. Although the population of homes with similar traits may be few, these are likely to be the most common. 2) Excludes bathrooms. 3) 11.5% of floorspace. 4) Based on a nominal 3' X 5' window. 5) Years.
Source(s): EIA, 2005 Residential Energy Consumption Survey: Characteristics, April 2008, Tables HC 1.1.1, HC1.1.3, HC 2.1, HC 2.2, HC 2.3, HC 2.4,

2.2.8 Presence of Air-Conditioning and Type of Heating System in New Single-Family Homes

		Type of Primary Heating System				
Year	Total Homes (thousands)	Warm-Air furnace	Heat pump	Hot Water or steam (1)	Other or none (2)	Air-Conditioning
1980	957	57%	24%	4%	15%	62%
1981	819	56%	25%	3%	16%	65%
1982	632	53%	26%	4%	17%	66%
1983	924	56%	29%	4%	12%	69%
1984	1,025	55%	30%	4%	11%	71%
1985	1,072	54%	30%	5%	11%	70%
1986	1,120	54%	29%	7%	10%	69%
1987	1,123	57%	27%	7%	9%	71%
1988	1,085	60%	26%	7%	8%	75%
1989	1,026	63%	24%	6%	7%	77%
1990	966	64%	23%	6%	6%	76%
1991	838	65%	22%	6%	7%	75%
1992	964	66%	24%	6%	5%	77%
1993	1,039	67%	24%	5%	5%	78%
1994	1,160	67%	24%	5%	4%	79%
1995	1,066	66%	25%	5%	4%	79%
1996	1,129	70%	23%	5%	2%	81%
1997	1,116	70%	23%	5%	2%	82%
1998	1,160	72%	21%	4%	3%	83%
1999	1,270	72%	22%	4%	2%	84%
2000	1,242	71%	23%	4%	2%	85%
2001	1,256	71%	23%	4%	1%	86%
2002	1,325	71%	23%	4%	2%	87%
2003	1,386	71%	24%	3%	2%	88%
2004	1,532	70%	26%	3%	1%	90%
2005	1,636	67%	29%	3%	1%	89%
2006	1,654	63%	33%	3%	2%	89%
2007	1,218	62%	34%	2%	2%	90%
2008	819	60%	34%	3%	3%	89%
2009	520	56%	37%	3%	4%	88%
2010	496	56%	38%	2%	3%	88%

Note(s) 1) Includes both air source and geothermal (ground source) versions. 2) Includes electric baseboard, panel, radiant heat, space heater, floor or wall furnace, solar, and other types.

Source(s): DOC, 2010 Characteristics of New Housing, June 2010, Type of Heating System Used in New Single-Family Houses Completed, and Presence of Air-Conditioning in New Single-Family Houses Completed.

2.3.1 Residential Energy Prices, by Year and Major Fuel Type ($2010 per Million Btu)

	Electricity	Natural Gas	Petroleum (1)	Avg.
1980	36.40	8.35	16.77	17.64
1990	35.19	8.63	13.27	18.64
2000	30.13	9.54	14.18	18.06
2005	30.64	13.66	18.93	21.50
2010	**33.69**	**11.08**	**23.75**	**22.42**
2015	33.22	10.28	28.73	22.24
2020	32.46	11.06	29.90	22.58
2025	32.31	12.11	31.22	23.36
2030	31.76	12.66	32.40	23.69
2035	32.47	13.86	33.86	24.92

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

Source(s): EIA, State Energy Data 2009: Prices and Expenditures, Jun. 2011, Table 2 for 1980-2009 prices, Table 8 for 1980-2009 consumption; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 3-5, Table A3, p. 6-8 for 2010-2035 consumption and prices; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators.

2.3.2 Residential Energy Prices, by Year and Fuel Type ($2010)

	Electricity (cents/kWh)	Natural Gas (cents/therm)	Distillate Oil ($/gal)	LPG ($/gal)
1980	12.42	83.51	1.53	2.24
1990	12.01	86.28	1.40	1.69
2000	10.28	95.36	1.51	1.70
2005	10.45	136.59	1.90	2.36
2010	**11.50**	**110.79**	**2.29**	**2.92**
2015	11.33	102.80	2.60	3.74
2020	11.08	110.57	2.64	3.96
2025	11.02	121.07	2.74	4.15
2030	10.84	126.62	2.82	4.34
2035	11.08	138.62	2.93	4.55

Source(s): EIA, State Energy Data 2009: Prices and Expenditures, Jun. 2011, Table 2, p. 24-25 for 1980-2009; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A3, p. 6-8 for 2010-2035 and Table G1, p. 215 for fuels' heat content; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators.

2.3.3 Residential Aggregate Energy Expenditures, by Year and Major Fuel Type ($2010 Billion) (1)

	Electricity	Natural Gas	Petroleum (2)	Total
1980	89.1	40.5	28.9	158.5
1990	110.9	39.0	18.2	168.2
2000	122.6	48.6	21.6	192.8
2005	142.1	67.7	26.9	236.7
2010	**166.8**	**56.1**	**29.0**	**251.8**
2015	159.3	51.3	31.1	241.7
2020	163.1	54.7	30.1	247.9
2025	171.3	59.1	29.8	260.3
2030	178.9	61.3	29.5	269.7
2035	193.0	66.0	29.6	288.6

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

Source(s): EIA, State Energy Data 2009: Prices and Expenditures, Jun. 2011, Table 2 for 1980-2009; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table 2, p. 3-5 and Table 3, p. 6-8 for 2010-2035; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators.

2.3.4 Cost of a Generic Quad Used in the Residential Sector ($2010 Billion) (1)

	Residential
1980	10.45
1990	10.12
2000	9.57
2005	11.10
2010	**9.98**
2015	9.88
2020	9.91
2025	10.09
2030	10.06
2035	10.57

Note(s): 1) See Table 1.5.1 for generic quad definition. This table provides the consumer cost of a generic quad in the buildings sector. Use this table to estimate the average consumer cost savings resulting from the savings of a generic (primary) quad in the buildings sector. 2) Price of

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 3-5 and Table A17, p. 34-35 for energy consumption and Table A3, p. 6-8 for energy prices (2010-2035). EIA, State Energy Data Report 2009, June 2011, Tables 8-12, p. 22-24 and EIA, State Energy Prices and Expenditures 2009, Tables 2 and 3 (1980-2009); EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price inflators.

2.3.5 2010 Residential Energy End-Use Expenditure Splits, by Fuel Type ($2010 Billion) (1)

	Natural Gas	Petroleum				Coal	Electricity	Total	Percent
		Distil.	LPG	Kerosene	Total				
Space Heating (2)	38.7	11.2	8.0	0.5	19.8	0.0	14.7	73.2	29.1%
Space Cooling (3)	0.0						36.3	36.3	14.4%
Water Heating (4)	14.3	2.1	2.0		4.0		14.2	32.6	12.9%
Lighting							23.9	23.9	9.5%
Refrigeration (5)							19.7	19.7	7.8%
Electronics (6)							17.9	17.9	7.1%
Cooking	2.4		0.8		0.8		7.8	11.0	4.4%
Wet Cleaning (7)	0.6						11.0	11.6	4.6%
Computers							5.8	5.8	2.3%
Other (8)	0.0		4.4		4.4		6.5	10.9	4.3%
Adjust to SEDS (9)							-1.3	-1.3	-0.5%
Total	**56.1**	**13.3**	**15.2**	**0.5**	**29.0**	**0.0**	**166.8**	**251.8**	100%

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes furnace fans ($4.5 billion). 3) Fan energy use included. 4) Includes residential recreational water heating ($1.4 billion). 5) Includes refrigerators ($15.3 billion) and freezers ($4.4 billion). 6) Includes color televisions ($11.0 billion) and other electronics ($7.4 billion). 7) Includes clothes washers ($1.1 billion), natural gas clothes dryers ($0.6 billion), electric clothes dryers ($6.5 billion), and dishwashers ($3.4 billion). 8) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. 9) Expenditures related to an energy adjustment that EIA uses to relieve discrepancies between data sources. Refers to energy attributable to the residential building sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A4-A5, p. 9-10 for energy consumption, Table A3, p. 6-8 for prices; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses.

2.3.6 2015 Residential Energy End-Use Expenditure Splits, by Fuel Type ($2010 Billion) (1)

	Natural Gas	Petroleum				Coal	Electricity	Total	Percent
		Distil.	LPG	Kerosene	Total				
Space Heating (2)	35.0	13.0	8.1	0.6	21.6	0.0	14.0	70.6	29.2%
Space Cooling (3)	0.0						33.8	33.8	14.0%
Water Heating	13.5	1.9	1.5		3.4		15.8	32.7	13.5%
Lighting							17.6	17.6	7.3%
Refrigeration (4)							15.0	15.0	6.2%
Electronics (5)							10.9	10.9	4.5%
Wet Cleaning (6)	0.6						10.8	11.4	4.7%
Cooking	2.2		0.9		0.9		3.8	6.8	2.8%
Computers							6.3	6.3	2.6%
Other (7)	0.0		5.2		5.2		31.3	36.5	15.1%
Total	**51.3**	**14.9**	**15.7**	**0.6**	**31.1**	**0.0**	**159.3**	**241.7**	100%

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes furnace fans ($4.6 billion). 3) Fan energy use included. 4) Includes refrigerators ($12.3 billion) and freezers ($2.8 billion). 5) Includes color televisions ($10.9 billion). 6) Includes clothes washers ($1.1 billion), natural gas clothes dryers ($0.6 billion), electric clothes dryers ($6.5 billion), and dishwashers ($3.3 billion). 7) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A4-A5, p. 9-10 for energy consumption, Table A3, p. 6-8 for prices

2.3.7 2025 Residential Energy End-Use Expenditure Splits, by Fuel Type ($2010 Billion) (1)

	Natural	Petroleum							
	Gas	Distil.	LPG	Kerosene	Total	Coal	Electricity	Total	Percent
Space Heating (2)	39.7	11.5	7.8	0.6	19.9	0.0	15.0	74.5	28.6%
Space Cooling (3)	0.0						36.2	36.2	13.9%
Water Heating	16.0	1.4	1.3		2.7		17.1	35.9	13.8%
Lighting							15.2	15.2	5.8%
Refrigeration (4)							15.5	15.5	6.0%
Electronics (5)							12.0	12.0	4.6%
Wet Cleaning (6)	0.8						9.8	10.5	4.1%
Cooking	2.7		0.8		0.8		4.3	7.8	3.0%
Computers							7.7	7.7	2.9%
Other (7)	0.0		6.4		6.4		38.7	45.0	17.3%
Total	**59.1**	**12.9**	**16.3**	**0.6**	**29.8**	**0.0**	**171.3**	**260.3**	100%

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes furnace fans ($4.7 billion). 3) Fan energy use included. 4) Includes refrigerators ($12.7 billion) and freezers ($2.8 billion). 5) Includes color televisions ($12 billion). 6) Includes clothes washers ($0.8 billion), natural gas clothes dryers ($0.8 billion), electric clothes dryers ($5.8 billion), and dishwashers ($3.2 billion). 7) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A4-A5, p. 9-10 for energy consumption, Table A3, p. 6-8 for prices

2.3.8 2035 Residential Energy End-Use Expenditure Splits, by Fuel Type ($2010 Billion) (1)

	Natural	Petroleum							
	Gas	Distil.	LPG	Kerosene	Total	Coal	Electricity	Total	Percent
Space Heating (2)	44.3	10.3	7.7	0.6	18.6	0.0	16.0	79.0	27.4%
Space Cooling (3)	0.0						40.6	40.6	14.1%
Water Heating	17.6	1.2	1.2		2.3		17.7	37.6	13.0%
Lighting							15.5	15.5	5.4%
Refrigeration (4)							17.0	17.0	5.9%
Electronics (5)							14.2	14.2	4.9%
Wet Cleaning (6)	0.9						10.4	11.3	3.9%
Cooking	3.2		0.8		0.8		4.8	8.9	3.1%
Computers							8.7	8.7	3.0%
Other (7)	0.0		7.7		7.7		47.9	55.7	19.3%
Total	**66.0**	**11.5**	**17.5**	**0.6**	**29.6**	**0.0**	**193.0**	**288.6**	100%

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes furnace fans ($4.8 billion). 3) Fan energy use included. 4) Includes refrigerators ($14.1 billion) and freezers ($2.9 billion). 5) Includes color televisions ($14.2 billion). 6) Includes clothes washers ($0.8 billion), natural gas clothes dryers ($0.9 billion), electric clothes dryers ($6.0 billion), and dishwashers ($3.6 billion). 7) Includes small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A4-A5, p. 9-10 for energy consumption, Table A3, p. 6-8 for prices

2.3.9 Average Annual Energy Expenditures per Household, by Year ($2010)

Year	Average Expenditure
1980	1,991
1990	1,785
2000	1,824
2005	2,175
2010	**2,201**
2015	2,030
2020	1,963
2025	1,957
2030	1,932
2035	1,978

Source(s): EIA, State Energy Data 2009: Prices and Expenditures, Jun. 2011 for 1980-2009; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 3-5, Table A4, p. 9-10 for consumption, Table A3, p. 6-8 for prices 2010-2035; EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators; and DOC, Statistical Abstract of the United States Historical Data for 1980-2009 occupied units.

2.3.10 2005 Energy End-Use Expenditures for an Average Household, by Region ($2010)

	Northeast	Midwest	South	West	National
Space Heating	1,050	721	371	352	575
Air-Conditioning	199	175	456	262	311
Water Heating	373	294	313	318	320
Refrigerators	194	145	146	154	157
Other Appliances and Lighting	827	665	715	716	725
Total (1)	**2,554**	**1,975**	**1,970**	**1,655**	**2,003**

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

Source(s): EIA, A Look at Residential Energy Consumption in 2005, October 2008, Table US-15; EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators.

2.3.11 2005 Energy Expenditures per Household, by Housing Type and Square Footage ($2010)

	Per Household	Per Square Foot (1)
Single-Family	**2,230**	**1.16**
Detached	2,280	1.16
Attached	1,768	1.20
Multi-Family	**1,359**	**1.66**
2 to 4 units	1,722	1.90
5 or more units	1,192	1.53
Mobile Home	**1,661**	**1.76**
All Homes	**2,003**	**1.12**

Note(s): 1) Energy expenditures per square foot were calculated using estimates of average heated floor space per household. According to the 2005 Residential Energy Consumption Survey (RECS), the average heated floor space per household in the U.S. was 1,618 square feet. Average total floor space, which includes garages, attics and unfinished basements, equaled 2,309 square feet.

Source(s): EIA, A Look at Residential Energy Consumption in 2005, Oct. 2008, Table US-1 part1; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price inflators.

2.3.12 2005 Household Energy Expenditures, by Vintage ($2010)

Year	Per Square Foot (1)	Per Household	Per Household Member	Percent of Residential Sector Expenditures
Prior to 1950	1.42	2,177	887	22%
1950 to 1969	1.34	1,956	771	22%
1970 to 1979	1.31	1,831	736	16%
1980 to 1989	1.18	1,865	741	16%
1990 to 1999	1.07	2,110	752	16%
2000 to 2005	1.02	2,147	777	9%
				Total 100%
Average	**1.24**	**2,003**	**780**	

Note(s): 1) Energy expenditures per square foot were calculated using estimates of average heated floor space per household. According to the 2005 Residential Energy Consumption Survey (RECS), the average heated floor space per household in the U.S. was 1,618 square feet. Average total floor space, which includes garages, attics and unfinished basements, equaled 2,309 square feet.

Source(s): EIA, A Look at Residential Energy Consumption in 2005, October 2008 for 2005 expenditures; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price inflators.

2.3.13 2005 Average Household Expenditures, by Census Region ($2010)

Item	Northeast	Midwest	South	West	United States
Energy (1)	2,554	1,975	1,970	1,655	2,003
Shelter (2)	11,144	8,727	7,931	12,545	9,744
Food	7,187	6,367	6,076	7,015	6,563
Telephone, water and other public services	1,434	1,475	1,627	1,667	1,565
Household supplies, furnishings and equipment (3)	2,408	2,598	2,456	3,146	2,631
Transportation (4)	8,556	8,579	8,842	11,141	9,233
Healthcare	2,856	3,144	2,884	2,929	2,948
Education	1,535	1,104	746	1,025	1,040
Personal taxes (5)	2,390	2,574	2,506	3,251	2,665
Other expenditures	13,178	13,238	12,009	14,242	13,008
Average Annual Income	**69,790**	**62,640**	**58,993**	**72,966**	**64,970**

Note(s): 1) Average household energy expenditures are calculated from the Residential Energy Consumption Survey (RECS), while average expenditures for other categories are calculated from the Consumer Expenditure Survey (CE). RECS assumed total US households to be 111,090,617 in 2005, while the CE data is based on 117,356,000 "consumer units," which the Bureau of Labor Statistics defines to be financially independent persons or groups of people that use their incomes to make joint expenditure decisions, including all members of a particular household who are related by blood, marriage, or other legal arrangements. CE calculated average annual energy expenditures for the United States to be $1,943. 2) Shelter includes both owned and rented dwellings, including any expenses for mortgage interest, property taxes, maintenance, repairs, insurance, and other expenses. 3) Household supplies, furnishings and equipments includes the following: laundry and cleaning supplies, postage and stationary, household textiles, furniture, floor coverings, appliances, and other household equipment. 4) Transportation expenditures include public transportation as well as the following vehicle-related expenses: net outlay of vehical purchases, gasoline and motor oil, vehicle finance, maintenance and repairs, insurance, licenses, rental fees, and other charges. CE estimated public transportation to comprise 5.4% of total transportation spending. 5) Personal taxes include federal, state and local income taxes, as well as $177 per year for "other taxes."

Source(s): EIA, A Look at Residential Energy Consumption in 2005, Oct. 2008, Tables US-1 part 1 for energy expenditures; Bureau of Labor Statistics, Consumer Expenditure Survey 2005, Table 8, Oct. 2010; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price inflators.

2.3.14 2005 Average Household Expenditures as Percent of Annual Income, by Census Region ($2010)

Item	Northeast	Midwest	South	West	United States
Energy (1)	3.7%	3.2%	3.3%	2.3%	3.1%
Shelter (2)	16.0%	13.9%	13.4%	17.2%	15.0%
Food	10.3%	10.2%	10.3%	9.6%	10.1%
Telephone, water and other public services	2.1%	2.4%	2.8%	2.3%	2.4%
Household supplies, furnishings and equipment (3)	3.5%	4.1%	4.2%	4.3%	4.1%
Transportation (4)	12.3%	13.7%	15.0%	15.3%	14.2%
Healthcare	4.1%	5.0%	4.9%	4.0%	4.5%
Education	2.2%	1.8%	1.3%	1.4%	1.6%
Personal taxes (5)	3.4%	4.1%	4.2%	4.5%	4.1%
Average Annual Expenditures	76.0%	79.5%	79.7%	80.2%	79.0%
Average Annual Income	**69,230**	**62,136**	**58,519**	**72,380**	**64,448**

Note(s): 1) Average household energy expenditures are calculated from the Residential Energy Consumption Survey (RECS), while average expenditures for other categories are calculated from the Consumer Expenditure Survey (CE). RECS assumed total US households to be 111,090,617 in 2005, while the CE data is based on 117,356,000 "consumer units," which the Bureau of Labor Statistics defines to be financially independent persons or groups of people that use their incomes to make joint expenditure decisions, including all members of a particular household who are related by blood, marriage, or other legal arrangements. CE calculated average annual energy expenditures for the United States to be $1,943 while RECS calculated it to be $1,987. 2) Shelter includes both owned and rented dwellings, including any expenses for mortgage interest, property taxes, maintenance, repairs, insurance, and other expenses. 3) Household supplies, furnishings and equipments includes the following: laundry and cleaning supplies, postage and stationary, household textiles, furniture, floor coverings, appliances, and other household equipment. 4) Transportation expenditures include public transportation as well as the following vehicle-related expenses: net outlay of vehical purchases, gasoline and motor oil, vehicle finance, maintenance and repairs, insurance, licenses, rental fees, and other charges. CE estimated public transportation to comprise 5.4% of total transportation spending. 5) Personal taxes include federal, state and local income taxes, as well as $177 per year for "other taxes."

Source(s): EIA, A Look at Residential Energy Consumption in 2005, Oct. 2008, Tables US-1 part 1 for energy expenditures; Bureau of Labor Statistics, Consumer Expenditure Survey 2005, Table 8; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price inflators.

2.3.15 2005 Households and Energy Expenditures, by Income Level ($2010)

Household Income	Households (10^6)		Energy Expenditures by Household	Energy Expenditures by Household Member	Mean Individual Energy Burden (1)
Less than $10,000	9.9	9%	1,497	778	24%
$10,000 to $14,999	8.5	8%	1,568	757	13%
$15,000 to $19,999	8.4	8%	1,602	731	9%
$20,000 to $29,999	15.1	14%	1,753	715	7%
$30,000 to $39,999	13.6	12%	1,852	707	5%
$40,000 to $49,999	11.0	10%	1,995	750	4%
$50,000 to $74,999	19.8	18%	2,129	771	3%
$75,000 to $99,999	10.6	10%	2,431	847	3%
$100,000 or more	14.2	13%	2,774	909	3%
Total	**111.1**	100%			**7%**

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

Source(s): EIA, A Look at Residential Energy Consumption in 2005, Oct. 2008, Table US-1 part 2; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price inflators.

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

	Residential				U.S.			
	Site Fossil	Electricity	Total	Growth Rate 2010-Year	Total	Growth Rate 2010-Year	Res.% of Total U.S.	Res.% of Total Global
1980	385	525	909	-	4723	-	19%	4.9%
1990	340	624	963	-	5039	-	19%	4.5%
2000	380	805	1185	-	5867	-	20%	5.0%
2005	364	897	1261	-	5996	-	21%	4.4%
2010	**353**	**879**	**1231**	**-**	**5634**	**-**	**22%**	**3.9%**
2015	339	759	1098	-2.3%	5434	-0.7%	20%	3.3%
2020	332	791	1122	-0.9%	5549	-0.2%	20%	3.2%
2025	324	838	1163	-0.4%	5618	0.0%	21%	3.1%
2030	319	883	1202	-0.1%	5695	0.1%	21%	3.0%
2035	312	925	1236	0.0%	5806	0.1%	21%	2.9%

Note(s): 1) Excludes emissions of buildings-related energy consumption in the industrial sector. Emissions assume complete combustion from energy consumption and exclude energy production activities such as gas flaring, coal mining, and cement production. 2) U.S. buildings emissions approximately equal the combined carbon emissions of Japan, France, and the United Kingdom.

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 1998, Oct. 1999, Tables E1-E2 for 1980-1989 greenhouse gas emissions; EIA, Emissions of Greenhouse Gases in the U.S. 2009, Feb. 2011, Tables 8-11 for 1990-2009 greenhouse gas emissions; EIA, Assumptions to the Annual Energy Outlook 2011, July 2011, Table 1.2, p. 14 for carbon coefficients; EIA, AEO 2012 Early Release, Jan. 2012, Table A2, p. 3-5 for 2010-2035 energy consumption and Table A18, p. 36 for 2010-2035 emissions; EIA, International Energy Outlook 2011, Sept. 2011, Table A10 for 2010-2035 global emissions; and EIA, Country Energy Profiles for global emissions (1980-2009), available at http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm, accessed 2/10/2012 for 1980-2009 global emissions.

2.4.2 2005 End-Use Carbon Dioxide Emissions Splits for an Average Household, by Region (Pounds of CO2)

	Northeast	Midwest	South	West	National
Space Heating	9,980	7,522	3,853	3,735	5,834
Space Cooling	2,066	2,851	6,648	3,252	4,373
Water Heating	3,500	3,458	3,901	3,401	3,636
Refrigerator	2,488	3,261	3,084	2,663	2,922
Other Appliances & Lighting	8,673	10,421	10,722	9,219	9,945
Total	**26,707**	**27,513**	**28,208**	**22,271**	**26,711**

Source(s): EIA, A Look at Residential Energy Consumption in 2005, Jul. 2008, Tables CE(2-5)-(9-12)c; EIA, Assumptions to the AEO 2011, July 2011, Table 2, p. 12 for coefficients; EIA, AEO 2012 Early Release, Jan. 2012, Tables 2 and 18.

2.4.3 2010 Residential Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Space Heating (4)	185.5	38.8		18.7	2.2	59.7	0.7	77.6	323.5	26.3%
Space Cooling	0.0							210.2	210.2	17.1%
Water Heating	68.7	7.1		4.6		11.7		90.4	170.8	13.9%
Lighting								126.0	126.0	10.2%
Electronics (5)								96.5	96.5	7.8%
Refrigeration (6)								80.7	80.7	6.6%
Wet Cleaning (7)	2.9							57.8	60.8	4.9%
Cooking	11.4			1.9		1.9		42.6	55.9	4.5%
Computers								30.5	30.5	2.5%
Other (8)				10.2		10.2		36.3	46.5	3.8%
Adjust to SEDS (9)								30.1	30.1	2.4%
Total	**268.5**	**45.9**		**35.3**	**2.2**	**83.5**	**0.7**	**878.7**	**1,231.4**	100%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. Carbon emissions calculated from EIA, Assumptions to the AEO 2011. 2) Includes kerosene space heating (2.2 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (23.9 MMT). 5) Includes color television (58.2 MMT) and other office equipment (30.5 MMT). 6) Includes refrigerators (66.1 MMT) and freezers (14.6 MMT). 7) Includes clothes washers (5.8 MMT), natural gas clothes dryers (2.9 MMT), electric clothes dryers (34.3 MMT), and dishwashers (17.8 MMT). Does not include water heating energy. 8) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting. 9) Emissions related to a discrepancy between data sources and that results from energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 3-5, Table A4, p. 9-10 and Table A5, p. 11-12 for energy consumption,and Table A18, p. 36 for emissions; EIA, Assumptions to the AEO 2011, July 2011, Table 1.2, p. 14 for emission coefficients; BTS/A.D. Little, Electricity Consumption by Small End-Uses in Residential Buildings, Aug. 1998, Appendix A for residential electric end-uses; EIA, AEO 1999, Dec. 1998, Table A4, p. 118-119.

2.4.4 2015 Residential Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Space Heating (4)	180.5	34.9		16.6	1.8	53.3	0.6	66.6	301.0	27.4%
Space Cooling	0.0							161.1	161.1	14.7%
Water Heating	69.6	5.1		3.1		8.2		75.3	153.1	13.9%
Lighting								83.7	83.7	7.6%
Refrigeration (5)								71.7	71.7	6.5%
Electronics (6)								52.0	52.0	4.7%
Wet Cleaning (7)	3.2							51.6	54.7	5.0%
Cooking	11.5			1.8		1.8		17.9	31.1	2.8%
Computers								30.0	30.0	2.7%
Other (8)				10.6		10.6		149.3	160.0	14.6%
Total	**264.7**	**40.1**		**32.2**	**1.8**	**74.0**	**0.6**	**759.1**	**1,098.4**	100%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (1.8 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (22.1 MMT). 5) Includes refrigerators (58.4 MMT) and freezers (13.3 MMT). 6) Includes color television (52 MMT). 7) Includes clothes washers (5.0 MMT), natural gas clothes dryers (3.2 MMT), electric clothes dryers (31.0 MMT), and dishwashers (15.6 MMT). Does not include water heating energy. 8) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 3-5, Table A4, p. 9-10 and Table A5, p. 11-12 for energy consumption,and Table A18, p. 36 for emissions; EIA, Assumptions to the AEO 2011, July 2011, Table 1.2, p. 14 for emission coefficients.

2.4.5 2025 Residential Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Space Heating (4)	173.9	27.9		15.2	1.6	44.7	0.6	73.2	292.3	25.1%
Water Heating	70.2	3.5		2.5		6.0		83.7	159.9	13.8%
Space Cooling	0.0							177.2	177.2	15.2%
Lighting								74.1	74.1	6.4%
Refrigeration (5)								75.8	75.8	6.5%
Electronics (6)								58.7	58.7	5.1%
Wet Cleaning (8)	3.3							47.9	51.2	4.4%
Cooking	11.7			1.6		1.6		20.8	34.2	2.9%
Computers								37.6	37.6	3.2%
Other (9)				12.4		12.4		189.1	201.5	17.3%
Total	**259.1**	**31.3**		**31.8**	**1.6**	**64.7**	**0.6**	**838.1**	**1,162.5**	100%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (1.6 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (22.9 MMT). 5) Includes refrigerators (62.2 MMT) and freezers (13.6 MMT). 6) Includes color television (58.7 MMT). 8) Includes clothes washers (3.9 MMT), natural gas clothes dryers (3.3 MMT), electric clothes dryers (28.5 MMT), and dishwashers (15.5 MMT). Does not include water heating energy. 9) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 3-5, Table A4, p. 9-10 and Table A5, p. 11-12 for energy consumption,and Table A18, p. 36 for emissions; EIA, Assumptions to the AEO 2011, July 2011, Table 1.2, p. 14 for emission coefficients.

2.4.6 2035 Residential Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Space Heating (4)	169.7	22.8		14.1	1.5	38.3	0.5	76.7	285.3	23.1%
Water Heating	67.2	2.6		2.1		4.7		84.8	156.7	12.7%
Space Cooling	0.0							194.5	194.5	15.7%
Electronics (5)								68.1	68.1	5.5%
Refrigeration (6)								81.5	81.5	6.6%
Lighting								74.3	74.3	6.0%
Wet Cleaning (7)	3.5							50.0	53.4	4.3%
Cooking	12.2			1.5		1.5		23.2	37.0	3.0%
Computers								41.9	41.9	3.4%
Other (8)				14.1		14.1		229.6	243.7	19.7%
Total	**252.7**	**25.4**		**31.9**	**1.5**	**58.7**	**0.5**	**924.5**	**1,236.4**	100%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (1.5 MMT). 3) Excludes electric imports by utilities. 4) Includes residential furnace fans (23.1 MMT). 5) Includes color television (68.1 MMT). 6) Includes refrigerators (67.6 MMT) and freezers (13.9 MMT). 7) Includes clothes washers (3.8 MMT), natural gas clothes dryers (3.5 MMT), electric clothes dryers (28.8 MMT), and dishwashers (17.4 MMT). Does not include water heating energy. 8) Includes residential small electric devices, heating elements, motors, swimming pool heaters, hot tub heaters, outdoor grills, and natural gas outdoor lighting.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 3-5, Table A4, p. 9-10 and Table A5, p. 11-12 for energy consumption,and Table A18, p. 36 for emissions; EIA, Assumptions to the AEO 2011, July 2011, Table 1.2, p. 14 for emission coefficients.

2.4.7 2009 Methane Emissions for U.S. Residential Buildings Energy Production, by Fuel Type

Fuel Type	MMT CO2 Equivalent (1)
Petroleum	1.0
Natural Gas	38.8
Coal	0.0
Wood	2.6
Electricity (2)	51.6
Total	**94.0**

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

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 2009, Mar. 2011, Table 18, p. 37 for energy production emissions; EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2009, April 2011, Table 3-10, p. 3-9 for stationary combustion emissions; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2, p. 3-5 for energy consumption.

2.5.1 Construction Statistics of New Homes Completed/Placed

	Single-Family		Multi-Family		Mobile Homes	Total
Year	Thousand Units	Average SF	Thousand Units	Average SF	Thousand Units	Thousand Units
1980	957	1,740	545	979	234	1,736
1981	819	1,720	447	980	229	1,495
1982	632	1,710	374	N.A.	234	1,240
1983	924	1,725	467	N.A.	278	1,669
1984	1,025	1,780	627	N.A.	288	1,940
1985	1,072	1,785	631	922	283	1,986
1986	1,120	1,825	636	911	256	2,012
1987	1,123	1,905	546	N.A.	239	1,908
1988	1,085	1,995	445	990	224	1,754
1989	1,026	2,035	397	1,000	203	1,626
1990	966	2,080	342	1,005	195	1,503
1991	838	2,075	253	1,020	174	1,265
1992	964	2,095	194	1,040	212	1,370
1993	1,039	2,095	153	1,065	243	1,435
1994	1,160	2,100	187	1,035	291	1,638
1995	1,066	2,095	247	1,080	319	1,632
1996	1,129	2,120	284	1,070	338	1,751
1997	1,116	2,150	284	1,095	336	1,736
1998	1,160	2,190	314	1,065	374	1,848
1999	1,270	2,223	334	1,104	338	1,942
2000	1,242	2,266	332	1,114	281	1,855
2001	1,256	2,324	315	1,171	196	1,767
2002	1,325	2,320	323	1,166	174	1,822
2003	1,386	2,330	292	1,173	140	1,818
2004	1,532	2,349	310	1,173	124	1,966
2005	1,636	2,434	296	1,247	123	2,055
2006	1,654	2,469	325	1,277	112	2,091
2007	1,218	2,521	284	1,300	95	1,597
2008	819	2,519	301	1,250	81	1,201
2009	520	2,438	274	1,227	55	849
2010	496	2,392	155	1,172	50	701

Source(s): DOC, 2010 Characteristics of New Housing, 2010, "Median and Average Square Feet of Floor Area in New Single-Family Houses Completed by Location", "Presence of Air-Conditioning in New Single Family Houses", "Number of Multifamily Units Completed by Number of Units Per Building", "Median and Average Square Feet of Floor Area in Units in New Multifamily Buildings Completed", "Placements of New Manufactured Homes by Region and Size of Home, 1980-2010"; NAHB, Housing Economics, Mar. 1995; NAHB, Facts, Figures and Trends, 1997, Characteristics of New Multi-Family Homes, 1971-1995, p. 7; DOC, Current Construction Reports, Characteristics of New Housing, C25/98-A, Table 18, p. 44.

2.5.2 2010 Five Largest Residential Homebuilders

Homebuilder	Number of Home Closings (1)	Gross Revenue ($million)	Market Share of Total New Home Closings (%) (2)
PulteGroup	17,095	4,420	5.3%
D.R. Horton	18,983	3,955	5.9%
NVR	10,030	2,981	3.1%
Lennar Corporation	10,955	2,631	3.4%
KB Home	7,346	1,575	2.3%
Total of Top Five	**64,409**	**15,563**	**19.9%**
Habitat for Humanity (3)	6,032	402	0.1%

Note(s): 1) 2010 total U.S. new home closings were 323,000 (only single-family). 2) Total share of closings of top 20 builders was 35%. Total share of the top 100 builders was 54%. 3) Habitat for Humanity built more than 400 homes during the week of May 31, 2007; Habitat for Humanity has built over 1,000 homes in the New Orleans area since Hurricane Katrina. Habitat for Humanity's 2,100 worldwide affiliates have completed more than 200,000 homes since 1976, providing more than 1,000,000 with housing.

Source(s): Housing Giants Magazine, May 2011, Professional Builder's 2011 Housing Giants Rankings.

2.5.3 Value of New Building Construction, by Year ($2010 Billion)

	Residential	GDP
1980	166.0	6,461
1985	213.5	7,579
1990	208.4	8,890
1995	238.0	10,063
2000	334.6	12,423
2005	525.5	13,986
2006	387.3	14,359
2007	247.4	14,639
2008	242.1	14,639
2009	143.2	14,254
2010	137.1	14,660

Source(s): DOC, Current Construction Reports: Value of New Construction Put in Place, C30, Aug. 2003, Table 1 for 1980-1990; DOC, Annual Value of Private Construction Put in Place 1993-2001, Annual Value of Private Construction Put in Place 2002-2011, Annual Value of Public Construction Put in Place 1993-2001, Annual Value of Public Construction Put in Place 2002-2011; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for GDP and price deflators.

2.5.4 2010 New Homes Completed/Placed, by Census Region (Thousand Units and Percent of Total Units)

Region	Single-Family Units		Multi-Family Units		Mobile Homes Units		Total	
Northeast	54	11%	26	17%	4	8%	84	12%
Midwest	82	17%	25	16%	6	11%	113	16%
South	258	52%	59	38%	34	68%	351	50%
West	103	21%	45	29%	6	13%	154	22%
Total	**496**	100%	**155**	100%	**50**	100%	**702**	100%

Source(s): DOC, Manufacturing, Mining and Construction Statistics: New Residential Construction: New Privately Owned Housing Units Completed, 2010; and DOC, Manufacturing, Mining and Construction Statistics: Placements of New Manufactured Homes by Region and Size of Home, 2010.

2.5.5 2010 Construction Method of Single-Family Homes, by Region (Thousand Units and Percent of Total Units)

Region	Stick-Built Units		Modular Units		Panelized/Precut Units		Total
Northeast	49	10%	4	33%	2	18%	54
Midwest	76	16%	3	25%	2	18%	82
South	247	52%	4	33%	6	55%	258
West	101	21%	1	8%	1	9%	103
Total	**473**	100%	**12**	100%	**11**	100%	**497**

Source(s): DOC, Manufacturing, Mining and Construction Statistics, New Residential Construction: Type of Construction Method of New Single-Family Houses Completed, 2010.

2.5.6 2010 Mobile Home Placements, by Census Region and Top Five States (Percent of National Total)

Region	
Northeast	8%
Midwest	11%
South	69%
West	13%
Total	100%

Top Five States	
Texas	15.2%
Louisiania	8.6%
Florida	5.4%
Tennessee	4.8%
North Carolina (1)	4.6%
Kentucky	4.6%

Note(s): 1) North Carolina and Kentucky are tied for fifth with 4.6% of the national total.

Source(s): DOC, Manufactured Housing Statistics, New Manufactured Homes Placed: by Size of Home by State - 2010, Placements of New Manufactured Homes by Region and Size of Home: 1980-2010, 2010.

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

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

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

2.5.8 2009 Sales Price and Construction Cost Breakdown of an Average New Single-Family Home ($2010) (1)

Function	Cost	
Finished Lot	77,320	20%
Construction Cost	224,630	59%
Financing	6,436	2%
Overhead & General Expenses	20,571	5%
Marketing	5,347	1%
Sales Commission	12,937	3%
Profit	33,979	9%
Total	**381,221**	**100%**

Function	Cost	
Building Permit Fees	4,305	2%
Impact Fees	3,195	1%
Water and Sewer Inspection	3,797	2%
Excavation, Foundation, & Backfill	16,029	7%
Steel	1,653	1%
Framing and Trusses	35,136	16%
Sheathing	3,906	2%
Windows	6,295	3%
Exterior Doors	1,948	1%
Interior Doors & Hardware	3,388	2%
Stairs	1,692	1%
Roof Shingles	8,553	4%
Siding	12,980	6%
Gutters & Downspouts	958	0%
Plumbing	11,865	5%
Electrical Wiring	8,388	4%
Lighting Fixtures	2,395	1%
HVAC	8,944	4%
Insulation	3,364	2%
Drywall	11,440	5%
Painting	7,711	3%
Cabinets, Countertops	12,563	6%
Appliances	3,617	2%
Tiles & Carpet	11,545	5%
Trim Material	7,464	3%
Landscaping & Sodding	7,156	3%
Wood Deck/Patio	1,967	1%
Asphalt Driveway	3,112	1%
Other	19,267	9%
Total	224,632	**100%**

Note(s): 1) Based on a NAHB Survey of 54 home builders asked about the average home built by their firm. Average finished area of the home was 2,716 SF and average lot size was 21,879 SF.

Source(s): NAHB, Breaking Down House Price and Construction Costs, 2010, Table 1; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for price inflators.

2.5.9 Annual Sales of Existing Homes, by Region

	Existing Home Sales (in thousands)				
	North-east	Mid-west	South	West	United States
1970	251	501	568	292	1,612
1971	311	583	735	389	2,018
1972	361	630	788	473	2,252
1973	367	674	847	446	2,334
1974	354	645	839	434	2,272
1975	370	701	862	543	2,476
1976	439	881	1,033	712	3,065
1977	515	1,101	1,231	803	3,650
1978	516	1,144	1,416	911	3,987
1979	526	1,061	1,353	887	3,827
1980	403	806	1,092	671	2,972
1981	353	632	917	516	2,418
1982	354	490	780	366	1,990
1983	493	709	1,035	481	2,718
1984	511	755	1,073	529	2,868
1985	622	866	1,172	554	3,214
1986	703	991	1,261	610	3,565
1987	685	959	1,282	600	3,526
1988	673	929	1,350	642	3,594
1989	635	886	1,075	694	3,290
1990	583	861	1,090	651	3,185
1991	591	863	1,067	624	3,145
1992	666	967	1,126	674	3,433
1993	709	1,027	1,262	740	3,738
1994	723	1,031	1,321	812	3,887
1995	717	1,010	1,315	810	3,852
1996	772	1,060	1,394	941	4,167
1997	812	1,088	1,474	997	4,371
1998	898	1,228	1,724	1,115	4,965
1999	910	1,246	1,850	1,177	5,183
2000	911	1,222	1,866	1,174	5,173
2001	912	1,271	1,967	1,184	5,334
2002	952	1,346	2,064	1,269	5,631
2003	1,019	1,468	2,283	1,405	6,175
2004	1,113	1,550	2,540	1,575	6,778
2005	1,169	1,588	2,702	1,617	7,076
2006	1,086	1,483	2,563	1,346	6,478
2007	1,006	1,327	2,235	1,084	5,652
2008	849	1,129	1,865	1,070	4,913
2009	868	1,163	1,914	1,211	5,156
2010	817	1,076	1,860	1,154	4,907

Source(s): HUD, US Housing Market Conditions: 3rd Quarter 2011, November 2011, Exhibit 7. Existing Home Sales 1969-Present, p. 73.

2.5.10 Home Price Index (HPI), All-Transactions, by Census Region (1)(2)

	New Eng.	Mid. Atl.	S. Atl.	E-S Centrl	W-S Centrl	E-N Centrl	W-N Centrl	MT	Pacific	United States
1975	63.1	71.8	68.5	68.8	56.0	63.5	62.1	56.5	46.2	61.3
1976	69.2	73.9	71.5	71.7	62.8	68.7	68.1	61.6	54.7	66.6
1977	73.1	78.0	76.0	79.8	69.0	76.8	77.0	70.8	68.4	74.3
1978	86.3	82.7	85.6	90.7	81.6	89.5	88.4	83.9	80.1	85.3
1979	97.9	94.4	94.6	99.3	95.4	99.0	98.7	96.7	93.9	96.4
1980	106.6	106.4	104.1	103.9	104.0	102.3	104.0	105.3	105.8	104.4
1981	114.8	109.9	109.7	109.2	113.9	104.7	101.5	113.8	112.2	109.3
1982	119.6	114.5	113.8	107.9	120.7	100.3	103.2	115.7	113.7	111.0
1983	133.8	123.9	120.4	113.8	124.3	104.2	109.5	118.9	115.8	116.5
1984	155.9	139.0	124.9	116.9	125.0	106.1	114.4	121.7	119.4	121.7
1985	184.0	157.4	131.0	124.0	124.1	110.6	117.4	124.0	125.2	128.3
1986	223.2	182.6	138.9	130.1	124.1	117.9	122.1	127.3	132.0	136.9
1987	265.1	215.5	147.2	136.3	115.3	127.5	126.4	124.9	143.1	145.6
1988	281.1	234.3	156.0	139.3	111.0	136.1	129.0	124.3	162.6	153.3
1989	284.4	239.6	163.3	143.2	113.5	144.5	132.5	127.1	194.2	162.1
1990	269.7	237.5	165.9	144.6	114.1	150.6	135.0	130.5	212.5	166.0
1991	256.3	235.9	167.3	147.4	116.4	156.0	138.0	134.5	213.9	168.1
1992	255.6	242.0	173.3	154.0	121.4	162.8	143.3	142.9	215.6	173.7
1993	255.5	245.0	176.9	159.6	125.7	168.7	148.6	153.0	212.0	177.8
1994	250.4	241.5	179.7	167.2	129.6	178.1	157.6	167.8	207.5	182.2
1995	257.0	244.9	185.8	176.0	133.8	187.3	164.8	178.9	210.0	188.7
1996	259.1	245.5	190.3	183.1	137.0	196.4	171.8	186.1	209.3	193.3
1997	269.5	251.0	197.4	191.0	141.2	206.2	179.6	194.3	218.2	201.0
1998	285.9	261.5	206.8	200.6	148.4	215.8	188.5	203.2	235.5	211.5
1999	309.6	274.7	215.7	206.9	155.5	225.4	199.0	211.7	250.2	222.0
2000	344.4	294.8	228.2	213.6	163.1	237.6	211.0	223.2	276.1	236.4
2001	382.1	320.0	246.4	224.4	172.9	251.1	225.3	238.4	306.1	254.2
2002	425.0	351.1	264.5	231.9	179.7	262.0	237.7	249.9	335.8	270.9
2003	459.9	378.9	280.7	239.6	185.3	271.1	248.1	260.1	365.9	285.8
2004	525.9	433.9	315.0	250.0	192.1	287.1	265.7	290.2	451.4	316.9
2005	577.0	488.3	364.0	266.8	202.9	302.0	282.1	338.4	537.2	351.9
2006	585.3	517.3	395.6	283.5	215.6	304.4	289.3	374.4	590.5	373.1
2007	575.8	521.2	397.9	294.3	225.4	302.0	292.6	379.6	568.3	374.8
2008	548.6	504.6	366.9	294.5	228.4	290.3	287.4	345.7	474.0	353.1
2009	525.8	486.3	343.8	292.0	229.1	279.4	282.7	316.2	430.3	337.1
2010	524.3	484.9	332.4	289.5	229.1	276.3	282.5	300.8	427.8	332.3
2011	512.0	469.0	313.2	282.6	225.6	267.1	275.7	277.1	405.6	319.0

Note(s): (1) The HPI is a broad measure of the movement of single-family house prices. It serves as a timely, accurate indicator of house price trends at various geographic levels (Federal Housing Finance Agency, "Frequently Asked Questions"). The Federal Housing Finance Agency (FHFA) calculated quarterly HPI for each census division using sales prices and appraisal data that were not seasonally adjusted; DOE estimated the average annual HPI for each census region using publicly-available data from FHFA. (2) Third quarter HPI values are listed.

Source(s): Federal Housing Finance Agency, Housing Price Indexes, All-Transactions Indexes, U.S. and Census Divisions through 2011Qr (Not Seasonally Adjusted). Accessed February 28, 2012.

2.5.11 Yearly Average Historic Mortgage Rates

	30-Year Fixed	15-Year Fixed	1-Year ARM (1)
1973	8.04	N/A	N/A
1974	9.19	N/A	N/A
1975	9.05	N/A	N/A
1976	8.87	N/A	N/A
1977	8.85	N/A	N/A
1978	9.64	N/A	N/A
1979	11.20	N/A	N/A
1980	13.74	N/A	N/A
1981	16.63	N/A	N/A
1982	16.04	N/A	N/A
1983	13.24	N/A	N/A
1984	13.88	N/A	11.51
1985	12.43	N/A	10.05
1986	10.19	N/A	8.43
1987	10.21	N/A	7.83
1988	10.34	N/A	7.90
1989	10.32	N/A	8.80
1990	10.13	N/A	8.36
1991	9.25	N/A	7.09
1992	8.39	7.96	5.62
1993	7.31	6.83	4.58
1994	8.38	7.86	5.36
1995	7.93	7.48	6.06
1996	7.81	7.32	5.67
1997	7.60	7.13	5.61
1998	9.64	6.59	5.58
1999	7.44	7.06	5.99
2000	8.05	7.72	7.04
2001	6.97	6.50	5.82
2002	6.54	5.98	4.62
2003	5.83	5.17	3.76
2004	5.84	5.21	3.90
2005	5.87	5.42	4.49
2006	6.41	6.07	5.54
2007	6.34	6.03	5.56
2008	6.03	5.62	5.17
2009	5.04	4.57	4.70
2010	4.69	4.10	3.78

Note(s): 1) To calculate adjustable-rate mortgage (ARM) rates, Freddie Mac indexes the products to US Treasury yields and asks lenders for both the initial coupon rate as well as the margin on the ARM products.

Source(s): US Department of Housing and Urban Development, US Housing Market Conditions: 3rd Quarter 2011, November 2011, Exhibit 14. Mortgage Interest Rates, Average Commitment Rates, and Points: 1973-Present.

2.5.12 Annual Home Improvement Loan Origination Volumes and Values, by Housing Vintage of Loan Applicant

	Volume (thousands)											
Housing Vintage	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1990-2000	N/A	N/A	N/A	N/A	49	74	93	95	74	36	23	20
1980-1989	105	103	95	86	117	190	224	235	196	113	75	65
1970-1979	242	231	214	186	144	270	306	320	277	173	123	107
1960-1969	178	165	153	134	97	172	191	200	168	102	70	62
1950-1959	135	123	113	96	147	249	268	279	234	139	93	81
1949 or earlier	126	113	100	84	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Total Volume	**786**	**735**	**675**	**586**	**553**	**955**	**1,083**	**1,128**	**949**	**563**	**383**	**335**

	Value (in $2010 billion)											
Housing Vintage	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1990-2000	N/A	N/A	N/A	N/A	2.5	7.6	11.8	10.6	7.3	3.1	2.4	1.8
1980-1989	3.5	3.7	3.7	4.0	5.5	16.2	23.2	22.1	16.9	8.1	6.5	4.9
1970-1979	7.0	7.2	7.5	7.7	6.7	21.4	28.9	27.9	21.9	11.3	9.3	7.3
1960-1969	5.3	5.4	5.7	5.9	4.7	15.4	20.3	19.6	15.0	7.3	6.0	4.9
1950-1959	4.0	4.0	4.3	4.3	6.9	22.3	28.0	27.2	21.4	10.2	8.0	6.6
1949 or earlier	3.5	3.5	3.7	3.5	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Total Value	**23.3**	**23.9**	**24.9**	**25.5**	**23.8**	**75.3**	**100.5**	**96.7**	**75.2**	**36.8**	**29.8**	**23.7**

Note(s): 1) After 2002, category represent 1959 and earlier vintage homes.

Source(s): The Federal Financial Institution Examination Council, Home Mortgage Disclosure Act, National Aggregate Report, Years: 1999-2010.

2.6.1 Value of Residential Building Improvements and Repairs, by Sector ($2010 Billion) (1)

	Improvements	Maintenance and Repairs	Total
1980	72.2	35.2	107.4
1985	82.3	65.3	147.6
1990	91.4	85.5	176.9
1995	105.8	63.8	169.6
2000	138.2	52.7	191.0
2003	156.2	51.9	208.0
2004	169.2	57.9	227.1
2005	179.0	59.7	238.6
2006	187.4	57.2	244.6
2007 (2)	178.7	57.0	235.7

Note(s): 1) Improvements includes additions, alterations, reconstruction, and major replacements. Repairs include maintenance. 2) The US Census Bureau discontinued the Survey of Residential Alterations and Repairs (SORAR) after 2007.

Source(s): DOC, Historic Expenditures for Residential Properties by Property Type: Quarterly 1962-2003 (Old structural purposes) for 1980-2000; DOC, Historic Expenditures for Residential Proerties by Property Type: Quarterly 2003-2007 (New structural purposes) for 1995-2007; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for GDP and price deflators.

2.6.2 2007 Professional and Do-It-Yourself Improvements, by Project ($2010)

	Professional Installation			Do-It-Yourself Installation		
Repair/Improvement	Projects (thousand)	Total Expenditures ($million)	Mean Expenditures ($)	Projects (thousand)	Total Expenditures ($million)	Mean Expenditures ($)
Room Additions, Alterations, and Remodelings	**3,957**	**65,635**	**16,587**	**3,986**	**21,802**	**5,470**
Kitchen	1,349	21,583	15,999	1,110	7,605	6,851
Bathroom	1,602	14,620	9,126	1,611	5,016	3,113
Bedroom	276	10,628	38,507	415	3,341	8,050
Other	730	18,803	25,758	850	5,840	6,871
Systems and Equipment	**11,708**	**23,536**	**2,010**	**7,156**	**4,954**	**692**
Plumbing (Pipes and Fixtures)	2,885	4,633	1,606	2,888	1,799	623
Electrical System	1,602	2,836	1,770	936	689	736
HVAC	2,936	12,403	4,224	556	1,298	2,335
Appliance/Major Equipment	4,285	3,664	855	2,776	1,168	421
Exterior Additions and Replacements	**6,216**	**32,576**	**5,241**	**2,986**	**5,791**	**1,939**
Roof	2,707	16,374	6,049	677	1,894	2,797
Siding	776	5,389	6,945	428	1,308	3,055
Windows/Doors	2,733	10,813	3,957	1,881	2,590	1,377
Interior Additions and Replacements	**6,207**	**22,120**	**3,564**	**4,721**	**6,777**	**1,436**
Insulation	727	1,695	2,331	918	800	871
Flooring/Paneling/Ceiling	4,836	16,535	3,419	3,467	4,742	1,368
Other Interior	644	3,890	6,041	336	1,236	3,678
Disaster Repair	**728**	**9,919**	**13,625**	**187**	**3,302**	**17,659**
Other Additions and Replacements (1)	**4,447**	**32,540**	**7,317**	**3,580**	**8,384**	**2,342**
Total (2)	**33,263**	**186,326**		**22,616**	**51,010**	

Note(s): 1) Other additions and replacements include porches, carports, swimming pools and other major improvements or repairs to lot or yard. 2)Total expenditures (professional installation plus do-it-yourself installation) are $1.8 billion higher compared to Table 2.6.1. This discrepancy is due to sampling methods used by HUD for the American Housing Survey and DOC in the Survey of Expenditures for Residential Improvements and Repairs. Individual households may report projects in multiple categories.

Source(s): Joint Center for Housing Studies of Harvard University, The Remodeling Market in Transition: Improving America's Housing 2009, 2009, Table A-2, p. 30; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for GDP and price deflators.

2.6.3 2007 and 2009 Professional Home Improvements, by Project ($2010)

Repair/Improvement	2007 Professional Installation Projects (thousand)	2007 Total Expenditures ($million)	2007 Mean Expenditures ($)	2009 Professional Installation Projects (thousand)	2009 Total Expenditures ($million)	2009 Mean Expenditures ($)
Room Additions, Alterations, and Remodelings	**3,957**	**65,635**	**16,587**	**3,322**	**50,519**	**15,207**
Kitchen	1,349	21,583	15,999	1,109	16,234	14,639
Bathroom	1,602	14,620	9,126	1,401	12,200	8,708
Bedroom	276	10,628	38,507	255	8,795	34,490
Other	730	18,803	25,758	557	13,289	23,859
Systems and Equipment	**11,708**	**23,536**	**2,010**	**11,262**	**20,863**	**1,852**
Plumbing (Pipes and Fixtures)	2,885	4,633	1,606	2,700	3,779	1,399
Electrical System	1,602	2,836	1,770	1,523	2,075	1,362
HVAC	2,936	12,403	4,224	2,824	11,864	4,201
Appliance/Major Equipment	4,285	3,664	855	4,215	3,146	746
Exterior Additions and Replacements	**6,216**	**32,576**	**5,241**	**6,163**	**28,957**	**4,699**
Roof	2,707	16,374	6,049	2,698	15,266	5,658
Siding	776	5,389	6,945	780	4,221	5,411
Windows/Doors	2,733	10,813	3,957	2,685	9,470	3,527
Interior Additions and Replacements	**6,207**	**22,120**	**3,564**	**5,479**	**14,681**	**2,679**
Insulation	727	1,695	2,331	861	1,256	1,459
Flooring/Paneling/Ceiling	4,836	16,535	3,419	4,081	11,537	2,827
Other Interior	644	3,890	6,041	537	1,888	3,515
Disaster Repair	728	9,919	13,625	806	9,149	11,352
Other Additions and Replacements (1)	**4,447**	**32,540**	**7,317**	**3,732**	**24,493**	**6,563**
Total	**33,263**	**186,326**		**30,764**	**148,662**	

Note(s): 1) Other additions and replacements include porches, carports, swimming pools and other major improvements or repairs to lot or yard.

Source(s): Joint Center for Housing Studies of Harvard University, The Remodeling Market in Transition, 2009, Table A.2, p. 30 for 2007; Joint Center for Housing Studies of Harvard University, A New Decade of Growth for Remodeling: Improving America's Housing, 2011, Table A-2, p. 28 for 2009; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for GDP and price deflators.

2.6.4 2007 and 2009 Do-It-Yourself Home Improvements, by Project ($2010)

	2007 DIY Installation			2009 DIY Installation		
Repair/Improvement	Projects (thousand)	Total Expenditures ($million)	Mean Expenditures ($)	Projects (thousand)	Total Expenditures ($million)	Mean Expenditures ($)
Room Additions, Alterations, and Remodelings	**3,986**	**21,802**	**5,470**	**3,375**	**15,711**	**4,655**
Kitchen	1,110	7,605	6,851	898	5,405	6,019
Bathroom	1,611	5,016	3,113	1,468	3,884	2,646
Bedroom	415	3,341	8,050	299	2,661	8,900
Other	850	5,840	6,871	710	3,761	5,298
Systems and Equipment	**7,156**	**4,954**	**692**	**6,994**	**4,238**	**606**
Plumbing (Pipes and Fixtures)	2,888	1,799	623	2,890	1,348	466
Electrical System	936	689	736	843	389	461
HVAC	556	1,298	2,335	532	1,413	2,657
Appliance/Major Equipment	2,776	1,168	421	2,729	1,088	399
Exterior Additions and Replacements	**2,986**	**5,791**	**1,939**	**2,714**	**4,460**	**1,643**
Roof	677	1,894	2,797	671	1,702	2,537
Siding	428	1,308	3,055	357	672	1,883
Windows/Doors	1,881	2,590	1,377	1,686	2,086	1,237
Interior Additions and Replacements	**4,721**	**6,777**	**1,436**	**4,411**	**4,822**	**1,093**
Insulation	918	800	871	922	569	618
Flooring/Paneling/Ceiling	3,467	4,742	1,368	3,174	3,645	1,149
Other Interior	336	1,236	3,678	315	608	1,929
Disaster Repair	**187**	**3,302**	**17,659**	**257**	**1,459**	**5,676**
Other Additions and Replacements (1)	**3,580**	**8,384**	**2,342**	**3,313**	**7,490**	**2,261**
Total	**22,616**	**51,010**		**21,064**	**38,180**	

Note(s): 1) Other additions and replacements include porches, carports, swimming pools and other major improvements or repairs to lot or yard.

Source(s): Joint Center for Housing Studies of Harvard University, The Remodeling market in Transition, 2009, Table A.2, p. 30 for 2007; Joint Center for Housing Studies of Harvard University, A New Decade of Growth for Remodeling: Improving America's Housing, 2011, Table A-2, p. 28 for 2009; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for GDP and price deflators.

2.6.5 Single-Family Residential Renovations, by Project and Vintage

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

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

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

2.6.6 2010-2011 National Professional Remodeling Cost and Amount Recouped in Resale Value

Envelope	Job Cost ($ thousand)	Resale Value ($ thousand)	Cost Recouped
Siding Replacement - Vinyl	11.4	8.2	72%
Window Replacement - Vinyl	11.1	7.9	72%
Window Replacement - Wood	12.0	8.7	72%
Roofing Replacement	21.5	12.8	60%
Entry Door Replacement - Fiberglass	3.6	2.1	60%
Entry Door Replacement - Steel	1.2	1.2	102%
Remodel			
Minor Kitchen Remodel	21.7	15.8	73%
Major Kitchen Remodel	58.4	40.1	69%
Bathroom Remodel	16.6	10.7	64%
Attic Bedroom Remodel	51.4	37.1	72%
Basement Remodel	64.5	45.2	70%
Home Office Remodel	28.9	13.2	46%
Additions			
Deck Addition - Wood	11.0	8.0	73%
Deck Addition - Composite	15.6	10.3	66%
Bathroom Addition	40.7	21.7	53%
Garage Addition	60.6	35.9	59%
Sunroom Addition	75.2	36.5	49%
Family Room Addition	85.7	53.6	63%
Master Suite Addition	108.1	68.1	63%
Two-Story Addition	165.2	107.3	65%
Back-Up Power Generator	14.7	7.1	49%

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

Source(s): © 2007 Hanley Wood, LLC. Reproduced by permission. Complete regional and city data from the Remodeling 2010-2011 Cost vs. Value Report can be downloaded for free at costvalue.remodelingmagazine.com.

2.6.7 2009 Home Improvement Spending by Household Income ($2010)

Income	Number of Homeowners (thousand)	Homeowners Reporting Projects (thousand)	Average Expenditure ($)	Total Expenditures ($million)
Under $40,000	24,675	6,113	5,697	34,825
$40-79,999	23,178	6,545	6,841	44,772
$80-119,999	14,051	4,299	9,189	39,505
120,000 and Over	13,005	4,097	16,531	67,731

Note(s): Home improvements include room additions, remodeling, replacements of household systems and appliances, porches and garages, additions and replacements of roofing, siding, window/doors, insulation, flooring/paneling/ceiling, and disaster repairs.

Source(s): Joint Center for Housing Studies of Harvard University, A New Decade of Growth for Remodeling, 2011, Table A-3, pg. 29; EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for GDP and price deflators.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

2.8.6 Manufactured Home Shipments, Estimated Retail Sales and Average Sales Prices (1980-2009)

Year	Manufactured Home Shipments	Estimated Retail Sales (2010$ Million)	Average Sales Price (2010$)	
			Single Section	Multi-Section
1980	221,091	10,146	$37,079	$66,046
1981	240,313	10,133	$35,385	$61,872
1982	238,808	9,396	$34,349	$56,715
1983	295,079	11,905	$33,811	$58,592
1984	294,993	11,742	$32,772	$56,287
1985	283,489	11,106	$31,989	$54,093
1986	244,660	9,635	$31,297	$54,154
1987	232,598	9,420	$31,439	$55,360
1988	218,429	9,057	$30,726	$55,505
1989	198,254	8,585	$31,199	$56,827
1990	188,172	8,017	$30,347	$56,095
1991	170,713	7,000	$29,456	$54,619
1992	210,787	8,655	$29,786	$53,787
1993	254,276	10,971	$30,981	$56,020
1994	303,932	13,220	$32,558	$58,189
1995	339,601	15,302	$35,015	$60,530
1996	363,411	16,730	$35,959	$61,530
1997	353,377	17,517	$36,513	$62,950
1998	372,843	20,118	$37,270	$64,446
1999	348,671	18,681	$37,368	$65,170
2000	250,550	16,270	$37,699	$66,909
2001	193,229	11,712	$37,110	$67,384
2002	168,491	10,742	$37,119	$67,391
2003	130,937	9,026	$37,514	$70,206
2004	130,802	8,279	$37,622	$72,500
2005	146,744	8,514	$37,735	$76,023
2006	117,373	7,670	$38,688	$76,411
2007	95,769	6,454	$38,831	$77,246
2008	81,889	5,244	$38,816	$77,529
2009	49,717	3,167	$39,977	$75,109

Note(s): Manufactured Housing Institute compiled data from the Institute for Building Technology and Safety (IBTS) and the US Census Bureau.

Source(s): Manufactured Housing Institute, "Manufactured Home Shipments, Estimated Retail Sales amd Average Sales Prices (1980-2009)"; EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for GDP and price deflators.

2.9.1 Program Definitions

DOE Weatherization: Department of Energy's Weatherization Assistance Program

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

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

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

HHS: Department of Health and Human Services

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

LIHEAP Eligible Households: Households with incomes below the Federal maximum poverty income level, i.e., 150% of the Federal poverty guidelines or 75% 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; HHS, LIHEAP Report to Congress FY 2001, Feb. 2003, Table E-1, p. 105 and Figure 1, p. iii for LIHEAP recipient household; Department of Energy, What is the Weatherization Program, p. 2, February 2009; U.S Department of Health and Human Services, Low Income Home Energy Assistance Program Guidance, Policy, and Procedures, February 2009.

2.9.2 Energy Burden Definitions

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

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

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

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

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

2.9.3 Households Weatherized and Weatherization Eligibility by Year (Million) (1)

	DOE	Federally Eligible (2)	Federally Ineligible	Below 125% Poverty Line	Below 150% Poverty Line	Total Households
1977	0.025	-	-	-	-	74.8
1980	0.181	-	-	-	-	79.6
1985	0.125	-	-	-	-	87.9
1987	0.100	-	-	-	-	90.5
1990	0.085	27.9	66.1	18.2	-	94.2
1991	0.105	-	-	-	-	95.3
1992	0.105	-	-	-	-	96.4
1993	0.090	30.7	65.9	19.4	-	97.7
1994	0.101	-	-	-	-	98.7
1995	0.103	-	-	-	-	100.0
1996	0.060	-	-	-	-	101.0
1997	0.067	34.1	67.4	19.7	-	102.2
1998	0.068	-	-	-	-	103.5
1999	0.068	-	-	-	-	104.9
2000	0.077	-	-	-	-	105.7
2001	0.078	33.8	73.2	20.1	26.5	107.0
2002	0.104	-	-	-	-	105.0
2003	0.100	-	-	-	-	105.6
2004	0.100	-	-	-	-	106.6
2005	0.093	29.6	81.5	19.4	26.6	108.8
2006	0.104	-	-	-	-	109.9
2007	0.104	-	-	-	-	110.4
2008	0.098	-	-	-	-	110.6
2009	0.075	-	-	-	-	111.2
2010	0.036	-	-	-	-	111.9
1977-2010	**3.42**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

Note(s): 1) The number of households weatherized represent the number of units completed during the specified Program Year. 2) Federally eligible for DOE and HHS (LIHEAP) Weatherization. Includes previously weatherized units.

Source(s): DOE for weatherization recipients; EIA, Housing Characteristics 1987, May 1989, Table 9, p. 20 for 1987 data; EIA, Housing Characteristics 1990, May 1992, Table 17, p. 54-55 for 1990 data; EIA, Housing Characteristics 1993, June 1995, Table 3.3a, p. 38-42 for 1993 data; EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table HC1-3a, p. 38-39; EIA, 1997 Residential Energy Consumption Survey for eligible households; EIA, 2001 Residential Energy Consumption Survey, Apr. 2004, Table HC2-3a for 2001 eligible households; National Association for State Community Services programs: Weatherization Assistance Program PY 2005 Funding Survey for 2005 data; DOC, The 2012 Statistical Abstract, Table 982 for 2005-2010 households; DOC, The 2006 Statistical Abstract, Table 945 for 1999-2004 households; DOC, The 2001 Statistical Abstract, Table 947 for 1994-1998 households; DOC, The 1997 Statistical Abstract, Table 1195 for 1990-1993 households; Personal communication, Adam Guzzo, U.S. DOE, Febuary 14, 2012 for 2008-2010 weatherization recipients.

2.9.4 Weatherization Population Facts

- Roughly 25% of Federally eligible households move in and out of poverty "classification" each year.
- The average income of Federally eligible households in FY 2005 was $16,264, based on RECS and Bureau of the Census' Current Population Survey (CPS) data.
- States target the neediest, especially the elderly, persons with disabilities, and families with children.
- Since the inception of the Weatherization Assistance Program in 1976, over 6.3 million households have received weatherization services with DOE and leveraged funding.
- In FY 2009, the energy burden on Federally eligible households was about four times the burden on Federally ineligible households (14% versus 4%).

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

Source(s): ORNL, Weatherization Works: Final Report on the National Weatherization Evaluation, Sept. 1994, p. 1 for migrating poor; ORNL, 1996 for targeting; HHS, LIHEAP Home Energy Notebook for FY 2005, May 2007, Table A-2a, p. 59 for Federally eligible average income; EERE, Weatherization and Intergovernmental Program, July 2010 for number households served; HHS, LIHEAP Home Energy Notebook for FY 2009, Sept. 2011, Table A-3b for energy burden.

2.9.5 Weatherization Program Facts

- PY 2010 weatherization funding breakdown: DOE 18.3%, LIHEAP 59.6%, others 22.1%.(1)
- The Federal Government's outlay for fuel subsidies runs from $4.0 to 4.4 billion per year. The major two agencies dispensing fuel subsidies are HUD and HHS (through LIHEAP).
- In 2006, HUD spent over $1.43 billion annually to pay all or part of the total utility bills (including water/sewer) for 1.2 million low-income units. Utilities (including water) made up approximately 23% of public housing authorities' expenditures. In addition, HUD estimates tenant expenditures on utilities (excluding water) at about $421 million in 2007.
- LIHEAP spends 85% of its funding on direct fuel subsidies and weatherization. Up to 15% can be spent for weatherization activities and the remainder is spent on fuel subsidies. A maximum of 25% of funding is available for weatherization activities if HHS approves a waiver. LIHEAP weatherization funding has ranged from 8-19% of total LIHEAP funds. In FY 2008, LIHEAP weatherization funding was 10% of total LIHEAP funds.

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

Source(s): National Association for State Community Services, Weatherization Assistance Program Funding Survey PY 2010 for spending; HUD, Implementing HUD's Energy Strategy, Dec. 2008, Table B-2, p. 9 and Table B-5, p. 11 for public housing utility costs and HUD spending; DHHS, LIHEAP Report to Congress for Fiscal Year 2008, Sept. 2011, Table I-7, 16 for LIHEAP weatherized households and cost splits.

2.9.6 Weatherization Costs and Savings

- DOE Weatherization program requires that States spend no more than an average of $6,572 per household in PY 2011. All States are using energy audits or priority lists to determine the most cost-effective weatherization measures.
- DOE weatherization created an average energy savings of $437 per household, reduced household annual annual consumption by 35% and returned savings of $1.80 per every $1 invested.

Source(s): DOE, Weatherization and Intergovernmental Program: Weatherization Assistance Program, June 2010; EERE/OWIP, Weatherization Program Notice 11-1, Dec. 2010, p. 6.

2.9.7 Residential Energy Burdens, by Weatherization Eligibility and Year (1)

	1987	1990		FY 2000 (2)			FY 2009 (3)		
	Mean Group	Mean Indvdl	Mean Group	Mean Indvdl	Mdn Indvdl	Mean Group	Mean Indvdl	Mdn Indvdl	Mean Group
Total U.S. Households	4.0%	6.8%	3.2%	6.1%	3.5%	2.4%	7.2%	4.4%	3.2%
Federally Eligible	**13.0%**	**14.4%**	**10.1%**	**12.1%**	**7.9%**	**7.7%**	**13.8%**	**9.6%**	**10.0%**
Federally Ineligible	4.0%	3.5%	N.A.	3.0%	2.6%	2.0%	3.6%	3.1%	2.6%
Below 125% Poverty Line	13.0%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Note(s): 1) Energy burden can be defined broadly as the burden placed on household incomes by the cost of energy, or the ratio of energy expenditures to income for a household. 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 use the median individual burden which shows the burden of a "typical" individual. 2) Data are derived from RECS 1997, adjusted to reflect FY 2000 HDD, CDD, and fuel prices. 3) Data are derived from RECS 2005, adjusted to reflect FY 2009 HDD, CDD, and fuel prices.

Source(s): EIA, Household Energy Consumption and Expenditures 1987, Oct. 1989, Table 13, p. 48-50 for 1987 mean group burdens; ORNL, The Scope of the Weatherization Program: Profile of the Population in Need, Mar. 1994, p. xi. for 1990 Federally ineligible mean individual burden; HHS, Characterizing the Impact of Energy Expenditures on Low-Income Households: An Analysis of Alternative National Energy Burden Statistics, Nov. 1994, p. viii for 1990 total U.S. Households and Federally eligible burdens; HHS, LIHEAP Home Energy Notebook for FY 2000, Apr. 2000, Tables A-2a, A-2b, and A-2c, p. 48-50 for FY 2000; and HHS, LIHEAP Home Energy Notebook for FY 2009, Sept. 2011, Tables A-3a, A-3b, and A-3c, p. 71-73.

2.9.8 FY 2009 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	9.0%	5.4%	3.7%	7.7%	4.7%	3.4%	7.1%	4.4%	3.3%	4.9%	3.0%	2.4%
Federally Eligible	**16.0%**	**10.9%**	**11.9%**	**15.1%**	**10.1%**	**11.2%**	**13.3%**	**10.2%**	**10.3%**	**9.8%**	**6.3%**	**7.3%**
Federally Ineligible	4.4%	3.9%	3.0%	3.9%	3.4%	2.8%	3.5%	3.0%	2.7%	2.8%	2.3%	2.0%

Note(s): 1) Data are derived from RECS 2005, adjusted to reflect FY 2009 HDD, CDD, and fuel prices.

Source(s): DHHS, LIHEAP Home Energy Notebook for FY 2009, Sept. 2011, Tables A-3a, A-3b, and A-3c, p. 70-72.

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

	Single-Family		Multi-Family Unit		Mobile Home	
2005 Household Income	Own	Rent	Own	Rent	Own	Rent
Less than $15,000	6.1	2.4	0.3	7.1	1.6	N.A.
$15,000 to $30,000	11.0	3.0	0.4	5.8	2.2	0.3
$30,000 to $49,999	15.7	2.5	N.A	3.9	1.2	N.A.
All Households	68.2	10.7	4.2	20.1	5.7	1.0
Federally Eligible	**10.9**	**4.5**	**1.1**	**9.4**	**2.5**	**0.6**
Federally Ineligible	57.3	6.2	3.1	10.7	3.2	0.4
Below 100% Poverty Line	5.3	2.4	0.7	6.1	1.5	0.3

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

2.9.10 2005 Average Energy Expenditures per Household Member and per Square Foot, by Weatherization Eligibility ($2010)

	$ Per Household Member	Members/ Hhold	$ Per Square Foot	Square Feet/ Hhold
Total U.S. Households	780	2.6	0.86	2,309
Federally Eligible	**617**	**2.7**	**1.10**	**1,532**
Federally Ineligible	844	2.5	0.82	2,590
Below 100% Poverty Line	603	2.7	1.14	1,442

Source(s): EIA, 2005 Residential Energy Consumption Survey: Household Energy Consumption and Expenditures Tables, Oct. 2008, Table US1 part2; EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators.

2.9.11 Households Weatherized with ARRA Funds by Grantee (1)

Grantee	Homes	Grantee	Homes
Alabama	6,704	Nebraska	3,590
Alaska	443	Nevada	8,081
Arizona	6,354	New Hampshire	2,742
Arkansas	5,231	New Jersey	11,290
California	41,649	New Mexico	3,201
Colorado	12,782	New York	40,021
Connecticut	8,940	North Carolina	11,671
Delaware	54	North Dakota	3,051
District of Columbia	962	Ohio	37,140
Florida	18,953	Oklahoma	6,165
Georgia	13,449	Oregon	5,626
Hawaii	604	Pennsylvania	29,042
Idaho	4,470	Rhode Island	2,144
Illinois	35,530	South Carolina	5,304
Indiana	18,768	South Dakota	2,458
Iowa	8,794	Tennessee	19,522
Kansas	6,339	Texas	48,065
Kentucky	7,639	Utah	4,516
Louisiana	4,698	Vermont	2,341
Maine	5,130	Virginia	7,104
Maryland	8,108	Washington	12,335
Massachusetts	17,687	West Virginia	3,710
Michigan	29,293	Wisconsin	21,684
Minnesota	18,224	Wyoming	1,012
Mississippi	5,937		
Missouri	17,334	Territories and Reservations	13,189
Montana	3,310	**Total**	**612,390**

Note(s): 1) Includes homes weatherized through November 30, 2011.

Source(s): Energy.gov, 2012, ARRA Homes Weatherized by Grantee, retrieved Feb. 13, 2012, from <http://energy.gov/downloads/arra-homes-weatherized-grantee>.

Chapter 3: Commercial Sector

Chapter 3 focuses on energy use in the commercial sector. Section 3.1 covers primary and site energy consumption in commercial buildings, as well as the delivered energy intensities of various building types and end uses. Section 3.2 provides data on various characteristics of the commercial sector, including floorspace, building types, ownership, and lifetimes. Section 3.3 provides data on commercial building expenditures, including energy prices. Section 3.4 covers environmental emissions from the commercial sector. Section 3.5 briefly addresses commercial building construction and retrofits. Sections 3.6, 3.7, 3.8, 3.9, and 3.10 provide details on select commercial buildings types, specifically office and retail space, medical facilities, educational facilities, and hotels and motels.

In chapter 3, commercial sector floorspace is divided by the intended commercial activity, such as medical facility, office space, and retail space. Buildings owned and/or operated by Federal, state, or municipal governments are included in the commercial building sector and are categorized according to their primary purpose. Energy consumption in Federal buildings is discussed in more detail in chapter 4.

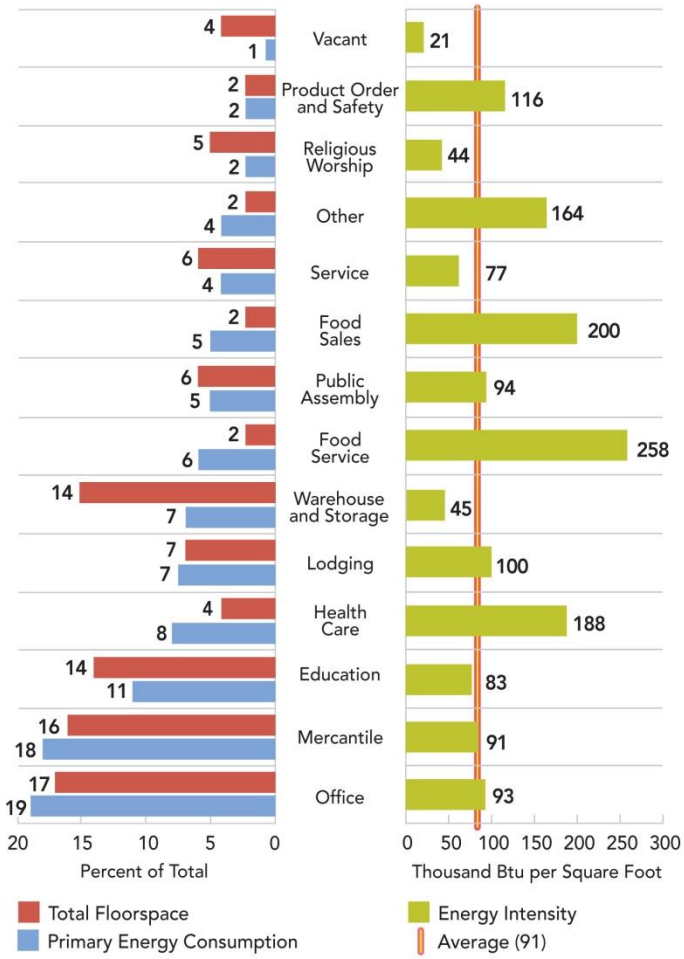
The main points from this chapter are summarized below:

- Commercial buildings represent just under one-fifth of U.S. energy consumption, with office space, retail space, and educational facilities representing about half of commercial sector energy consumption.
- The recession is evidenced by the sharp decrease in energy expenditures in the commercial building sector–a 10% drop. The value of new commercial construction also declined by 22%, the largest percentage drop in the last 30 years. The decline in economic activity had a positive effect on carbon dioxide emissions, which decreased 6%.
- The top three end uses in the commercial sector are space heating, lighting, and space cooling, which represent close to half of commercial site energy consumption.
- Commercial floor space and primary energy consumption grew by 58% and 69%, respectively, between 1980 and 2009. The Energy Information Administration (EIA) projects that they will continue to grow at slower rates between 2009 and 2035, 28% and 22%, respectively. Average energy prices, on the other hand, have been, and are expected to remain, relatively stable.

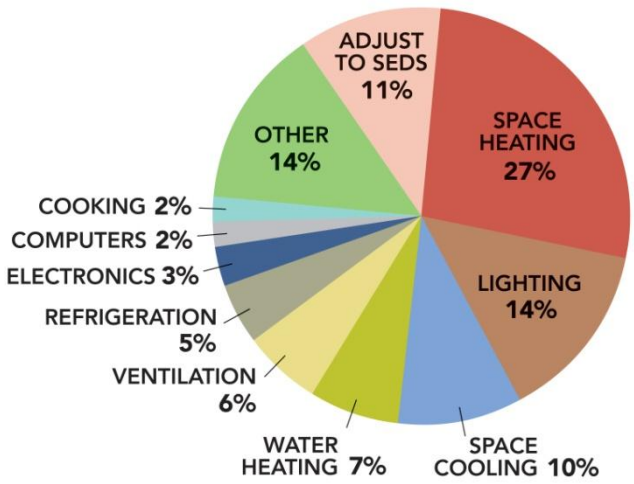
In aggregate, commercial buildings consumed 17.9 quads of primary energy in 2009, representing 46.0% of building energy consumption and 18.9% of U.S. energy consumption. (3.1.1) In comparison, the residential sector consumed 21.0 quads of primary energy, equal to 22.3% of U.S. energy consumption. (2.1.1)

In 2003, the most recent year for which such data are available, office and retail buildings represented the greatest proportions of commercial floor space—17% and 16%, respectively—and 19% and 18%, respectively, of commercial sector energy consumption. Warehouses and storage facilities accounted for 14% of commercial floorspace. (3.2.2) However, the average site energy intensity of these buildings was only 45.2 kBtu per square foot, less than half that of office (92.9 kBtu/ft^2) and retail spaces (73.9 kBtu/ft^2). (3.1.13) As a result, they represent only 7% of commercial sector energy consumption. (3.2.2) Other low-energy-intensity buildings include those used for religious worship and those that are vacant. Medical buildings and food sales and service buildings tend to contain energy-intensive end uses, such as scanning, refrigeration, and cooking, and also tend to be occupied more hours per day and more days per week. Therefore, floorspace devoted to health care, food sales, and food service have high site energy intensities (187,700, 199,700, and 258,300 Btu per square foot, respectively). (3.1.13) Thus, while these buildings represent 8.5% of commercial floor space, they represent close to 19% of commercial primary energy consumption. (3.2.2)

2003 COMMERCIAL BUILDING FLOORSPACE, ENERGY CONSUMPTION, AND ENERGY INTENSITY, BY BUILDING ACTIVITY

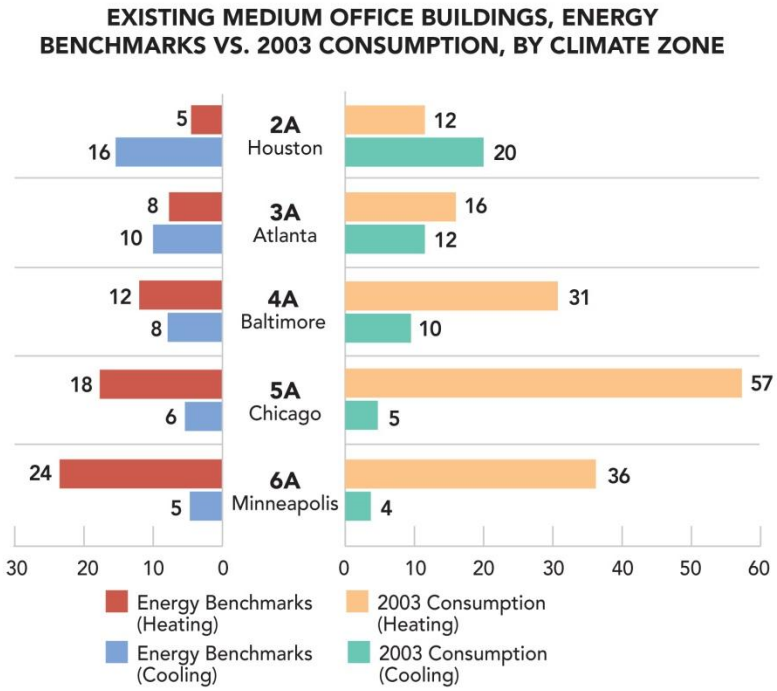


SITE ENERGY CONSUMPTION BY END USE



Space heating consumed 27% of site energy in the commercial sector in 2010, more than any other end use. Other significant end-uses include lighting (14%) and space cooling (10%). Given that the building types that contribute the most to total commercial sector energy consumption, including office, mercantile, education, and lodging, are occupied many hours per day and, in some cases, 24 hours per day, it is not surprising that space conditioning and lighting account for almost half of commercial energy consumption. (3.1.4)

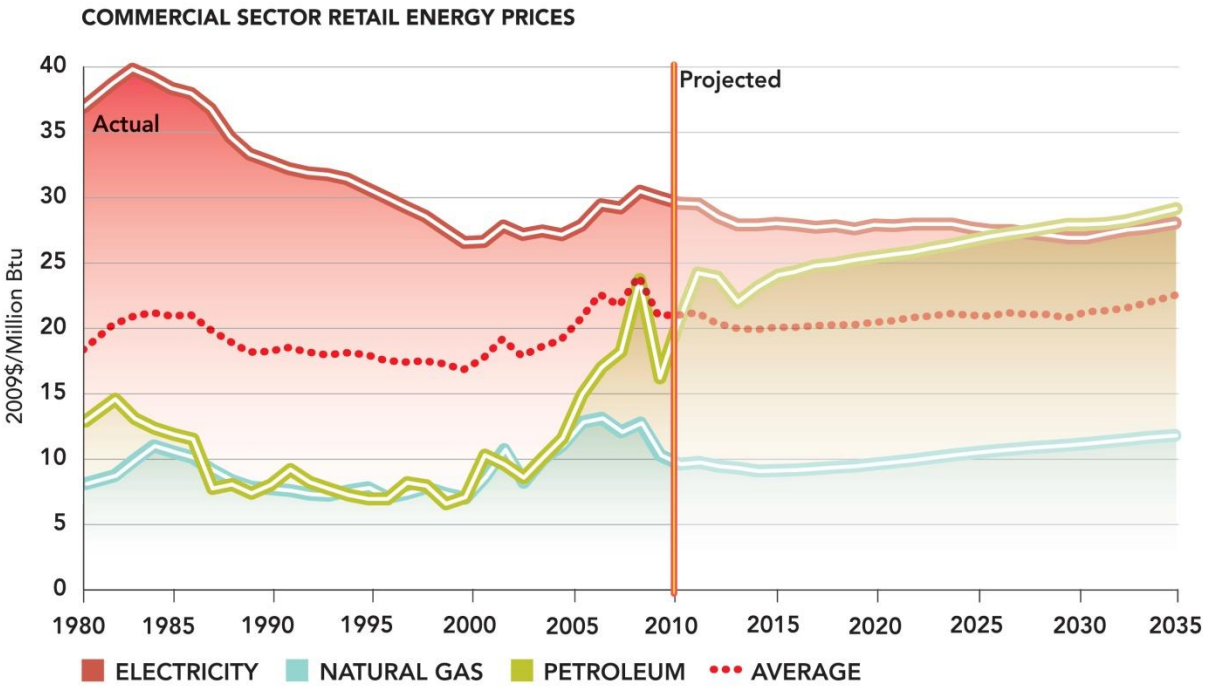
Some of these end-use splits vary considerably by building type. Lighting and space conditioning are the most energy-intensive end uses in mercantile and office buildings. However, in floorspace devoted to food sales, for example, refrigeration requires more energy per square foot than all of the end uses in office space combined—94,800 Btu per square foot for food sales refrigeration compared to 92,900 Btu per square foot for office space end uses in aggregate. (3.1.13) Interestingly, water heating accounts for 31% of the energy consumed in lodging (3.1.13) but only 4% of total commercial energy consumption. (3.1.4)



These statistics also indicate that the energy intensity of commercial buildings has remained relatively constant. Between 1980 and 2010, primary energy consumption per square foot increased by 8%. Between 2010 and 2035, EIA actually expects energy intensity to decrease by 6%. (3.1.3) Historical and projected building occupancy rates are currently unavailable, so it is not known how fluctuations in office and retail occupancy rates affect overall consumption and consumption per square foot.

While there has been some change over time in the real prices of specific fuel sources, consumption-weighted average energy prices (fuel-specific energy prices weighted by the amount of each fuel consumed in the commercial sector in a given year) have remained relatively constant. Between 1980 and 2008, electricity prices fell in real terms by 19%, while natural gas prices increased by 27% and petroleum prices increased by 21%. Over this same period, the average price of energy in the commercial sector increased by 14%. This may be misleading, however, as the average price did not experience gradual growth, but rather fluctuated between 1980 and 2009 levels.

EIA projects that average energy prices will decline by 5% between 2009 and 2035. The annual growth rate from 1980 through 2035 is expected to be just under 0.4%. Thus, while the average energy price is expected to fluctuate in the short term, the average energy price is expected to remain relatively constant over the long term. (3.3.1)


COMMERCIAL SECTOR RETAIL ENERGY PRICES
2009$/Million Btu
40
35
30
25
20
15
10
5
0
Actual
Projected
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
ELECTRICITY
NATURAL GAS
PETROLEUM
AVERAGE

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

	Natural Gas		Petroleum (1)		Coal		Renewable(2)		Electricity Sales	Electricity Losses	Electricity Total		Total(3)	Growth Rate 2010-Year
1980	2.63	24.9%	1.31	12.4%	0.12	1.1%	0.02	0.2%	1.91	4.58	6.49	61.4%	10.57	-
1990	2.67	20.1%	0.99	7.4%	0.12	0.9%	0.10	0.7%	2.86	6.57	9.43	70.9%	13.30	-
2000	3.23	18.9%	0.80	4.7%	0.09	0.5%	0.13	0.7%	3.96	8.95	12.90	75.2%	17.15	-
2005	3.07	17.2%	0.75	4.2%	0.10	0.5%	0.12	0.7%	4.35	9.46	13.81	77.4%	17.85	-
2010	**3.29**	**18.0%**	**0.72**	**3.9%**	**0.06**	**0.3%**	**0.14**	**0.8%**	**4.54**	**9.52**	**14.05**	**77.0%**	**18.26**	**-**
2015	3.41	18.7%	0.62	3.4%	0.06	0.3%	0.15	0.8%	4.63	9.35	13.99	76.7%	18.23	0.0%
2020	3.48	18.2%	0.62	3.2%	0.06	0.3%	0.15	0.8%	4.93	9.95	14.88	77.5%	19.19	0.5%
2025	3.50	17.4%	0.62	3.1%	0.06	0.3%	0.15	0.8%	5.23	10.54	15.77	78.4%	20.10	0.6%
2030	3.58	17.1%	0.62	3.0%	0.06	0.3%	0.16	0.7%	5.57	10.99	16.55	78.9%	20.96	0.7%
2035	3.65	16.7%	0.62	2.9%	0.06	0.3%	0.16	0.7%	5.89	11.45	17.33	79.4%	21.83	0.7%

Note(s): 1) Petroleum includes distillate and residual fuels, liquefied petroleum gas, kerosene, and motor gasoline. 2) Includessite-marketed and non-marketed renewable energy. 3) 2010 commerical site-to-source electricity conversion = 3.10.

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for 2009-2035 and Table A17, p. 34-35 for non-marketed renewable energy.

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

	Wood (2)	Solar Thermal (3)	Solar PV(3)	GHP	Total	Growth Rate 2010-Year
1980	0.021	N.A	N.A.	0.000	0.021	-
1990	0.094	N.A	N.A.	0.003	0.096	-
2000	0.119	N.A	N.A.	0.008	0.126	-
2005	0.104	N.A	N.A.	0.014	0.117	-
2010	**0.110**	**0.028**	**0.006**	**N.A.**	**0.144**	**-**
2015	0.110	0.032	0.007	N.A.	0.148	0.6%
2020	0.110	0.033	0.007	N.A.	0.150	0.4%
2025	0.110	0.034	0.009	N.A.	0.152	0.4%
2030	0.110	0.036	0.010	N.A.	0.155	0.4%
2035	0.110	0.039	0.012	N.A.	0.161	0.4%

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

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables,Table A17, p. 34-35 for 2008-2035.

3.1.3 Commercial Delivered and Primary Energy Consumption Intensities, by Year

	Floorspace (million SF)	Percent Post-2000 Floorspace (1)	*Delivered Energy Consumption* Total (10^15 Btu)	*Delivered Energy Consumption* Consumption per SF (thousand Btu/SF)	Primary Energy Consumption Total (10^15 Btu)	Primary Energy Consumption Consumption per SF (thousand Btu/SF)
1980	50.9	N.A.	5.99	117.7	10.57	207.7
1990	64.3	N.A.	6.74	104.8	13.30	207.0
2000 (2)	68.5	N.A.	8.20	119.7	17.15	250.3
2010 (2)	**81.1**	**26%**	**8.74**	**107.7**	**18.22**	**224.6**
2015 (2)	84.1	34%	8.88	105.5	18.19	216.2
2020 (2)	89.1	43%	9.02	101.2	19.15	214.9
2025 (2)	93.9	52%	9.56	101.8	20.06	213.6
2030 (2)	98.2	60%	9.96	101.5	20.92	213.1
2035 (2)	103.0	68%	10.38	100.8	21.78	211.4

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

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; DOE for 1980 floorspace; EIA, Annual Energy Outlook 1994, Jan. 1994, Table A5, p. 62 for 1990 floorspace; EIA, AEO 2003, Jan. 2003, Table A5, p. 127 for 2000 floorspace; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A5, p. 11-12, and Table A17, p. 34-35 for 2008-2035.

3.1.4 2010 Commercial Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas	Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	Site Electric	*Site* Total	*Site* Percent	Primary Electric (4)	Primary Total	Primary Percent
Lighting						1.19	1.19	13.6%	3.69	3.69	20.2%
Space Heating	1.65	0.22		0.06	0.11	0.28	2.33	26.6%	0.88	2.93	16.0%
Space Cooling	0.04					0.84	0.88	10.1%	2.60	2.64	14.5%
Ventilation						0.54	0.54	6.1%	1.66	1.66	9.1%
Refrigeration						0.39	0.39	4.5%	1.21	1.21	6.6%
Water Heating	0.44	0.03			0.03	0.09	0.58	6.7%	0.28	0.78	4.3%
Electronics						0.26	0.26	3.0%	0.81	0.81	4.4%
Computers						0.21	0.21	2.4%	0.66	0.66	3.6%
Cooking	0.18					0.02	0.20	2.3%	0.07	0.25	1.4%
Other (5)	0.30	0.01	0.14	0.05	0.01	0.69	1.20	13.7%	2.13	2.64	14.5%
Adjust to SEDS (6)	0.68	0.25				0.02	0.95	10.9%	0.06	0.99	5.4%
Total	**3.29**	**0.52**	**0.14**	**0.12**	**0.14**	**4.54**	**8.74**	100%	**14.05**	**18.26**	100%

Note(s): 1) Includes (0.43 quad) distillate fuel oil and (0.08 quad) residual fuel oil. 2) Kerosene (0.01 quad) and coal (0.06 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of (0.11 quad) biomass, (0.03 quad) solar water heating, (less than 0.01 quad) solar PV, and (less than 0.01 quad) wind. 4) Site-to-source electricity conversion (due to generation and transmission losses) = 3.10. 5) Includes service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 6) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Tables A2, p. 3-5, Table A5, p. 11-12, and Table A17, p. 34-35; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2 and 5-25 - 5-26; EIA, AEO 1998, Dec. 1997, Table A5, p. 108-109 for 1995 ventilation; and DOE/Navigant Consulting, 2010 U.S. Lighting Market Characterization, Jan. 2012, Table 4.8, p. 34; EIA, Supplement to the AEO 2012 Early Release, Jan. 2012, Table 32.

3.1.5 2015 Commercial Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas	Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	Site Electric	*Site* Total	*Site* Percent	Primary Electric (4)	Primary Total	Primary Percent
Lighting						1.01	1.01	11.4%	3.05	3.05	16.7%
Space Heating	1.69	0.20		0.06	0.11	0.17	2.23	25.2%	0.50	2.57	14.1%
Space Cooling	0.04					0.51	0.54	6.1%	1.52	1.56	8.6%
Ventilation						0.54	0.54	6.1%	1.62	1.62	8.9%
Refrigeration						0.35	0.35	4.0%	1.06	1.06	5.8%
Electronics						0.32	0.32	3.6%	0.95	0.95	5.2%
Water Heating	0.48	0.03			0.03	0.09	0.63	7.1%	0.27	0.81	4.5%
Computers						0.19	0.19	2.1%	0.57	0.57	3.1%
Cooking	0.19					0.02	0.21	2.4%	0.07	0.26	1.4%
Other (5)	0.33	0.01	0.14	0.05	0.01	0.81	1.35	15.2%	2.45	2.99	16.4%
Adjust to SEDS (6)	0.68	0.19				0.63	1.50	16.9%	1.90	2.77	15.2%
Total	**3.33**	**0.43**	**0.14**	**0.11**	**0.15**	**4.63**	**8.88**	100%	**13.99**	**18.23**	100%

Note(s): 1) Includes (0.35 quad) distillate fuel oil and (0.08 quad) residual fuel oil. 2) Kerosene (less than 0.01 quad) and coal (0.06 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of (0.11 quad) biomass, (0.03 quad) solar water heating, (less than 0.01 quad) solar PV, and (less than 0.01 quad) wind. 4) Site-to-source electricity conversion (due to generation and transmission losses) = 3.02. 5) Includes service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 6) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Tables A2, p. 3-5, Table A5, p. 11-12, and Table A17, p. 34-35; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, Supplement to the AEO 2012 Early Release, Jan. 2012, Table 32.

3.1.6 2025 Commercial Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas	Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	Site Electric	*Site* Total	*Site* Percent	Primary Electric (4)	Primary Total	Primary Percent
Lighting						1.08	1.08	11.3%	3.27	3.27	16.3%
Space Heating	1.68	0.18		0.06	0.11	0.16	2.20	23.1%	0.49	2.53	12.6%
Ventilation						0.60	0.60	6.2%	1.80	1.80	9.0%
Space Cooling	0.03					0.52	0.55	5.7%	1.56	1.59	7.9%
Electronics						0.40	0.40	4.2%	1.22	1.22	6.1%
Refrigeration						0.34	0.34	3.6%	1.02	1.02	5.1%
Water Heating	0.52	0.03			0.03	0.09	0.67	7.0%	0.27	0.85	4.2%
Computers						0.20	0.20	2.1%	0.60	0.60	3.0%
Cooking	0.21					0.02	0.23	2.4%	0.07	0.27	1.4%
Other (5)	0.48	0.01	0.15	0.05	0.01	1.12	1.82	19.1%	3.39	4.09	20.3%
Adjust to SEDS (6)	0.58	0.18				0.69	1.46	15.3%	2.09	2.85	14.2%
Total	**3.50**	**0.41**	**0.15**	**0.12**	**0.15**	**5.23**	**9.56**	100%	**15.77**	**20.10**	100%

Note(s): 1) Includes (0.33 quad) distillate fuel oil and (0.08 quad) residual fuel oil. 2) Kerosene (less than 0.01 quad) and coal (0.06 quad) are assumed attributable to space heating. Motor gasoline (0.05 quad) assumed attributable to other end-uses. 3) Comprised of (0.11 quad) biomass, (0.03 quad) solar water heating, (0.01 quad) solar PV, and (less than 0.01 quad) wind. 4) Site-to-source electricity conversion (due to generation and transmission losses) = 3.02. 5) Includes service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 6) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Tables A2, p. 3-5, Table A5, p. 11-12, and Table A17, p. 34-35; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, Supplement to the AEO 2012 Early Release, Jan. 2012, Table 32.

3.1.7 2035 Commercial Energy End-Use Splits, by Fuel Type (Quadrillion Btu)

	Natural Gas	Fuel Oil (1)	LPG	Other Fuel(2)	Renw. En.(3)	Site Electric	*Site* Total	*Site* Percent	Primary Electric (4)	Primary Total	Primary Percent
Lighting						1.15	1.15	11.1%	3.40	3.40	15.6%
Space Heating	1.65	0.18		0.06	0.11	0.16	2.16	20.8%	0.48	2.48	11.3%
Ventilation						0.65	0.65	6.2%	1.91	1.91	8.7%
Space Cooling	0.03					0.54	0.57	5.5%	1.59	1.62	7.4%
Electronics						0.46	0.46	4.5%	1.37	1.37	6.3%
Refrigeration						0.36	0.36	3.4%	1.05	1.05	4.8%
Water Heating	0.54	0.03			0.04	0.09	0.70	6.8%	0.25	0.87	4.0%
Computers						0.22	0.22	2.1%	0.64	0.64	2.9%
Cooking	0.22					0.02	0.25	2.4%	0.06	0.29	1.3%
Other (5)	0.81	0.01	0.16	0.06	0.01	1.46	2.51	24.2%	4.30	5.35	24.5%
Adjust to SEDS (6)	0.40	0.18				0.77	1.36	13.1%	2.28	2.86	13.1%
Total	**3.65**	**0.40**	**0.16**	**0.12**	**0.16**	**5.89**	**10.38**	100%	**17.33**	**21.83**	100%

Note(s): 1) Includes (0.32 quad) distillate fuel oil and (0.08 quad) residual fuel oil. 2) Kerosene (0.01 quad) and coal (0.06 quad) are assumed attributable to space heating. Motor gasoline (0.06 quad) assumed attributable to other end-uses. 3) Comprised of (0.11 quad) biomass, (0.04 quad) solar water heating, (0.01 quad) solar PV, and (less than 0.01 quad) wind. 4) Site-to-source electricity conversion (due to generation and transmission losses) = 2.94. 5) Includes service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, combined heat and power in commercial buildings, and manufacturing performed in commercial buildings. 6) Energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Tables A2, p. 3-5, Table A5, p. 11-12, and Table A17, p. 34-35; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, Supplement to the AEO 2012 Early Release, Jan. 2012, Table 32.

3.1.8 Commercial Delivered Energy Consumption Intensities, by Vintage

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

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

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

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

Note(s): 1) See Table 3.1.3 for primary versus delivered energy consumption.
Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, Oct. 2006, Table C12a.

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

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

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

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

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

Note(s): 1) Mall buildings are no longer included in most CBECs tables; therefore, some data is not directly comparable to past CBECs.
Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, June 2006, Table C3.

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

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.

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

	Education	Food Sales	Food Service	Health Care	Inpatient	Outpatient	Lodging
Space Heating	39.4	28.9	43.1	70.4	91.8	38.1	22.2
Cooling	8.0	9.8	17.4	14.1	18.6	7.2	4.9
Ventilation	8.4	5.9	14.8	13.3	20.0	3.3	2.7
Water Heating	5.8	2.9	40.4	30.2	48.4	2.5	31.4
Lighting	11.5	36.7	25.4	33.1	40.1	22.6	24.3
Cooking	0.8	8.6	63.5	3.5	5.6	N.A.	3.2
Refrigeration	1.6	94.8	42.1	2.6	2.0	3.5	2.3
Office Equipment	0.4	1.6	1.0	1.2	1.1	1.3	N.A.
Computers	3.4	1.9	1.4	3.4	3.9	2.6	1.3
Other	4.0	9.1	9.5	16.1	18.1	13.2	7.0
Total	83.1	199.7	258.3	187.7	249.2	94.6	100.0

	Mercantile	Service	Retail (No Mall)	Enclosed and Strip Malls	Office	Public Assembly	Public Order and Safety
Space Heating	24.0	35.9	24.8	23.6	32.8	49.7	49.9
Cooling	9.9	3.8	5.9	12.4	8.9	9.6	8.9
Ventilation	6.0	6.0	3.7	7.5	5.2	15.9	9.5
Water Heating	5.1	1.0	1.1	7.7	2.0	1.0	14.0
Lighting	27.5	15.6	25.7	28.6	23.1	7.0	16.5
Cooking	2.3	N.A.	0.6	3.4	0.3	0.8	1.3
Refrigeration	4.4	2.1	5.0	4.0	2.9	2.2	2.9
Office Equipment	0.7	0.3	0.6	0.8	2.6	N.A.	0.6
Computers	1.1	1.0	1.0	1.1	6.1	N.A.	1.6
Other	10.3	11.4	5.6	13.2	9.0	6.5	10.6
Total	91.3	77.0	73.9	102.2	92.9	93.9	115.8

	Religious Worship	Warehouse and Storage	Other	Vacant
Space Heating	26.2	19.3	79.4	14.4
Cooling	2.9	1.3	10.5	0.6
Ventilation	1.4	2.0	6.1	0.4
Water Heating	0.8	0.6	2.1	0.1
Lighting	4.4	13.1	34.1	1.7
Cooking	0.8	N.A.	N.A.	N.A.
Refrigeration	1.7	3.5	6.0	N.A.
Office Equipment	0.1	0.2	N.A.	N.A.
Computers	0.3	0.6	3.0	N.A.
Other	4.9	4.8	18.9	3.1
Total	43.5	45.2	164.4	20.9

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

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

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

	Site Consumption				Primary Consumption			U.S. Natural Gas Total
	Commercial	Industry	Electric Gen.	Transportation	**Commercial**	Industry	Transportation	(quads)
1980	**13%**	41%	19%	3%	**18%**	49%	3%	20.22
1990	**14%**	43%	17%	3%	**19%**	49%	4%	19.57
2000	**14%**	40%	22%	3%	**21%**	47%	3%	23.66
2005	**14%**	35%	27%	3%	**23%**	42%	3%	22.49
2010	**13%**	**33%**	**31%**	**3%**	**24%**	**41%**	**3%**	**24.71**
2015	**13%**	33%	32%	3%	**25%**	41%	3%	25.99
2020	**13%**	34%	31%	3%	**25%**	42%	3%	26.13
2025	**14%**	34%	30%	3%	**25%**	42%	3%	25.80
2030	**14%**	33%	32%	3%	**26%**	40%	3%	26.49
2035	**13%**	32%	34%	3%	**26%**	40%	3%	27.11

Note(s): 1) Commercial buildings accounted for 24% (or $43.4 billion) of total U.S. natural gas expenditures in 2009.

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for 2008-2035 consumption, Table A3, p. 4-6 for 2009 expenditures.

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

	Site Consumption				Primary Consumption			U.S. Petroleum Total
	Commercial	Industry	Electric Gen.	Transportation	**Commercial**	Industry	Transportation	(quads)
1980	**4%**	28%	8%	56%	**6%**	31%	56%	34.2
1990	**3%**	25%	4%	64%	**4%**	26%	64%	33.6
2000	**2%**	24%	3%	67%	**3%**	25%	67%	38.4
2005	**2%**	24%	3%	68%	**3%**	25%	68%	40.7
2010	**2%**	**22%**	**1%**	**72%**	**2%**	**22%**	**72%**	**37.2**
2015	**2%**	21%	1%	73%	**2%**	22%	73%	36.9
2020	**2%**	22%	1%	73%	**2%**	22%	73%	37.1
2025	**2%**	22%	1%	73%	**2%**	22%	73%	37.0
2030	**2%**	22%	1%	73%	**2%**	22%	73%	37.3
2035	**2%**	22%	1%	73%	**2%**	22%	73%	38.0

Note(s): 1) Commercial buildings accounted for an estimated 2% or $10.7 billion of total U.S. petroleum expenditures in 2009.

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for 2009-2035 consumption; and EIA, State Energy Data 2009: Price and Expenditure, June 2011, Tables 2-6 for 2009 expenditures.

3.2.1 Total Commercial Floorspace and Number of Buildings, by Year

	Commercial Sector Floorspace (10^9 square feet)	Percent Post-2000 Floorspace (2)	Buildings (10^6)
1980	50.9 (1)	N.A.	3.1 (3)
1990	64.3	N.A.	4.5 (3)
2000 (4)	68.5	N.A.	4.7 (5)
2008 (4)	78.8	15%	N.A.
2010 (4)	**81.1**	**26%**	N.A.
2015 (4)	84.1	34%	N.A.
2020 (4)	89.2	43%	N.A.
2025 (4)	93.9	52%	N.A.
2030 (4)	98.2	60%	N.A.
2035 (4)	103.0	68%	

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

Source(s): EIA, Annual Energy Outlook 1994, Jan. 1994, Table A5, p. 62 for 1990 floorspace; EIA, AEO 2003, Jan. 2003, Table A5, p. 127-128 for 2000 floorspace; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A5, p. 11-12 for 2008-2035 floorspace; EIA Commercial Building Characteristics 1989, June 1991, Table A4, p. 17 for 1990 number of buildings; EIA, Commercial Building Characteristics 1999, Aug. 2002, Table 3 for 1999 number of buildings and floorspace; and EIA, Buildings and Energy in the 1980s, June 1995, Table 2.1, p. 23 for number of buildings in 1980.

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

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

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

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

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

Floors	
One	40%
Two	25%
Three	12%
Four to Nine	16%
Ten or More	8%
Total	100%

Ownership	
Nongovernment Owned	**76%**
Owner-Occupied	36%
Nonowner-Occupied	37%
Unoccupied	3%
Government Owned	**24%**
Federal	3%
State	5%
Local	15%
Total	100%

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

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

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

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

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

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

Note(s): 1) 35% of commercial floorspace is found in 2.2% of commercial buildings that are larger than 100,000 square feet.
Source(s): EIA, 2003 Commercial Buildings Energy Consumption Survey: Building Characteristics Tables, Oct. 2006, Table A1, p. 1-2.

3.2.6 Commercial Building Vintage, as of 2003

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

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

3.2.7 Commercial Building Median Lifetimes (Years)

Building Type	Median (1)	66% Survival (2)	33% Survival (2)
Assembly	55	40	75
Education	62	45	86
Food Sales	55	41	74
Food Service	50	35	71
Health Care	55	42	73
Large Office	65	46	92
Mercantile & Service	50	36	69
Small Office	58	41	82
Warehouse	58	41	82
Lodging	53	38	74
Other	60	44	81

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

Source(s): EIA, Assumptions for the Annual Energy Outlook 2011, July 2011, Table 5.2, p. 40; EIA, Model Documentation Report: Commercial Sector 'Demand Module of the National Energy Modeling System, May 2010, p. 30-35; and PNNL, Memorandum: New Construction in the Annual Energy Outlook 2003, Apr. 24, 2003 for Note 2.

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

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

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

3.3.1 Commercial Energy Prices, by Year and Major Fuel Type ($2010 per Million Btu)

	Electricity	Natural Gas	Petroleum (1)	Average
1980	37.22	7.70	13.06	18.52
1990	32.49	7.20	9.31	18.62
2000	26.86	8.19	10.44	17.66
2005	28.11	12.15	15.14	20.92
2010 (2)	**29.73**	**9.10**	**20.28**	**20.99**
2015	28.07	8.59	24.07	20.11
2020	27.78	9.21	25.46	20.46
2025	27.74	10.12	26.73	21.07
2030	26.98	10.53	27.98	21.01
2035	27.99	11.55	28.94	22.14

Note(s): 1) Commercial petroleum products include distillate fuel, LPG, kerosene, motor gasoline, and residual fuel. 2) In 2010, buildings average electricity price was $30.47/MMBtu or ($0.10/kWh), average natural gas price was $10.611/MMBtu ($1.06/therm), and petroleum was $22.66/MMBtu ($3.14/gal.). Averages do not include wood or coal prices.

Source(s): EIA, State Energy Data Prices and Expenditures Database, June 2011 for 1980-2009 and prices; EIA, State Energy Consumption Database, June 2011 for 1980-2009 consumption; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A3, p. 6-8, Table A12, p. 25-26, and Table A13, p. 27-28 for 2009-2035 consumption and prices; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for price deflators.

3.3.2 Commercial Energy Prices, by Year and Fuel Type ($2010)

	Electricity (cents/kWh)	Natural Gas (cents/therm)	Distillate Oil ($/gal)	Residual Oil ($/gal)
1980	12.70	77.01	1.43	2.05
1990	11.08	72.04	0.78	1.26
2000	9.17	81.85	0.84	1.28
2005	9.59	121.45	1.24	2.07
2010	**10.14**	**90.95**	**1.66**	**2.86**
2015	9.58	85.91	2.41	3.28
2020	9.48	92.13	2.63	3.49
2025	9.47	101.25	2.73	3.69
2030	9.20	105.25	2.85	3.89
2035	9.55	115.50	2.82	4.06

Source(s): EIA, State Energy Data Prices and Expenditures Database, June 2011 for 1980-2009; EIA, Annual Energy Outlook 2010, May 2010, Table G1, p. 221 for fuels' heat content; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A3, p. 6-8 for 2009-2035; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for price deflators.

3.3.3 Commercial Buildings Aggregate Energy Expenditures, by Year and Major Fuel Type ($2010 Billion) (1)

	Electricity	Natural Gas	Petroleum (2)	Total
1980	70.9	20.5	17.2	108.6
1990	92.9	19.4	9.2	121.5
2000	106.3	26.6	8.3	141.2
2005	122.3	37.4	11.4	171.2
2010	**134.8**	**29.9**	**14.5**	**179.2**
2015	130.0	29.3	15.0	174.4
2020	136.9	32.1	15.7	184.8
2025	145.0	35.5	16.6	197.0
2030	150.1	37.7	17.3	205.1
2035	164.8	42.2	18.0	225.0

Note(s): 1) Expenditures exclude wood and coal. 2009 U.S. energy expenditures were 1.06 trillion. 2) Commercial petroleum products include distillate fuel oil, LPG, kerosene, motor gasoline, and residual fuel.

Source(s): EIA, State Energy Data Prices and Expenditures Database, June 2011 for 1980-2009; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 and Table A3, p. 6-8 for 2010-2035; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for price deflators.

3.3.4 2010 Commercial Energy End-Use Expenditure Splits, by Fuel Type ($2010 Billion) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal (3)	Electricity	Total	Percent
Lighting								35.4	35.4	19.7%
Space Heating	15.0	2.9	0.9		0.1	3.9	0.1	8.5	27.5	15.3%
Space Cooling	0.4							25.0	25.3	14.1%
Ventilation								15.9	15.9	8.9%
Refrigeration								11.6	11.6	6.5%
Water Heating	4.0	0.6				0.6		2.7	7.3	4.1%
Electronics								7.8	7.8	4.3%
Computers								6.3	6.3	3.5%
Cooking	1.6							0.7	2.3	1.3%
Other (4)	2.7	0.3		3.3	1.2	4.8		20.4	28.0	15.6%
Adjust to SEDS (5)	6.2	5.2				5.2		0.6	12.0	6.7%
Total	**29.9**	**9.0**	**0.9**	**3.3**	**1.3**	**14.5**	**0.1**	**134.8**	**179.4**	100%

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating ($0.1 billion) and motor gasoline other uses ($1.2 billion). 3) Coal average price is from AEO 2012 Early Release, all users price. 4) Includes service station equipment, ATMs, medical equipment, telecommunications equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 5) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A3, p. 6-8 for prices, and Table A5, p. 11-12 for energy consumption; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation Oct. 1999, p. 1-2, 5-25 and 5-26 for ventilation; and BTP/Navigant Consulting, DOE/Navigant Consulting, 2010 U.S. Lighting Market Characterization, Jan. 2012, Table 4.8, p. 34; EIA, Supplement to the AEO 2012 Early Release, Jan. 2012, Table 32.

3.3.5 2015 Commercial Energy End-Use Expenditure Splits, by Fuel Type ($2010 Billion) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal (3)	Electricity	Total	Percent
Lighting								28.4	28.4	16.3%
Space Heating	14.6	2.9	1.3		0.1	4.3	0.1	4.7	23.7	13.6%
Ventilation								15.1	15.1	8.6%
Space Cooling	0.3							14.2	14.5	8.3%
Refrigeration								9.9	9.9	5.7%
Electronics								8.8	8.8	5.1%
Water Heating	4.1	0.7				0.7		2.5	7.3	4.2%
Computers								5.3	5.3	3.0%
Cooking	1.7							0.6	2.3	1.3%
Other (4)	2.9	0.3		3.7	1.4	5.4		22.8	31.1	17.8%
Adjust to SEDS (5)	5.8	4.5				4.5		17.7	28.1	16.1%
Total	**29.3**	**8.4**	**1.3**	**3.7**	**1.5**	**14.9**	**0.1**	**130.0**	**174.5**	100%

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating ($0.1 billion) and motor gasoline other uses ($1.4 billion). 3) Coal average price is from AEO 2012 Early Release, all users price. 4) Includes service station equipment, ATMs, medical equipment, telecommunications equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 5) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A3, p. 6-8 for prices, and Table A5, p. 11-12 for energy consumption; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, and EIA, Supplement to the AEO 2012 Early Release, Jan. 2012, Table 32.

3.3.6 2025 Commercial Energy End-Use Expenditure Splits, by Fuel Type ($2010 Billion) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal (3)	Electricity	Total	Percent
Lighting								30.1	30.1	15.2%
Space Heating	17.1	2.8	1.5		0.1	4.4	0.2	4.5	26.1	13.3%
Electronics								11.2	11.2	5.7%
Space Cooling	0.3							14.3	14.6	7.4%
Water Heating	5.2	0.8				0.8		2.5	8.5	4.3%
Computers								5.5	5.5	2.8%
Refrigeration								9.4	9.4	4.8%
Ventilation								16.6	16.6	8.4%
Cooking	2.1							0.6	2.7	1.4%
Other (4)	4.8	0.3		4.3	1.7	6.3		31.2	42.3	21.5%
Adjust to SEDS (5)	5.9	4.9				4.9		19.2	30.0	15.2%
Total	**35.5**	**8.9**	**1.5**	**4.3**	**1.9**	**16.5**	**0.2**	**145.0**	**197.1**	100%

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating ($0.1 billion) and motor gasoline other uses ($1.7 billion). 3) Coal average price is from AEO 2011 Early Release, all users price. 4) Includes service station equipment, ATMs, medical equipment, telecommunications equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 5) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A3, p. 6-8 for prices, and Table A5, p. 11-12 for energy consumption; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; and EIA, Supplement to the AEO 2012 Early Release, Jan. 2012, Table 32.

3.3.7 2035 Commercial Energy End-Use Expenditure Splits, by Fuel Type ($2010 Billion) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal (3)	Electricity	Total	Percent
Lighting								32.3	32.3	14.4%
Space Heating	19.0	2.7	1.6		0.2	4.5	0.2	4.6	28.2	12.5%
Water Heating	6.3	1.0				1.0		18.1	25.4	11.3%
Space Cooling	0.4							15.1	15.5	6.9%
Electronics								13.0	13.0	5.8%
Refrigeration								10.0	10.0	4.4%
Computers								6.0	6.0	2.7%
Cooking	2.6							0.6	3.2	1.4%
Ventilation								2.4	2.4	1.1%
Other (4)	9.3	0.4		4.9	2.0	7.2		40.9	57.5	25.5%
Adjust to SEDS (5)	4.6	5.3				5.3		21.7	31.6	14.0%
Total	**42.2**	**9.4**	**1.6**	**4.9**	**2.2**	**18.0**	**0.2**	**164.8**	**225.1**	100%

Note(s): 1) Expenditures include coal and exclude wood. 2) Includes kerosene space heating ($0.2 billion) and motor gasoline other uses ($2.0 billion). 3) Coal average price is from AEO 2012 Early Release, all users price. 4) Includes service station equipment, ATMs, medical equipment, telecommunications equipment, pumps, lighting, emergency electric generators, and manufacturing performed in commercial buildings. 5) Expenditures related to an energy adjustment EIA uses to relieve discrepancies between data sources. Energy attributable to the commercial buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A3, p. 6-8 for prices, and Table A5, p. 11-12 for energy consumption; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; and EIA, Supplement to the AEO 2012 Early Release, Jan. 2012, Table 32.

3.3.8 Average Annual Energy Expenditures per Square Foot of Commercial Floorspace, by Year ($2010)

Year	($/SF) (2)
1980(1)	2.12
1990	1.98
2000	2.06
2005	2.30
2010	**2.44**
2015	2.29
2020	2.29
2025	2.32
2030	2.31
2035	2.42

Note(s): 1) End of year 1979. 2) Square footage estimated for years in gray.

Source(s): EIA, State Energy Data Prices and Expenditures Database, June 2011 for 1980-2009; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 and Table A5, p. 11-12 for consumption, Table A3, p. 6-8 for prices for 2008-2035; EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for price deflators. for price deflators; EIA, AEO 1994, Jan. 1994, Table A5, p. 62 for 1990 floorspace; and PNNL for 1980 floorspace.

3.3.9 2003 Energy Expenditures per Square Foot of Commercial Floorspace and per Building, by Building Type

	Per Square Foot ($2010)	Per Building ($2010 thousand)		Per Square Foot ($2010)	Per Building ($2010 thousand)
Food Service	4.88	27.2	Mercantile	2.23	38.1
Food Sales	4.68	26.0	Education	1.43	36.6
Health Care	2.76	68.0	Service	1.39	9.1
Public Order and Safety	2.07	32.0	Warehouse and Storage	0.80	13.5
Office	2.01	29.8	Religious Worship	0.76	7.8
Public Assembly	1.73	24.6	Vacant	0.34	4.8
Lodging	1.72	61.5	Other	2.99	65.5

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

Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, Oct. 2006, Table 4; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for price deflators.

3.3.10 2003 Energy Expenditures per Square Foot of Commercial Floorspace, by Vintage ($2010)

Vintage	($/SF)
Prior to 1960	1.44
1960 to 1969	1.70
1970 to 1979	1.88
1980 to 1989	2.09
1990 to 1999	1.88
2000 to 2003	1.72
Average	**1.77**

Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, Table C4; and EIA, Annual Energy Review 2010, August 2011, Appendix D, p. 353 for price deflators.

3.3.11 Energy Service Company (ESCO) Industry Activity ($Million Nominal) (1)

	Estimated Revenue ($Million Nominal) (1)	
	Low	High
1990	143	342
1991	218	425
1992	331	544
1993	505	703
1994	722	890
1995	1,105	1,159
1996	1,294	1,396
1997	1,394	1,506
1998	1,551	1,667
1999	1,764	1,925
2000	1,876	2,186
2001	-	-
2002	-	-
2003	-	-
2004	2,447	2,507
2005	2,949	3,004
2006	3,579	3,627
2007	-	-
2008	4,087	4,171

2008 Revenue Sources

Market Segment	Share
MUSH (2)	69%
Federal	15%
Commercial & Industrial	7%
Residential	6%
Public Housing	3%

2008 Revenues by Project/Technology Type

Market Segment	Share
Energy Efficiency	75%
Onsite Renewables	14%
Engine/Turbine Generators	6%
Consulting/Master Planning	3%
Other	2%

Note(s): 1) Estimates based on surveys of major ESCOs and input from industry experts. 2) Includes municipal and state governments, universities and colleges, K-12 schools, and hospitals.

Source(s): LBNL, Market Trends in the U.S. ESCO Industry: Results from the NAESCO Database Project, LBNL-49601, May 2002 for 1990-2000; LBNL, A Survey of the U.S. ESCO Industry: Market Growth and Development from 2000 to 2006, LBNL-62679, May 2007 for 2004-2006; and LBNL, A Survey of the U.S. ESCO Industry: Market Growth and Development from 2008 to 2011, LBNL-3479E, June 2010 for 2008.

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

	Commercial				U.S.			
	Site Fossil	Electricity	Total	Growth Rate 2010-Year	Total	Growth Rate 2010-Year	Com.% of Total U.S.	Com.% of Total Global
1980	245	409	653	-	4,723	-	14%	3.5%
1990	227	566	793	-	5,039	-	16%	3.7%
2000	239	783	1,022	-	5,867	-	17%	4.3%
2005	227	842	1,069	-	5,996	-	18%	3.8%
2010 (2)	**231**	**805**	**1,036**	-	**5,634**	-	**18%**	**3.4%**
2015	231	734	965	-1.4%	5,434	-0.7%	18%	3.1%
2020	235	776	1,010	-0.3%	5,549	-0.2%	18%	3.0%
2025	235	826	1,061	0.2%	5,618	0.0%	19%	2.9%
2030	240	872	1,111	0.3%	5,695	0.1%	20%	2.8%
2035	244	916	1,159	0.4%	5,806	0.1%	20%	2.7%

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) Carbon emissions calculated from EIA, Assumptions to the AEO 2010 and differs from EIA, AEO 2011 Early Release, Table A18. Commercial sector total varies by 0.1% from EIA, AEO 2011 Early Release. 3) U.S. commercial buildings emissions approximately equal the combined carbon emissions of Canada and Mexico.

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 2009, Feb. 2011, Tables 8-11 for 1990-2009 greenhouse gas emissions; EIA, Assumptions to the Annual Energy Outlook 2010, May 2010, Table 1.2, p. 12 for carbon coefficients; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2011, Summary Reference Case Tables, Table A2, p. 3-5 for 2010-2035 energy consumption and Table A18, p. 36 for 2010-2035 emissions; EIA, International Energy Outlook 2011, Sept. 2011, Table A10 for 2010-2035 global emissions; and EIA, Country Energy Profiles for global emissions (1980-2009), available at http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm, accessed 2/10/2012 for 1980-2009 global emissions.

3.4.2 2010 Commercial Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Lighting								211.9	211.9	20.4%
Space Heating	87.4	10.2	6.7		0.3	17.3	5.6	50.5	160.7	15.5%
Space Cooling	2.3							149.1	151.3	14.6%
Ventilation								95.2	95.2	9.2%
Refrigeration								69.1	69.1	6.7%
Electronics								46.4	46.4	4.5%
Water Heating	23.2	2.0				2.0		16.2	41.4	4.0%
Computers								37.7	37.7	3.6%
Cooking	9.5							4.1	13.6	1.3%
Other (4)	15.8	0.9		9.0	3.8	13.7		122.0	151.5	14.6%
Adjust to SEDS (5)	36.2	18.4				18.4		2.8	57.3	5.5%
Total	**174.4**	**31.5**	**6.7**	**9.0**	**4.1**	**51.3**	**5.6**	**805.0**	**1,036.3**	100%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. Carbon emissions calculated from EIA, Assumptions to the AEO 2011 and differs from EIA, AEO 2012 Early Release, Table A18. Commercial sector total varies by 0.0% from EIA, AEO 2012. 2) Includes kerosene space heating (0.3 MMT) and motor gasoline other uses (3.8 MMT). 3) Excludes electric imports by utilities. 4) Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 5) Emissions related to a discrepancy between data sources. Energy attributable to the buildings sector, but not directly to specific end-uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A4, p. 9-10 and Table A5, p. 11-12 for energy consumption, and Table A18, p. 36 for emissions; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; EIA, Assumptions to the Annual Energy Outlook 2011, July 2011, Table 1.2, p. 14 for carbon coefficients; BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, p. 1-2; OE/Navigant Consulting, 2010 U.S. Lighting Market Characterization, Jan. 2012, Table 4.8, p. 34; and EIA, AEO 1999, Dec. 1998, Table A4, p. 118-119 and Table A5, p. 120-121 for 1996 data.

3.4.3 2015 Commercial Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Lighting								160.0	160.0	16.6%
Space Heating	89.9	9.0	6.2		0.3	15.5	5.5	26.4	137.3	14.2%
Space Cooling	1.9							80.0	81.9	8.5%
Ventilation								85.0	85.0	8.8%
Refrigeration								55.8	55.8	5.8%
Electronics								49.9	49.9	5.2%
Water Heating	25.5	2.0				2.0		14.3	41.8	4.3%
Computers								30.0	30.0	3.1%
Cooking	10.2							3.6	13.8	1.4%
Other (4)	17.6	0.9		8.6	3.5	12.9		128.6	159.2	16.5%
Adjust to SEDS (5)	36.0	13.9				13.9		99.8	149.8	15.5%
Total	**181.2**	**25.8**	**6.2**	**8.6**	**3.8**	**44.4**	**5.5**	**733.4**	**964.5**	100%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (0.3 MMT) and motor gasoline other uses (3.5 MMT). 3) Excludes electric imports by utilities. 4) Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 5) Emissions related to a discrepancy between data sources. Energy attributable to the buildings sector, but not directly to specific end uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A4, p. 9-10 and Table A5, p. 11-12 for energy consumption, and Table A18, p. 36 for emissions; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; and EIA, Assumptions to the Annual Energy Outlook 2011, July 2010, Table 1.2, p. 14 for carbon coefficients.

3.4.4 2025 Commercial Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Lighting								171.2	171.2	16.1%
Space Heating	89.4	7.7	6.3		0.4	14.3	5.5	25.7	135.0	12.7%
Ventilation								94.4	94.4	8.9%
Space Cooling	1.8							81.5	83.3	7.8%
Electronics								63.8	63.8	6.0%
Refrigeration								53.7	53.7	5.1%
Computers								31.2	31.2	2.9%
Water Heating	27.5	2.3				2.3		14.0	43.7	4.1%
Cooking	11.0							3.5	14.5	1.4%
Other (4)	25.3	0.9		9.3	3.8	14.0		177.4	216.8	20.4%
Adjust to SEDS (5)	30.9	13.4				13.4		109.4	153.7	14.5%
Total	**185.8**	**24.3**	**6.3**	**9.3**	**4.2**	**44.0**	**5.5**	**825.9**	**1,061.3**	100%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (0.4 MMT) and motor gasoline other uses (3.8 MMT). 3) Excludes electric imports by utilities. 4) Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 5) Emissions related to a discrepancy between data sources. Energy attributable to the buildings sector, but not directly to specific end uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A4, p. 9-10 and Table A5, p. 11-12 for energy consumption, and Table A18, p. 36 for emissions; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; and EIA, Assumptions to the Annual Energy Outlook 2011, July 2010, Table 1.2, p. 14 for carbon coefficients.

3.4.5 2035 Commercial Buildings Energy End-Use Carbon Dioxide Emissions Splits, by Fuel Type (Million Metric Tons) (1)

	Natural	Petroleum								
	Gas	Distil.	Resid.	LPG	Oth(2)	Total	Coal	Electricity (3)	Total	Percent
Lighting								179.6	179.6	15.5%
Space Heating	87.3	6.7	6.6		0.4	13.7	5.5	25.5	132.0	11.4%
Ventilation								100.7	100.7	8.7%
Space Cooling	1.7							84.1	85.8	7.4%
Electronics								72.3	72.3	6.2%
Refrigeration								55.6	55.6	4.8%
Water Heating	28.8	2.5				2.5		13.3	44.7	3.9%
Computers								33.6	33.6	2.9%
Cooking	11.9							3.4	15.2	1.3%
Other (4)	42.8	1.0		9.8	4.2	14.9		227.3	285.0	24.6%
Adjust to SEDS (5)	21.3	13.1				13.1		120.5	154.9	13.4%
Total	**193.8**	**23.3**	**6.6**	**9.8**	**4.6**	**44.3**	**5.5**	**915.8**	**1,159.3**	100%

Note(s): 1) Emissions assume complete combustion from energy consumption, excluding gas flaring, coal mining, and cement production. Emissions exclude wood since it is assumed that the carbon released from combustion is reabsorbed in a future carbon cycle. 2) Includes kerosene space heating (0.4 MMT) and motor gasoline other uses (4.2 MMT). 3) Excludes electric imports by utilities. 4) Includes commercial service station equipment, ATMs, telecommunications equipment, medical equipment, pumps, emergency electric generators, and manufacturing performed in commercial buildings. 5) Emissions related to a discrepancy between data sources. Energy attributable to the buildings sector, but not directly to specific end uses.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5, Table A4, p. 9-10 and Table A5, p. 11-12 for energy consumption, and Table A18, p. 36 for emissions; EIA, National Energy Modeling System (NEMS) for AEO 2012 Early Release, Jan. 2012; and EIA, Assumptions to the Annual Energy Outlook 2011, July 2010, Table 1.2, p. 14 for carbon coefficients.

3.4.6 2009 Methane Emissions for U.S. Commercial Buildings Energy Production, by Fuel Type (1)

Fuel Type	MMT CO2 Equivalent
Petroleum	0.5
Natural Gas	26.8
Coal	0.3
Wood	0.4
Electricity (2)	50.5
Total	**78.5**

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

Source(s): EIA, Emissions of Greenhouse Gases in the U.S. 2009, Mar. 2011, Table 18, p. 37 for energy production emissions; EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2009, April 2011, Table 3-10, p. 3-9 for stationary combustion emissions; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Summary Reference Case Tables, Table A2, p. 3-5 for energy consumption.

3.5.1 Value of New Commercial Building Construction, by Year ($2010 Billion)

	Value of New Construction Put in Place	U.S. GDP	Comm. Bldgs Percent of Total U.S. GDP
1980	159.8	6,461	2.5%
1985	226.3	7,579	3.0%
1990	227.2	8,890	2.6%
1995	203.8	10,063	2.0%
2000	312.7	12,423	2.5%
2005	302.2	13,986	2.2%
2006	334.7	14,359	2.3%
2007	383.3	14,639	2.6%
2008	399.6	14,639	2.7%
2009	328.5	14,254	2.3%
2010	257.5	14,660	1.8%

Source(s): DOC, Current Construction Reports: Value of New Construction Put in Place, C30, Aug. 2003, Table 1 for 1980-1990; DOC, Annual Value of Private Construction Put in Place, August 2008 for 1995-2000; DOC, Annual Value of Private Construction Put in Place, August 2011 for 2002-2010; DOC, Annual Value of Public Construction Put in Place, August 2008 for 1995-2000; DOC, Annual Value of Public Construction Put in Place, August 2011 for 2002-2010; and EIA, Annual Energy Review 2010, August 2011, Appendix D, p. 353 for GDP and price deflators.

3.5.2 Value of Building Improvements and Repairs, by Sector ($2009 Billion) (1)

	Improvements	Maintenance and Repairs	Total	Percent of GDP
1980	N.A.	N.A.	N.A.	N.A.
1985	88.8	51.4	140.2 (2)	2.0%
1990	88.9	53.4	142.3 (3)	1.8%
1995	113.5	37.4	150.9	1.6%
2000	152.8	47.1	200.0	1.8%
2003	127.9	39.4	167.3	1.4%
2004	129.2	39.8	169.1	1.4%
2005	135.4	41.8	177.2	1.4%
2006	141.4	43.6	198.2	1.5%
2007	182.7	56.3	239.0	1.8%
2008	197.4	60.9	258.3	1.9%
2009	163.9	50.6	214.5	1.6%
2010	124.1	38.3	162.4	1.2%

Note(s): 1) Improvements includes additions, alterations, reconstruction, and major replacements. Repairs include maintenance. 2) 1986. 3) 1989.
Source(s): DOC, Current Construction Reports: Expenditures for Nonresidential Improvements and Repairs: 1992, CSS/92, Sept. 1994, Table A, p. 2 for 1986-1990 expenditures; DOC, 1997 Census of Construction Industries: Industry Summary, Jan. 2000, Table 7, p. 15; DOC, Annual Value of Private Construction Put in Place, May 2008 for 1995-2000; DOC, Annual Value of Private Construction Put in Place, August 2011 for 2003-2010; and EIA, Annual Energy Review 2010, August 2011, Appendix D, p. 353 for GDP and price deflators.

3.6.1 2009 Energy Consumption per Square Foot of Office Floorspace by Vintage (Thousand Btu/SF) (1)

Vintage	Energy Intensity
2000-2009	81.4
1990-1999	74.1
1980-1989	73.1
1970-1979	102.8
1960-1969	71.4
Pre-1959	75.5

Buildings providing consumption data: 436

Note(s): 1) Commercial office buildings sampled include the following: Class A, B, C.
Source(s): BOMA International, Experience Exchange Report 2010, 2010.

3.6.2 Energy Expenditures per Square Foot of Office Floorspace by Building Age ($2009) (1)

Age (years)	2009	Number of Responses	2006	Number of Responses	2004	Number of Responses
0-9	**2.1**	451	2.1	483	1.8	564
10-19	**1.9**	582	2.3	503	2.0	848
20-29	**2.1**	1,161	2.4	939	2.0	786
30-39	**2.4**	416	2.7	314	2.3	290
40-49	**2.5**	150	3.0	68	2.9	57
50+	**2.5**	187	2.5	128	2.1	164
All Buildings	**2.2**	3,494	**2.4**	2,619	**1.8**	2,939

Note(s): 1) Energy includes electric, gas, fuel oil, purchased steam, purchased chilled water, and water/sewage expenditures. BOMA cautions that any data based on fewer than 25 responses may not be a reliable estimate.
Source(s): BOMA International, The Experience Exchange Report 2010, 2010; BOMA International, The Experience Exchange Report 2007, August 2007; BOMA International, The Experience Exchange Report 2005, August 2005; and EIA, Annual Energy Review 2007, August 2010, Appendix D, p. 383 for price deflators.

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

	2006		2004	
	Energy Intensity (thousand Btu/SF)	Energy Expenditures ($2010/SF)	Energy Intensity (thousand Btu/SF)	Energy Expenditures ($2010/SF)
Medical Offices	90.79	2.56	N.A.	2.36
Financial Offices	N.A.	3.12	N.A.	3.32
Corporate Facilities(2)	96.78	2.74	89.38	2.72
Class A	81.88	2.44	78.84	2.08
Class B	74.87	2.30	N.A.	2.04
Class C	N.A.	2.44	N.A.	1.84
All Buildings	81.1	2.42	77.83	2.09

Note(s): 1) Categories are not mutually exclusive. 2) Coporate Facilities are any building that the owner occupies atleast 75% of the rentable space.
Source(s): BOMA International, The Experience Exchange Report 2007, August 2007; BOMA International, The Experience Exchange Report 2005, August 2005; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for price deflators.

3.6.4 2009 Energy Consumption Expenditures by Selected City ($2009/SF) (1)

	Urban	Number of Responses	Suburban	Number of Responses
New York, NY	4.32	33	N.A.	N.A.
Los Angeles, CA	2.84	22	2.47	78
Chicago, IL	1.72	58	N.A.	N.A.
Houston, TX	2.16	27	2.29	149
Phoenix, AZ	2.23	13	1.81	42
Philadelphia, PA	2.81	14	2.87	33
San Antonio, TX	N.A.	N.A.	N.A.	15
San Diego, CA	2.67	14	1.69	75
Dallas, TX	2.27	23	2.19	131
San Jose, CA	N.A.	N.A.	1.88	76
San Francisco, CA	2.55	64	2.19	46
Miami, FL	N.A.	N.A.	2.77	29
Washington, DC	3.29	78	N.A.	N.A.
Seattle, WA	1.51	24	1.75	29
Boston, MA	3.19	32	2.99	47
National Average (2)	**2.33**		**2.08**	

Note(s): 1) Energy includes electric, gas, fuel oil, purchased steam, purchased chilled water, and water/sewage expenditures. "N/A" indicates that the sample size was not large enough to be assumed representative of a given city. BOMA cautions that any data based on fewer than 25 responses may not be a reliable estimate. 2) Averages based on 1,246 urban respondents and 2,942 suburban respondents across 92 US

Source(s): BOMA International, The Experience Exchange Report 2010, 2010.

3.6.5 Top 10 Office Building Owners Globally as of Year End, 2010 (million SF)

Owner	Floorspace Owned
1. RREEF Americas	71.9
2. Brookfield Properties Corp.	69.3
3. The Blackstone Group	65.6
4. CB Richard Ellis Investors	62.7
5. Hines	59.2
6. LaSalleInvestment Management	42.8
7. TIAA-CREF	42.1
8. Boston Properties	38.4
9. Vornado Realty Trust	35.2
10. Duke Realty Corp.	34.7
Total for Top 10:	**521.9**

Source(s): National Real Estate Investor, The 2011 Best of The Best Rankings: 2011 Top 25 Office Owners, June 1, 2011.
http://nreionline.com/property/office/real_estate_top_office_owners_9/

3.6.6 Top 10 Property Managers Globally as of Year End, 2010 (million SF)

Managing Company	Floorspace Managed
1. CB Richard Ellis Group	2,900
2. Colliers International	2,000
3. Jones Lang LaSalle	1,800
4. Cushman & Wakefield	723
5. Newmark Knight Frank	445
6. Cassidy Turley	430
7. NAI Global	315
8. Grubb & Ellis	302
9. Lincoln Property Co.	271
10. ProLogis	265
Total for Top 10:	**9,451**

Source(s): National Real Estate Investor, The 2011 Best of The Best Rankings: 2011 Top 25 Property Managers, June 12, 2011. http://nreionline.com/bestofthebest/top_25_property_managers_2011/

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

Shell	
Percent Glass (WWR)	20-40%
Window U-Factor	0.33-0.56
SHGC	0.31-0.49
Wall R-Value	7.6-15.2
Roof R-Value	
Attic	30-60
Insulation Above Deck	15-30
Wall Material	Mass (HC > 7 Btu/ft^2)
Lighting	
Average Power Density (Watts/SF)	0.9
System and Plant	
System and Plant	
Packaged Single-Zone	
Packaged Single-Zone w/ Economizer	Cooling Capacity > 54 kBtu
Heating Plant:	
Gas Furnace	80% Combustion Efficiency
Cooling Plant:	
Air conditioner (135-240 thousand Btu*hr.)	10.8 EER/11.2 IPLV - 11.0 EER/11.5 IPLV
Service Hot Water:	
Gas Water Heater	90% Thermal Efficiency

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

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

3.6.8 Energy Benchmarks for Existing Large Office Buildings, by Selected City and End-Use (thousand Btu per square foot)

	IECC	Heating		Cooling		Water Heating		Ventilation	
	Climate Zone	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Miami	1A	0.3	0.8	21.9	24.5	0.3	0.2	3.1	3.5
Houston	2A	4.2	4.4	17.7	20.9	0.3	0.3	2.8	3.3
Phoenix	2B	3.0	3.3	16.2	18.3	0.3	0.3	3.2	3.7
Atlanta	3A	6.9	8.5	14.1	17.5	0.4	0.4	2.6	3.2
Los Angeles	3B	2.8	2.9	11.9	13.0	0.4	0.4	2.5	2.7
Las Vegas	3B	4.6	4.7	10.8	13.0	0.3	0.3	2.7	3.3
San Francisco	3C	5.0	6.4	5.6	6.6	0.4	0.4	1.8	2.1
Baltimore	4A	9.8	14.4	12.0	15.5	0.4	0.4	2.4	3.1
Albuquerque	4B	6.6	8.3	6.5	7.6	0.4	0.4	2.3	2.7
Seattle	4C	10.1	15.0	4.5	5.3	0.5	0.4	1.7	2.1
Chicago	5A	14.8	15.1	7.4	7.7	0.5	0.5	2.0	2.1
Boulder	5B	9.5	9.5	4.9	5.0	0.5	0.5	2.0	2.0
Minneapolis	6A	19.6	21.3	6.7	7.0	0.5	0.5	2.0	2.1
Helena	6B	14.2	15.7	3.7	3.8	0.5	0.5	1.8	1.9
Duluth	7	24.3	26.6	3.8	3.6	0.6	0.6	1.8	1.8
Fairbanks	8	45.9	47.9	2.7	2.2	0.7	0.6	2.0	1.7

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. 'Post' refers to buildings construction in or after 1980. 'Pre' refers to buildings construction before 1980. The benchmark building had 498,407 square feet and 12 floors. Benchmark interior lighting energy = 16.07 thousand Btu/SF. Interior equipment energy consumption = 15.94 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/reference_buildings.html>. Version 1.3_5.0, January 2012.

3.6.9 Energy Benchmarks for Newly Constructed Large Office Buildings, by Selected City and End-Use (thousand Btu per square foot)

	IECC Climate Zone	Heating	Cooling	Water Heating	Ventilation (1)
Miami	1A	0.2	18.7	0.2	2.8
Houston	2A	3.2	15.2	0.3	2.5
Phoenix	2B	2.2	13.9	0.3	2.9
Atlanta	3A	3.1	11.1	0.4	2.1
Los Angeles	3B	0.5	8.6	0.4	1.9
Las Vegas	3B	1.4	8.4	0.3	2.2
San Francisco	3C	4.2	5.0	0.4	1.7
Baltimore	4A	6.2	9.8	0.4	2.1
Albuquerque	4B	3.0	5.4	0.4	1.9
Seattle	4C	5.7	3.8	0.4	1.5
Chicago	5A	9.5	6.4	0.5	1.7
Boulder	5B	5.4	4.1	0.5	1.7
Minneapolis	6A	14.4	5.8	0.5	1.7
Helena	6B	10.0	3.1	0.5	1.5
Duluth	7	17.6	3.3	0.6	1.6
Fairbanks	8	31.7	1.7	0.6	1.3

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. The benchmark building had 498,407 square feet and 12 floors. Benchmark interior lighting energy = 10.7 thousand Btu/SF. Interior equipment energy

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/new_construction.html>, January 2012.

3.6.10 Energy Benchmarks for Existing Medium Office Buildings, by Selected City and End-Use (thousand Btu per square foot)

	IECC	Heating		Cooling		Water Heating		Ventilation	
	Climate Zone	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Miami	1A	1.0	0.0	22.0	19.2	0.4	0.4	1.9	13.0
Houston	2A	4.6	1.8	15.5	14.7	0.5	0.5	1.5	12.8
Phoenix	2B	4.0	0.7	17.5	19.4	0.4	0.4	1.9	15.0
Atlanta	3A	7.8	4.3	10.1	10.4	0.6	0.5	1.4	13.9
Los Angeles	3B	4.1	0.3	8.0	3.5	0.5	0.5	1.4	10.9
Las Vegas	3B	5.6	1.4	13.2	14.6	0.5	0.5	1.8	14.5
San Francisco	3C	5.8	1.7	2.9	1.2	0.6	0.6	1.1	8.9
Baltimore	4A	12.1	9.6	8.0	7.8	0.6	0.6	1.3	12.8
Albuquerque	4B	8.0	4.6	6.7	6.9	0.6	0.6	1.6	14.4
Seattle	4C	11.8	7.3	2.5	1.3	0.6	0.6	1.2	11.1
Chicago	5A	17.8	14.2	5.5	4.5	0.7	0.6	1.4	11.4
Boulder	5B	11.6	8.3	4.4	3.9	0.7	0.6	1.5	12.6
Minneapolis	6A	23.6	22.4	4.8	3.8	0.7	0.7	1.4	11.0
Helena	6B	18.1	15.0	2.9	2.3	0.7	0.7	1.4	12.9
Duluth	7	28.9	29.4	2.4	1.7	0.8	0.7	1.4	10.3
Fairbanks	8	52.8	56.4	1.6	1.2	0.8	0.8	1.7	13.2

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. 'Post' refers to buildings construction in or after 1980. 'Pre' refers to buildings construction before 1980. The benchmark building had 44,985 square feet and 3 floors. Benchmark interior lighting energy = 16.82 thousand Btu/SF. Interior equipment energy consumption = 18.85 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/reference_buildings.html>. Version 1.3_5.0, January 2012.

3.6.11 Energy Benchmarks for Newly Constructed Medium Office Buildings, by Selected City and End-Use (thousand Btu per square foot)

	IECC Climate Zone	Heating	Cooling	Water Heating	Ventilation (1)
Miami	1A	0.3	14.9	0.4	1.5
Houston	2A	3.2	11.8	0.5	1.3
Phoenix	2B	2.6	12.8	0.4	1.6
Atlanta	3A	4.5	7.5	0.5	1.2
Los Angeles	3B	0.9	4.8	0.5	1.0
Las Vegas	3B	2.4	9.3	0.5	1.4
San Francisco	3C	5.2	2.5	0.6	1.1
Baltimore	4A	8.5	6.5	0.6	1.2
Albuquerque	4B	4.7	5.3	0.6	1.4
Seattle	4C	7.8	2.0	0.6	1.1
Chicago	5A	12.0	4.4	0.6	1.2
Boulder	5B	7.5	3.6	0.6	1.3
Minneapolis	6A	17.7	3.9	0.7	1.2
Helena	6B	13.3	2.4	0.7	1.2
Duluth	7	21.0	2.0	0.7	1.3
Fairbanks	8	38.6	0.9	0.8	1.1

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. The benchmark building had 53,608 square feet and 3 floors. Benchmark interior lighting energy = 10.7 thousand Btu/SF. Interior equipment energy

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/new_construction.html>, January 2012

3.7.1 2010 Top Retail Companies, by Sales

Chain	2010 Revenues ($billion)	% Change over 2009 Revenues	# Stores 2010	% Change over 2009 Stores
Wal-Mart Stores, Inc.	419.0	3.4%	8,970	6.0%
The Kroger Co.	82.2	7.1%	3,605	-0.4%
Costco	76.3	9.1%	572	1.1%
The Home Depot	68.0	2.8%	2,248	0.2%
Walgreen Co.	67.4	6.4%	8,046	7.3%
Target Corp.	67.4	3.1%	1,750	0.6%
CVS Caremark	57.3	3.6%	7,182	2.2%
Best Buy	50.3	1.2%	4,172	3.7%
Lowes Cos.	48.8	3.4%	1,749	2.3%
Sears Holdings	43.3	-1.6%	4,038	2.2%

Source(s): Chain Store Age. Chain Store Age Top 100: The Nation's Largest Retailers, August/September, 2011.

3.7.2 2010 Top Chain Restaurants, by Sales

Chain	2010 Sales ($billion)	% Change over 2009 Sales	Franchised Stores	Company-owned Stores	Total Stores
McDonald's	32.4	4.5%	12,477	1,550	14,027
Subway (1)	10.6	6.0%	23,850	0	23,850
Burger King (1,2)	8.6	-4.4%	6,380	873	7,253
Wendy's (1)	8.3	-0.6%	5,182	1,394	6,576
Starbucks Coffee (1)	7.6	-9.4%	4,424	6,707	11,131
Taco Bell	6.9	1.5%	4,389	1,245	5,634
Dunkin' Donuts (1)	6.0	5.3%	6,746	26	6,772
Pizza Hut	5.4	8.0%	7,083	459	7,542
KFC	4.7	-4.1%	4,275	780	5,055
Sonic	3.6	-5.7%	3,117	455	3,572

Note(s): 1) Includes figures estimated by Technomic, Inc. 2) Total change in units calculated from data reported in 2010 QSR 50
Source(s): QSR Magazine, 2011 QSR 50 - December, 2011, Available at http://www.qsrmagazine.com/reports/2011-qsr-50?microsite=9341.

3.7.3 2010 Top Supermarkets, by Sales

Supermarket	2010 All Commodity Volume ($millions)	No. of Stores (> $2 million in sales)	Square Feet Selling Area (thousands)
Wal-Mart Stores	143.8	3,001	185,743
Kroger Co.	63.1	2,460	105,777
Safeway, Inc.	35.0	1,461	53,663
Supervalu, Inc.	29.4	1,504	49,826
Ahold USA, Inc. (Stop and Shop, Giant)	25.6	746	31,226
Publix Super Markets, Inc.	22.2	1,035	38,181
Delhaize America, Inc. (Food Lion)	19.0	1,641	48,691
H.E. Butt Grocery Co. (HEB)	12.4	291	14,644
Meijer Inc.	8.8	195	12,498
Great Atlantic & Pacific Tea Co. (Pathmark)	8.1	373	12,385

Note(s): All commodity volume in this example represents the "annualized range of the estimated retail sales volume of all items sold at a retail site that pass through the retailer's cash registers. TDLinx ACV is an estimate based on best available data- a directional measure to be used as an indicator of store and account size, not an actual retail sales report". (Progressive Grocer)
Source(s): Progressive Grocer, 2011 Progressive Grocer Super 50

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

Shell	
Percent Glass	**0.4**
Window (U-Factor	**0.38-0.69**
SHGC	**0.40-0.44**
Wall R-Value (2)	**7.6-15.2 c.i.**
Roof R-Value	
Attic	**30-60**
Insulation Above Deck	**15-25 c.i.**
Lighting	
Average Power Density (W/ft.^2)	**1.3**
System and Plant	
Heating Plant	
Gas Furnace(>225 kBtuh)	**80% Combustion Efficiency**
Cooling Plant	
Air conditioner (>135-240 kBtuh)	**10.8 EER/11.2 IPLV - 11.0 EER/11.5 IPLV**
Service Hot Water	
Gas Storage Water Heater (>75kBtuh)	**90% Thermal Efficiency**

Note(s): 1) Guide provides approximate parameters for constructing a building which is 30% more efficient than ASHRAE 90.1-1999. Ranges are due to climate zone dependencies. 2) Assumes a wall with heat content greaater than 7 Btu/ft^2.

Source(s): ASHRAE, Advanced Energy Design Guide for Small Retail Buildings, 2008.

3.7.5 Energy Benchmarks for Existing Retail Buildings, by Selected City and End-Use (thousand Btu per square foot)

	IECC	Heating		Cooling		Ventilation	
	Climate Zone	Post	Pre	Post	Pre	Post	Pre
Miami	1A	0.5	0.7	23.0	25.2	14.3	16.1
Houston	2A	11.6	12.4	16.2	18.9	14.6	16.9
Phoenix	2B	8.3	10.2	17.2	21.3	14.2	17.5
Atlanta	3A	24.9	26.2	9.2	11.2	15.1	17.4
Los Angeles	3B	6.9	7.7	3.3	3.9	13.4	14.1
Las Vegas	3B	15.4	17.9	11.6	14.8	12.7	16.9
San Francisco	3C	22.4	22.5	0.7	1.0	10.6	12.1
Baltimore	4A	43.0	46.9	6.2	7.9	13.3	16.2
Albuquerque	4B	30.2	33.8	5.3	6.8	13.7	16.5
Seattle	4C	38.4	42.0	0.9	1.3	11.1	13.7
Chicago	5A	59.5	62.9	4.4	5.3	15.3	18.7
Boulder	5B	43.3	47.2	3.2	4.2	15.2	18.7
Minneapolis	6A	75.5	82.2	3.7	4.3	19.5	21.1
Helena	6B	60.3	66.1	1.9	2.3	20.8	22.2
Duluth	7	92.8	103.7	1.2	1.4	21.1	21.9
Fairbanks	8	156.4	173.4	0.5	0.5	27.1	30.0

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. 'Post' refers to buildings construction in or after 1980. 'Pre' refers to buildings construction before 1980. The benchmark building had 24,683 square feet and 1 floor. Benchmark interior lighting energy = 37.28 thousand Btu/SF. Interior equipment energy consumption = 7.63 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/reference_buildings.html>. Version 1.3_5.0, January 2012.

3.7.6 Energy Benchmarks for Newly Constructed Retail Buildings, by Selected City and End-Use (thousand Btu per square foot)

	IECC Climate Zone	Heating	Cooling	Ventilation
Miami	1A	0.2	17.0	11.2
Houston	2A	8.1	11.9	10.7
Phoenix	2B	6.4	13.1	10.2
Atlanta	3A	15.3	5.8	9.6
Los Angeles	3B	4.3	1.8	8.0
Las Vegas	3B	11.0	7.5	7.8
San Francisco	3C	16.1	0.4	4.3
Baltimore	4A	28.4	4.3	9.1
Albuquerque	4B	20.2	3.5	8.5
Seattle	4C	28.8	0.6	7.0
Chicago	5A	39.8	2.9	8.9
Boulder	5B	29.7	2.0	8.4
Minneapolis	6A	52.3	2.4	9.0
Helena	6B	45.2	1.1	8.4
Duluth	7	68.9	0.6	5.6
Fairbanks	8	108.9	0.1	9.4

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. The benchmark building had 24,683 square feet and 1 floor. Benchmark interior lighting energy = 19.2 thousand Btu/SF. Interior equipment energy

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/new_construction.html>, January 2012

3.7.7 Energy Benchmarks for Existing Supermarkets, by Selected City and End-Use (thousand Btu per square foot)

	IECC	Heating		Cooling		Water Heating		Ventilation	
	Climate Zone	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Miami	1A	2.2	2.2	11.8	12.4	0.4	0.4	11.1	11.1
Houston	2A	21.6	21.5	9.7	10.7	0.4	0.4	18.0	18.5
Phoenix	2B	21.4	21.2	11.2	13.2	0.4	0.4	13.6	15.6
Atlanta	3A	41.3	41.1	5.4	6.1	0.5	0.5	21.1	21.7
Los Angeles	3B	22.5	22.3	1.1	1.1	0.5	0.5	12.7	12.3
Las Vegas	3B	32.9	32.6	8.3	10.2	0.4	0.4	18.8	20.1
San Francisco	3C	50.0	48.4	0.3	0.3	0.5	0.5	13.2	13.1
Baltimore	4A	64.7	67.0	3.8	4.5	0.5	0.5	22.3	23.7
Albuquerque	4B	50.7	51.1	3.2	4.1	0.5	0.5	23.7	25.2
Seattle	4C	66.3	68.5	0.4	0.5	0.5	0.5	18.8	20.0
Chicago	5A	81.6	84.5	2.4	2.7	0.5	0.5	27.3	28.6
Boulder	5B	65.3	67.2	1.9	2.3	0.5	0.5	28.3	30.0
Minneapolis	6A	99.9	104.0	2.0	2.3	0.6	0.6	29.9	31.6
Helena	6B	87.3	95.4	1.1	1.3	0.6	0.6	32.1	34.1
Duluth	7	123.5	129.6	0.8	0.6	0.6	0.6	32.1	34.6
Fairbanks	8	188.2	200.6	0.2	0.2	0.7	0.6	40.4	44.6

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. 'Post' refers to buildings construction in or after 1980. 'Pre' refers to buildings construction before 1980. The benchmark building had 44,985 square feet and 1 floor. Benchmark interior lighting energy = 31.86 thousand Btu/SF. Interior equipment energy consumption = 20.74 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/reference_buildings.html>. Version 1.3_5.0, January 2012.

3.7.8 Energy Benchmarks for Newly Constructed Supermarkets, by Selected City and End-Use (thousand Btu per square foot)

	IECC Climate Zone	Heating	Cooling	Water Heating	Ventilation
Miami	1A	2.1	7.9	0.4	8.3
Houston	2A	19.1	6.2	0.4	11.2
Phoenix	2B	19.7	8.2	0.4	11.0
Atlanta	3A	34.9	3.0	0.5	11.7
Los Angeles	3B	23.0	0.6	0.5	23.0
Las Vegas	3B	30.7	4.7	0.4	11.4
San Francisco	3C	43.6	0.2	0.5	9.4
Baltimore	4A	53.5	2.4	0.5	12.2
Albuquerque	4B	44.9	1.8	0.5	13.0
Seattle	4C	59.5	0.3	0.5	10.9
Chicago	5A	67.6	1.5	0.5	13.3
Boulder	5B	57.7	1.1	0.5	14.5
Minneapolis	6A	81.4	1.3	0.6	14.4
Helena	6B	74.1	0.7	0.6	18.4
Duluth	7	99.8	0.6	0.6	16.6
Fairbanks	8	145.6	0.3	0.6	20.5

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations.The benchmark building had 44,985 square feet and 1 floor. Benchmark interior lighting energy = 19.7 thousand Btu/SF. Interior equipment energy

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/new_construction.html>, January 2012

3.7.9 Number of Stores and Average Sales in the Grocery Industry as of 2007

Store Type	Number of Stores (1,000s)	US Annual Sales ($Billions)
Supermarket	35.0	535.4
Convenience	145.9	306.6
Grocery (<$2million)	13.7	18.2
Wholesale Clubs	1.2	101.5
Military Convenience Stores	0.4	2.2
Total	**196.2**	**963.9**

Source(s): DOE/EERE/Navigant Consulting, Energy Savings Potential and R&D Opportunities for Commercial Refrigeration, Sept. 2009, Table 3-2, p. 27.

3.8.1 Medical Offices, Utilities Cost Per Square Foot ($2010)

Expense	Downtown	Suburban	All
HVAC Electricity	2.39	1.81	1.84
Non-HVAC Electricity	N/A	1.51	1.53
Natural Gas	0.52	0.41	0.41
Water/Sewer	0.15	0.22	0.21
Overall Utilities (1)	**2.53**	**2.59**	**2.57**

Note(s): 1) Does not equal sum of the other categories. Can also include purchased steam, purchased chilled water, and fuel oil.
Source(s): BOMA International, The Experience Exchange Report 2010, 2010.

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

	Total Square Footage (billion)	Energy Use (quadrillion Btus)	Energy Intensity (thousand Btus/SF)
1999	1.87	0.43	229.0
2003	1.91	0.48	249.3
2008	2.15	0.45	210.1
2010	**2.24**	**0.48**	**213.7**
2015	2.45	0.51	208.2
2020	2.66	0.54	202.9
2025	2.88	0.56	194.8
2030	3.09	0.59	190.9
2035	3.30	0.61	184.6

Source(s): EIA, The Commercial Energy Consumption Survey 2003, Table A2. Census Region, Number of Buildings and Floorspace for All Buildings (Including Malls); EIA, The Commercial Energy Consumption Survey 1999, Table B3. Page 11 Census Region, Number of Buildings and Floorspace; EIA, The Annual Energy Outlook 2012 Early Release supplemental tables for regional detail, Table 32, Jan. 2012.

3.8.3 Energy Benchmarks for Existing Hospitals, by Selected City and End-Use (thousand Btu per square foot)

	IECC	Heating		Cooling		Water Heating		Ventilation	
	Climate Zone	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Miami	1A	34.6	40.7	88.9	85.4	1.8	1.8	20.0	21.0
Houston	2A	42.1	48.0	89.5	86.9	2.2	2.1	19.6	20.8
Phoenix	2B	42.2	48.6	82.1	80.2	2.0	1.9	20.7	21.9
Atlanta	3A	45.8	53.9	83.7	82.1	2.5	2.5	19.0	20.6
Los Angeles	3B	45.4	46.9	75.4	71.0	2.5	2.4	18.5	18.8
Las Vegas	3B	40.9	48.0	69.5	69.0	2.2	2.2	18.5	21.2
San Francisco	3C	49.2	52.8	66.5	64.1	2.8	2.7	17.1	18.0
Baltimore	4A	49.0	60.3	79.8	79.7	2.8	2.7	18.2	19.8
Albuquerque	4B	36.2	42.6	56.1	55.4	2.8	2.7	18.7	20.1
Seattle	4C	50.5	61.2	65.4	64.6	3.0	2.9	17.5	18.6
Chicago	5A	52.5	55.9	67.3	64.0	3.1	3.0	17.8	18.0
Boulder	5B	39.1	41.1	52.6	50.1	3.0	3.0	18.1	18.2
Minneapolis	6A	55.7	60.5	59.7	56.9	3.3	3.2	17.3	17.5
Helena	6B	45.5	49.4	48.4	46.0	3.3	3.2	17.3	17.4
Duluth	7	59.8	64.0	50.6	47.2	3.6	3.5	16.9	16.5
Fairbanks	8	86.9	91.1	34.3	31.1	4.0	3.9	16.5	15.3

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. 'Post' refers to buildings construction in or after 1980. 'Pre' refers to buildings construction before 1980. The benchmark building had 241,263 square feet and 5 floors. Benchmark interior lighting energy = 32.89 thousand Btu/SF. Interior equipment energy consumption = 31.03 thousand Btu/SF. Ventilation includes energy used by fans and heat rejection systems.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/reference_buildings.html>. Version 1.3_5.0, January 2012.

3.8.4 Energy Benchmarks for Newly Constructed Hospitals, by Selected City and End-Use (thousand Btu per square foot)

	IECC Climate Zone	Heating	Cooling	Water Heating	Ventilation (1)
Miami	1A	40.6	67.5	1.8	17.4
Houston	2A	47.2	68.1	2.1	17.1
Phoenix	2B	42.5	62.3	1.9	17.4
Atlanta	3A	48.6	62.5	2.5	16.4
Los Angeles	3B	47.6	55.5	2.4	15.7
Las Vegas	3B	41.8	52.0	2.2	16.2
San Francisco	3C	56.6	51.5	2.7	16.1
Baltimore	4A	55.4	60.5	2.7	16.1
Albuquerque	4B	37.9	41.7	2.7	15.5
Seattle	4C	55.1	49.7	2.9	15.2
Chicago	5A	58.2	51.0	3.0	15.6
Boulder	5B	42.3	39.3	3.0	15.1
Minneapolis	6A	62.8	45.5	3.2	15.1
Helena	6B	50.8	36.6	3.2	14.7
Duluth	7	67.0	38.5	3.5	14.7
Fairbanks	8	89.1	25.2	3.9	13.5

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. The benchmark building had 241,263 square feet and 5 floors. Benchmark interior lighting energy = 16.36 thousand Btu/SF. Interior equipment energy consumption = 15.15 thousand Btu/SF. Ventilation includes energy used by fans and heat rejection systems.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/new_construction.html>. Version 1.3_5.0, January 2012.

3.8.5 Energy Benchmarks for Existing Outpatient Buildings, by Selected City and End-Use (thousand Btu per square foot)

	IECC	Heating		Cooling		Water Heating		Ventilation	
	Climate Zone	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Miami	1A	65.4	60.3	69.6	61.9	0.7	0.7	24.6	23.9
Houston	2A	73.2	76.2	54.0	52.9	0.8	0.8	22.1	24.0
Phoenix	2B	79.1	79.8	54.7	52.9	0.7	0.7	23.8	25.3
Atlanta	3A	83.1	91.1	41.8	42.1	0.9	0.9	22.1	24.6
Los Angeles	3B	87.8	86.3	37.4	35.6	0.9	0.9	22.5	23.1
Las Vegas	3B	76.6	80.5	44.1	44.0	0.8	0.8	23.2	25.5
San Francisco	3C	85.0	93.4	25.0	24.7	1.0	1.0	20.3	22.2
Baltimore	4A	85.9	97.6	34.8	35.3	1.0	1.0	21.0	23.5
Albuquerque	4B	76.5	83.6	30.4	30.9	1.0	1.0	24.1	26.4
Seattle	4C	91.7	103.1	22.8	22.6	1.1	1.0	20.9	22.9
Chicago	5A	92.4	96.0	28.1	26.4	1.1	1.1	21.2	22.1
Boulder	5B	79.9	82.9	24.7	23.3	1.1	1.1	23.4	24.4
Minneapolis	6A	97.1	102.0	24.9	23.5	1.2	1.1	21.1	22.1
Helena	6B	88.6	93.2	19.9	18.8	1.2	1.2	22.3	23.3
Duluth	7	100.6	104.6	17.0	15.5	1.3	1.3	20.8	21.2
Fairbanks	8	129.2	132.6	12.2	10.8	1.5	1.4	20.6	20.3

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. 'Post' refers to buildings construction in or after 1980. 'Pre' refers to buildings construction before 1980. The benchmark building had 40,932 square feet and 3 floors. Benchmark interior lighting energy = 18.42 thousand Btu/SF. Interior equipment energy consumption = 46.01 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/reference_buildings.html>. Version 1.3_5.0, January 2012.

3.8.6 Energy Benchmarks for Newly Constructed Outpatient Buildings, by Selected City and End-Use (thousand Btu per square foot)

	IECC Climate Zone	Heating	Cooling	Water Heating	Ventilation
Miami	1A	49.4	49.3	0.7	19.5
Houston	2A	58.9	41.4	0.8	19.4
Phoenix	2B	60.3	40.6	0.7	19.9
Atlanta	3A	66.0	31.9	0.9	19.3
Los Angeles	3B	63.8	26.4	0.9	18.3
Las Vegas	3B	57.7	32.1	0.8	19.6
San Francisco	3C	72.1	19.8	1.0	18.5
Baltimore	4A	72.1	27.4	1.0	19.0
Albuquerque	4B	63.5	23.7	1.0	21.7
Seattle	4C	74.7	17.7	1.0	18.5
Chicago	5A	75.3	21.3	1.1	18.8
Boulder	5B	65.9	19.3	1.1	21.0
Minneapolis	6A	81.3	19.0	1.1	18.9
Helena	6B	74.3	15.6	1.2	20.0
Duluth	7	84.2	13.2	1.3	18.7
Fairbanks	8	99.7	8.8	1.4	17.7

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and are designed to provide a consistent baseline to compare building performance in energy-use simulations. The benchmark building had 40,932 square feet and 3 floors. Benchmark interior lighting energy = 13.02 thousand Btu/SF. Interior equipment energy consumption = 46.01 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/reference_buildings.html>. Version 1.3_5.0, January 2012.

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

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

Note(s): 1) Educational facilities include K-12 as well as higher education facilities. 2) Due to rounding, sum does not add up to total.
Source(s): EIA, 2003 Commercial Building Energy Consumption and Expenditures End-Uses, Sept. 2008, Table E1A and E2A.

3.9.2 Number of Elementary and Secondary Schools in the United States, Enrollment, and Students per School, 2007-2008

	Number of Schools (thousands)	Enrollment (millions)	Average Students per School
Public Schools	98.9	49.2	498
Elementary	67.1		
Secondary	24.6		
Combined	5.9		
Other (1)	1.3		
Private Schools	33.7	6.0	177
Elementary	21.9		
Secondary	2.9		
Combined	8.9		

Note(s): 1) Includes special education, alternative, and other schools not classified by grade span.
Source(s): U.S. Department of Education/National Center for Educational Statistics (NCES), Digest of Education Statistics: 2010, April 2011, Table 2 for enrollment, Table 5 for number of educational institutions.

3.9.3 National Enrollment and Expenditures for Public K-12 Facilities ($2010)

School Year Beginning	Enrollment (millions)	Expenditures ($billion)	Expenditures per Pupil
1986	39.4	272.2	6,904
1990	41.2	330.2	8,011
1995	44.8	255.1	5,689
2000	47.2	348.4	7,380
2005	49.1	449.1	9,145
2010	49.3	523.7	10,621
2015	50.7	567.1	11,193
2018	51.8	610.5	11,784
2020	52.7	638.8	12,129

Source(s): NCES, Projections of Educational Statistics to 2010, Table 18 for 1995-2020; NCES, Projections of Educational Statistics to 2015, Sept. 2006, Table 34, p. 78 for 1990; NCES, Projections of Educational Statistics to 2011, Oct. 2001, Table 33, p. 88 for 1986; and EIA, Annual Energy Review 2010, October 2011, Appendix D, p. 353 for price inflators.

3.9.4 Total Expenditures for K-12 School Plant Operations and Maintenance, by Function ($2010 Billion)

	1995-96		2000-01		2005-06		2006-07		2007-08	
Salaries and Benefits	18.4	53%	21.5	51%	24.2	49%	24.8	49%	25.4	51%
Purchased Services	10.4	30%	12.0	28%	13.2	27%	13.6	27%	13.6	27%
Supplies	5.7	16%	8.6	20%	11.2	23%	11.4	23%	12.0	24%
Other	0.3	1%	0.3	1%	0.4	1%	0.4	1%	0.5	1%
Total	**34.9**	100%	**42.5**	100%	**49.0**	100%	**50.2**	100%	**51.4**	100%

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

Source(s): NCES, Digest of Educational Statistics 2010, April 2011, Table 188; EIA, Annual Energy Review 2010, August 2011, Appendix D, p. 353 for price inflators.

3.9.5 New Construction and Renovations Expenditures for Public K-12 Schools ($2010 Billion)

	New Schools	Additions	Renovations	Total
2000	11.72	7.65	7.04	26.41
2001	12.70	6.54	5.59	24.83
2002	14.91	6.31	4.76	25.98
2003	13.23	5.95	4.29	23.47
2004	13.98	4.91	4.20	23.09
2005	14.16	5.48	4.29	23.93
2006	13.71	5.31	4.16	23.18
2007	13.32	5.16	4.04	22.52
2008	13.21	3.30	3.36	19.87
2009	12.06	2.14	2.34	16.54
2010	8.67	3.07	2.80	14.54

Note(s): Data includes public school districts only and is presented in calendar years, rather than school years.

Source(s): School Planning & Management, 6th Annual School Construction Report, February 2001 Table 1, p. 28 for 2000; School Planning & Management, 2002 Construction Report, February 2002 Table 1, p. 3 for 2001; School Planning & Management, 2003 Construction Report, February 2003 Table 1, p. 3 for 2002; School Planning & Management, 9th Annual Construction Report, February 2004, Table 1, p. 3 for 2003; School Planning & Management, 10th Annual School Construction Report, February 2005, Table 1, p. C3 for 2004; School Planning & Management, 11th Annual Construction Report, February 2006, Table 1, p. C3 for 2005; School Planning & Management, The 2007 Construction Report, February 2007, Table 1, p. C3 for 2006; School Planning & Management, The 2008 Annual School Construction Report, February 2008, Table 1, p. CR3 for 2007; School Planning & Management, The 2009 Annual School Construction Report, February 2009, Table 1, p. CR3 for 2008; School Planning & Management, 15th Annual School Construction Report, February 2010, Table 1, p. CR3 for 2009; School Planning & Management, 16th Annual School Construction Report, February 2011, Table 1, p. CR3 for 2010; and EIA, Annual Energy Review 2010, August 2011, Appendix D, p. 353 for price inflators.

3.9.6 2010 Regional New Construction and Renovations Expenditures for Public K-12 Schools ($Million)

Region	New Schools	Additions	Renovation	Total
Region 1 (CT, MA, ME, NH, RI, VT)	312.3	94.0	246.6	**652.9**
Region 2 (NJ, NY, PA)	513.3	392.5	588.9	**1,494.7**
Region 3 (DE, MD, VA, WV)	541.2	133.9	154.2	**829.3**
Region 4 (KY, NC, SC, TN)	1,012.6	202.7	115.0	**1,330.3**
Region 5 (AL, FL, GA, MS)	1,338.0	327.6	175.9	**1,841.4**
Region 6 (IN, MI, OH)	359.6	286.3	278.9	**924.8**
Region 7 (IL, MN, WI)	309.3	206.1	135.3	**650.7**
Region 8 (IA, KS, MO, NE)	217.6	231.4	187.8	**636.8**
Region 9 (AR, LA, OK, TX)	1,653.9	479.6	387.8	**2,521.2**
Region 10 (CO, MT, ND, NM, SD, UT, WY)	548.2	130.9	93.3	**772.4**
Region 11 (AZ, CA, HI, NV)	1,605.4	407.3	275.2	**2,287.9**
Region 12 (AK, ID, OR, WA)	258.2	181.8	158.1	**598.1**
Total	**8,669.5**	**3,074.1**	**2,796.8**	**14,540.4**

Source(s): School Planning & Management, 16th Annual School Construction Report, February 2011 p. CR3

3.9.7 Percentage of Public K-12 Schools with Environmental Factors that Interfere with Classroom Instruction (1)

	Permanent Buildings (2)			Temporary Buildings (3)		
	Small	Medium	Large	Small	Medium	Large
Lighting, artificial	5%	6%	6%	11%	3%	10%
Lighting, natural	6%	6%	4%	11%	5%	12%
Heating	14%	11%	12%	11%	6%	12%
Air conditioning	16%	16%	17%	15%	6%	14%
Ventilation	11%	12%	12%	20%	8%	16%
Indoor air quality	8%	11%	9%	12%	9%	14%
Acoustincs or noise control	12%	13%	12%	23%	14%	19%
Physical condition of buildings	10%	11%	10%	15%	12%	15%
Size or configuration of rooms	14%	12%	13%	15%	16%	18%

Note(s): 1) Small school is defined as having 1-349 students, medium 350-699 students, and a large school has 700 or more students. 2) Based on the 99% of public schools with classrooms in permanent buildings. 3) Based on the 33% of public schools with classrooms in temporary

Source(s): National Center for Education Statistics, Digest of Educational Statistics 2010, April 2011, Table 106, for 2005 data.

3.9.8 Advanced Energy Design Guide for Typical Educational Facilities (1)

Shell		
Percent Glass		Maximum 35%
Window U-Factor		0.33 - 0.56
Wall R-Value		5.7 - 15.2
Roof R-Value		
Attic		30.0 - 60.0
Insulation Above Deck		25.0
Wall Material		Mass: Heat Capacity > 7 Btu/SF*F
Lighting		
Average Power Density(Watts/ft.^2)		
With Daylighting		1.2
Without Daylighting		0.9 - 1.1
System and Plant		
System and Plant		
1 Central System		
Packaged Multi-Zone w/ Economizer		Comply with ASHRAE 90.1
Heating Plant:	Gas Boiler	80-85 Combustion Efficiency
Cooling Plant:	Water-Cooled Chiller	Comply with ASHRAE 90.1
Service Hot Water:	Gas Boiler	90 Combustion Efficiency

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

Source(s): ASHRAE, Advanced Energy Design Guide for K-12 School Buildings, 2008.

3.9.9 Energy Benchmarks for Existing Primary Schools, by Selected City and End-Use (thousand Btu per square foot)

	IECC	Heating		Cooling		Water Heating		Ventilation	
	Climate Zone	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Miami	1A	0.7	0.7	20.6	22.4	1.4	1.4	3.1	3.4
Houston	2A	6.4	8.3	13.3	17.2	1.7	1.7	2.4	2.9
Phoenix	2B	4.1	6.1	14.2	19.6	1.6	1.5	2.9	3.6
Atlanta	3A	12.5	16.8	7.6	10.6	2.0	2.0	2.1	2.7
Los Angeles	3B	4.4	4.4	6.1	6.6	1.9	1.9	2.2	2.4
Las Vegas	3B	6.6	10.2	10.1	14.5	1.8	1.7	2.6	3.4
San Francisco	3C	10.9	12.6	2.3	3.0	2.2	2.1	1.9	2.2
Baltimore	4A	18.6	29.8	5.4	7.8	2.2	2.2	1.8	2.5
Albuquerque	4B	13.3	19.5	4.7	6.8	2.2	2.1	2.3	3.1
Seattle	4C	17.0	25.8	1.4	2.0	2.3	2.3	1.5	2.0
Chicago	5A	27.0	33.3	3.9	4.5	2.4	2.4	1.9	2.1
Boulder	5B	18.2	24.1	2.7	3.4	2.4	2.3	1.8	2.2
Minneapolis	6A	34.8	43.2	2.9	3.5	2.6	2.5	1.7	2.0
Helena	6B	28.0	33.5	1.6	1.9	2.6	2.5	1.7	1.9
Duluth	7	42.3	51.8	1.2	1.3	2.9	2.8	1.5	1.9
Fairbanks	8	84.2	99.3	0.7	0.8	3.2	3.1	2.0	2.2

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. 'Post' refers to buildings construction in or after 1980. 'Pre' refers to buildings construction before 1980. The benchmark building had 73,932 square feet and 1 floor. Benchmark interior lighting energy = 23.72 thousand Btu/SF. Interior equipment energy consumption = 18.77 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/reference_buildings.html>. Version 1.3_5.0, January 2012.

3.9.10 Energy Benchmarks for Newly Constructed Primary Schools, by Selected City and End-Use (thousand Btu per square foot)

	IECC Climate Zone	Heating	Cooling	Water Heating	Ventilation
Miami	1A	0.3	15.9	1.4	2.7
Houston	2A	4.7	11.5	1.7	2.2
Phoenix	2B	3.3	12.4	1.5	2.5
Atlanta	3A	8.3	6.2	2.0	1.8
Los Angeles	3B	2.0	3.6	1.9	1.5
Las Vegas	3B	4.7	8.5	1.7	2.2
San Francisco	3C	8.8	2.0	2.1	1.7
Baltimore	4A	15.8	5.0	2.2	1.7
Albuquerque	4B	10.3	4.2	2.1	2.0
Seattle	4C	12.9	1.1	2.3	1.3
Chicago	5A	21.4	3.6	2.4	1.7
Boulder	5B	15.2	2.6	2.3	1.6
Minneapolis	6A	30.9	2.9	2.5	1.7
Helena	6B	24.0	1.5	2.5	1.4
Duluth	7	37.0	1.2	2.8	1.5
Fairbanks	8	59.6	0.5	3.1	1.4

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations.The benchmark building had 73,932 square feet and 1 floor. Benchmark interior lighting energy = 15.80 thousand Btu/SF. Interior equipment energy

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/new_construction.html>, January 2012.

3.9.11 Energy Benchmarks for Existing Secondary Schools, by Selected City and End-Use (thousand Btu per square foot)

	IECC	Heating		Cooling		Water Heating		Ventilation	
	Climate Zone	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Miami	1A	1.0	10.2	73.6	17.5	1.2	1.4	6.0	9.1
Houston	2A	9.5	7.0	49.7	20.7	1.5	1.3	5.2	10.9
Phoenix	2B	6.6	20.9	53.9	10.0	1.3	1.7	5.7	8.8
Atlanta	3A	18.7	5.8	31.4	5.2	1.7	1.6	5.0	7.3
Los Angeles	3B	5.7	11.5	25.2	14.4	1.7	1.5	5.0	10.3
Las Vegas	3B	10.5	15.8	34.7	1.7	1.5	1.8	5.3	7.5
San Francisco	3C	16.1	36.2	11.4	7.3	1.9	1.9	4.8	8.4
Baltimore	4A	31.0	22.9	23.8	7.0	2.0	1.9	4.9	8.7
Albuquerque	4B	20.5	35.2	15.1	1.5	1.9	2.0	5.1	7.3
Seattle	4C	30.1	45.1	7.1	4.8	2.0	2.1	4.6	7.2
Chicago	5A	42.3	32.2	17.9	3.7	2.1	2.1	5.0	7.0
Boulder	5B	29.6	61.0	10.1	3.7	2.1	2.3	5.0	7.2
Minneapolis	6A	56.4	48.1	14.7	2.1	2.3	2.3	5.1	7.1
Helena	6B	44.9	74.7	6.6	1.3	2.3	2.5	5.1	7.2
Duluth	7	68.1	130.1	6.6	0.6	2.6	2.8	5.2	8.5
Fairbanks	8	120.1	0.0	3.8	0.0	2.8	0.0	6.0	0.0

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. 'Post' refers to buildings construction in or after 1980. 'Pre' refers to buildings construction before 1980. The benchmark building had 210,810 square feet and 2 floors. Benchmark interior lighting energy = 18.41 thousand Btu/SF. Interior equipment energy consumption = 11.83 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/reference_buildings.html>. Version 1.3_5.0, January 2012.

3.9.12 Energy Benchmarks for Newly Constructed Secondary Schools, by Selected City and End-Use (thousand Btu per square foot)

	IECC Climate Zone	Heating	Cooling	Water Heating	Ventilation
Miami	1A	0.7	54.0	1.1	5.5
Houston	2A	8.1	41.0	1.4	5.2
Phoenix	2B	5.8	44.4	1.3	5.6
Atlanta	3A	15.3	25.3	1.7	4.9
Los Angeles	3B	4.1	15.9	1.6	4.7
Las Vegas	3B	8.6	28.2	1.5	5.2
San Francisco	3C	13.9	9.6	1.8	4.7
Baltimore	4A	27.5	20.9	1.9	4.9
Albuquerque	4B	17.9	13.8	1.9	5.1
Seattle	4C	25.8	5.9	2.0	4.5
Chicago	5A	36.7	15.9	2.1	4.9
Boulder	5B	26.3	9.5	2.1	4.9
Minneapolis	6A	50.4	13.4	2.3	5.0
Helena	6B	40.4	6.0	2.3	5.0
Duluth	7	61.0	6.1	2.5	5.3
Fairbanks	8	96.7	2.2	2.8	5.5

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations.The benchmark building had 210,810 square feet and 2 floors. Benchmark interior lighting energy = 15.20 thousand Btu/SF. Interior equipment energy consumption = 11.83 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/new_construction.html>, January 2012

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

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

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

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

3.10.2 Lodging Industy, Sales and Occupancy Rates

Year	Properties (1)	Guestrooms (thousand)	Sales ($2010 billion)	Avg. Occupancy Rate	Avg. Room Rate ($2010)
2001	41,393	4,200	126.47	60.3%	107.75
2002	47,040	4,398	123.25	59.1%	100.35
2003	47,584	4,416	123.83	61.1%	97.04
2004	47,598	4,412	130.02	61.3%	98.61
2005	47,590	4,402	135.78	63.1%	100.57
2006	47,135	4,389	142.96	63.3%	104.79
2007	48,062	4,476	145.12	63.1%	108.13
2008	49,505	4,626	143.24	60.4%	108.85
2009	50,800	4,762	128.41	54.7%	98.78
2010	51,015	4,802	127.70	57.6%	98.07

Note(s): 1) Based on properties with 15 or more rooms

Source(s): The American Hotel & Lodging Association, 2002 Lodging Industy Profile, p. 2-3; The American Hotel & Lodging Association, 2003 Lodging Industy Profile, p. 2-3, 2002; The American Hotel & Lodging Association, 2004 Lodging Industy Profile, p. 2-4, 2004; The American Hotel & Lodging Association, 2005 Lodging Industy Profile, p. 2, 4, 2005; The American Hotel & Lodging Association, 2006 Lodging Industy Profile, p. 2, 4, 2006; The American Hotel & Lodging Association, 2007 Lodging Industy Profile, p. 2, 4, 2007; The American Hotel & Lodging Association, 2008 Lodging Industry Profile p. 2, 4, 2008; The American Hotel & Lodging Association, 2009 Lodging Industry Profile, available at: http://www.ahla.com/content.aspx?id=28832; The American Hotel & Lodging Association, 2010 Lodging Industry Profile; The American Hotel & Lodging Association, 2011 Lodging Industry Profile, available at: http://www.ahla.com/content.aspx?id=32567

3.10.3 Lodging Industry Profile (Thousands)

	2004		2006		2008		2010	
Location	Properties	Rooms	Properties	Rooms	Properties	Rooms	Properties	Rooms
Suburban	15.8	1,564	15.9	1,577	16.8	1,668	17.5	1,746
Highway	6.7	446	6.8	452	7.1	480	7.3	498
Urban	4.6	706	4.5	691	4.7	721	4.9	754
Airport	1.9	274	2.0	275	2.1	294	2.2	305
Resort	4.1	595	3.6	567	3.7	584	3.8	595
Small Metro	14.5	826	14.4	827	15.1	878	15.4	904
Rate								
Under $30	0.9	56	0.9	58	1.2	54	0.8	54
$30-44.99	8.0	510	7.1	435	7.3	418	6.6	406
$45-59.99	16.1	1,045	14.8	933	15.0	916	14.5	896
$60-85	14.3	1,368	14.2	1295	14.5	1326	15.8	1386
Over $85	8.3	1,434	10.1	1668	11.4	1913	13.4	2060
Number of Rooms								
Under 75	27.5	1,164	26.9	1147	27.8	1188	28.1	1212
75 - 149	14.3	1,524	14.5	1542	15.8	1668	16.9	1773
150 - 299	4.2	847	4.1	824	4.3	853	4.4	876
300 - 500	1.1	398	1.1	399	1.1	416	1.1	419
Over 500	0.5	479	0.5	478	0.5	502	0.5	522

Source(s): The American Lodging Association, 2007 Lodging Industy Profile, p. 2, 4, 2007; The American Lodging Association, 2008 Profile p. 2, 4, 2008; The American Hotel & Lodging Association, 2009 Lodging Industry Profile, available at: http://www.ahla.com/content.aspx?id=28832; The American Hotel & Lodging Association, 2010 Lodging Industry Profile, available at: http://www.ahla.com/content.aspx?id=30505; The American Hotel & Lodging Association, 2011 Lodging Industry Profile, available at http://www.ahla.com/content.aspx?id=32567

3.10.4 Energy Benchmarks for Existing Large Hotels, by Selected City and End-Use (thousand Btu per square foot)

	IECC	Heating		Cooling		Water Heating		Ventilation	
	Climate Zone	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Miami	1A	1.4	0.1	155.0	142.0	30.1	29.4	8.9	11.2
Houston	2A	7.1	1.9	119.9	117.9	38.1	37.1	8.8	10.8
Phoenix	2B	4.5	1.1	113.2	111.5	33.5	32.7	9.1	11.4
Atlanta	3A	13.1	3.8	91.3	88.5	45.7	44.6	8.8	10.5
Los Angeles	3B	3.1	0.7	77.5	74.9	44.3	43.1	8.9	10.4
Las Vegas	3B	7.4	2.2	78.9	83.0	39.0	38.0	9.0	11.2
San Francisco	3C	8.0	2.6	48.8	49.6	50.8	49.5	8.7	10.0
Baltimore	4A	20.8	6.9	82.8	74.4	51.8	50.5	8.8	10.1
Albuquerque	4B	13.7	5.4	51.3	54.8	50.6	49.4	9.1	10.9
Seattle	4C	18.2	6.4	46.7	40.4	54.9	53.5	8.9	9.9
Chicago	5A	29.1	9.7	71.1	63.4	57.1	55.6	8.8	9.6
Boulder	5B	20.5	8.0	47.6	44.8	56.8	55.4	9.0	10.1
Minneapolis	6A	37.2	12.6	67.5	59.8	61.6	60.1	8.8	9.6
Helena	6B	30.3	11.5	43.4	37.9	62.5	60.9	9.0	9.8
Duluth	7	45.5	15.9	51.3	40.6	69.2	67.4	8.9	9.3
Fairbanks	8	74.5	24.3	32.3	23.8	78.3	76.3	9.2	9.1

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. 'Post' refers to buildings construction in or after 1980. 'Pre' refers to buildings construction before 1980. The benchmark building had 122,075 square feet and 6 floors. Benchmark interior lighting energy = 17.56 thousand Btu/SF. Interior equipment energy consumption = 24.77 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/reference_buildings.html>. Version 1.3_5.0, January 2012.

3.10.5 Energy Benchmarks for Newly Constructed Large Hotels, by Selected City and End-Use (thousand Btu per square foot)

	IECC Climate Zone	Heating	Cooling	Water Heating	Ventilation
Miami	1A	1.3	69.1	29.4	8.7
Houston	2A	5.9	53.7	37.1	8.6
Phoenix	2B	3.8	47.4	32.7	8.8
Atlanta	3A	10.2	43.0	44.6	8.7
Los Angeles	3B	3.1	34.7	43.1	8.5
Las Vegas	3B	6.0	35.4	38.0	8.8
San Francisco	3C	6.6	23.2	49.5	8.9
Baltimore	4A	17.2	37.0	50.5	8.6
Albuquerque	4B	12.3	23.9	49.4	8.8
Seattle	4C	15.0	21.1	53.5	8.5
Chicago	5A	24.2	31.6	55.6	8.6
Boulder	5B	18.4	21.7	55.4	8.8
Minneapolis	6A	31.7	29.0	60.1	8.6
Helena	6B	27.1	18.6	60.9	8.7
Duluth	7	39.6	21.9	67.4	8.7
Fairbanks	8	60.9	13.2	76.3	8.4

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations.The benchmark building had 122,075 square feet and 6 floors. Benchmark interior lighting energy = 11.28 thousand Btu/SF. Interior equipment energy consumption = 24.77 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/new_construction.html>, January 2012

3.10.6 Energy Benchmarks for Newly Constructed Small Hotels, by Selected City and End-Use (thousand Btu per square foot)

	IECC Climate Zone	Heating	Cooling	Water Heating	Ventilation
Miami	1A	0.2	17.9	5.4	5.3
Houston	2A	2.5	13.6	6.5	5.0
Phoenix	2B	1.8	14.1	5.9	5.3
Atlanta	3A	4.5	9.7	7.6	4.8
Los Angeles	3B	1.6	7.5	7.4	4.5
Las Vegas	3B	3.0	10.5	6.6	4.9
San Francisco	3C	4.2	5.2	8.3	4.3
Baltimore	4A	8.0	7.8	8.4	4.5
Albuquerque	4B	5.1	7.1	8.2	5.0
Seattle	4C	6.9	4.1	8.8	4.1
Chicago	5A	11.6	6.3	9.1	4.4
Boulder	5B	8.2	5.4	9.1	4.8
Minneapolis	6A	16.3	5.8	9.7	4.4
Helena	6B	12.8	4.0	9.9	4.5
Duluth	7	20.7	3.9	10.8	4.3
Fairbanks	8	36.6	2.7	12.0	3.9

Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations.The benchmark building had 43,186 square feet and 4 floors. Benchmark interior lighting energy = 13.79 thousand Btu/SF. Interior equipment energy consumption = 21.98 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/new_construction.html>, January 2012

3.10.7 Energy Benchmarks for Existing Small Hotels, by Selected City and End-Use (thousand Btu per square foot)

	IECC	Heating		Cooling		Water Heating		Ventilation	
	Climate Zone	Post	Pre	Post	Pre	Post	Pre	Post	Pre
Miami	1A	0.2	0.0	25.7	21.2	5.6	5.4	6.7	2.6
Houston	2A	2.8	0.7	17.7	16.1	6.7	6.5	5.6	2.0
Phoenix	2B	2.0	0.2	18.7	17.0	6.0	5.9	6.2	2.3
Atlanta	3A	5.4	1.9	12.0	11.1	7.8	7.6	5.4	1.6
Los Angeles	3B	1.7	0.0	9.5	9.7	7.6	7.4	5.2	1.4
Las Vegas	3B	3.4	0.6	13.6	13.5	6.8	6.6	5.7	1.9
San Francisco	3C	4.4	0.3	5.8	6.1	8.5	8.3	4.5	0.9
Baltimore	4A	9.2	3.7	9.6	8.8	8.6	8.4	4.9	1.3
Albuquerque	4B	5.9	1.8	8.8	8.8	8.4	8.2	5.5	1.4
Seattle	4C	7.6	2.0	4.9	5.0	9.1	8.8	4.6	0.8
Chicago	5A	13.5	5.2	7.8	6.9	9.4	9.1	4.9	1.1
Boulder	5B	9.1	3.2	6.8	6.4	9.3	9.1	5.3	1.1
Minneapolis	6A	18.3	8.8	7.4	6.5	10.0	9.7	4.8	1.1
Helena	6B	14.2	5.8	5.1	5.0	10.1	9.9	5.0	1.0
Duluth	7	22.8	11.6	4.9	4.2	11.1	10.8	4.6	0.9
Fairbanks	8	41.6	26.7	3.9	3.1	12.3	12.0	4.6	1.1

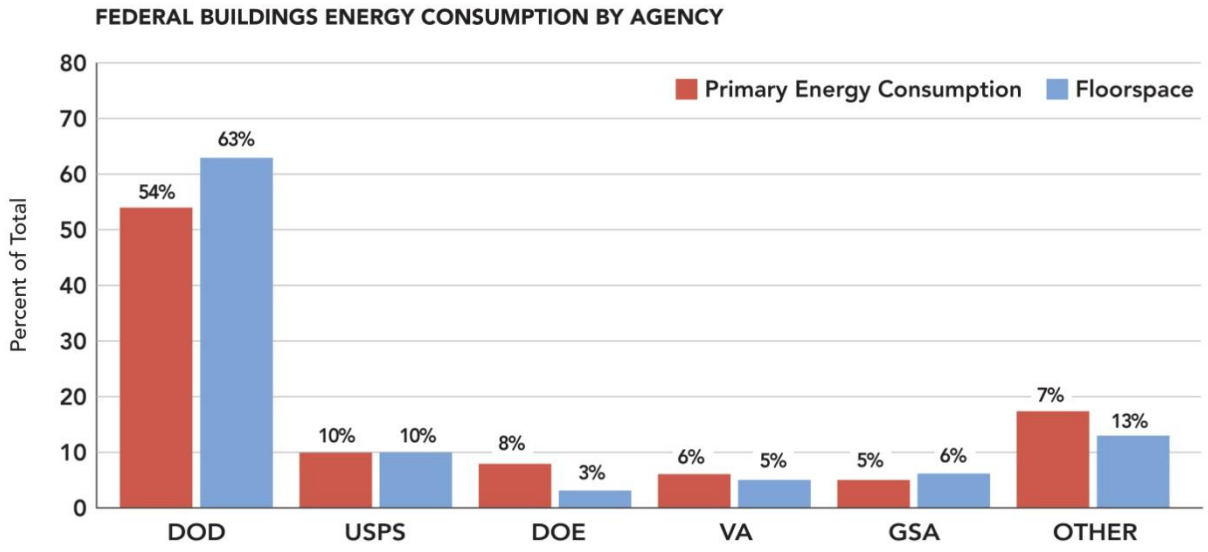
Note(s): Commercial building energy benchmarks are based off of the current stock of commercial buildings and reflect 2004 ASHRAE 90.1 Climate Zones. They are designed to provide a consistent baseline to compare building performance in energy-use simulations. 'Post' refers to buildings construction in or after 1980. 'Pre' refers to buildings construction before 1980. The benchmark building had 43,186 square feet and 4 floors. Benchmark interior lighting energy = 21.51 thousand Btu/SF. Interior equipment energy consumption = 21.98 thousand Btu/SF.

Source(s): DOE/EERE/BT, Commercial Building Benchmark Models, Version 1.3_5.0, November 2010, accessed at <http://www1.eere.energy.gov/buildings/commercial_initiative/reference_buildings.html>. Version 1.3_5.0, January 2012.

Chapter 4: Federal Sector

This chapter provides information on Federal building energy consumption, characteristics, and expenditures, as well as information on legislation affecting said consumption. The main points from this chapter are summarized below:

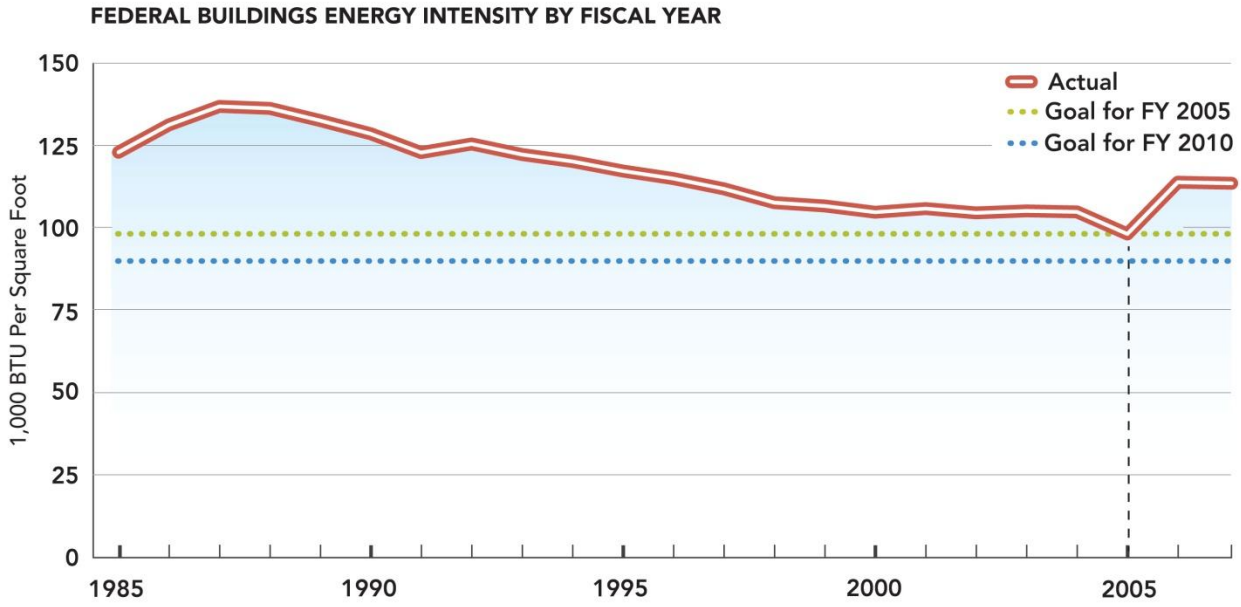
- In FY 2007, Federal buildings accounted for 2.2% of all building energy consumption and 0.9% of total U.S. energy consumption.
- Five Federal agencies were responsible for 83% of all Federal building primary energy consumption in FY 2007. The Department of Defense alone accounted for more than half of this amount.
- From 2006 to 2007, the amount of renewable energy used by Federal agencies as a percentage of total electricity used decreased from 7% to 5%.



Federal buildings consumed 0.88 quads of primary energy in fiscal year (FY) 2007, the most recent year for which comprehensive data are available. (4.1.1) This quantity represented 56% of total Federal energy consumption, 2.2% of all building energy consumption, and 0.9% of total U.S. energy consumption. Adjusting for delivery losses, site energy consumption in Federal buildings was 0.39 quads, of which 49% came from electricity. (4.1.2) Other fuels consumed included natural gas (34%), fuel oil (7%), coal (5%), and purchased steam (4%). Overall, Federal agencies spent $6.0 billion ($2010) on energy in FY 2007, a 2.4% decrease from FY 2006 spending. (4.3.1)

Five Federal agencies were responsible for 83% of all Federal building primary energy consumption in FY 2007: the Department of Defense (DOD) (54%), the U.S. Postal Service (USPS) (10%), the Department of Energy (DOE) (10%), the Department of Veterans Affairs (VA) (6%), and the General Services Administration (GSA) (5%). (4.1.2) These five agencies occupied 87% of all Federal building floor space with DOD accounting for 63% of the total, USPS 10%, GSA 6%, VA 5%, and DOE 3%. (4.2.1)

To account for changes in Federal facilities from year to year, the Federal Energy Management Program tracks reductions in energy consumption through energy intensity. Between FY 2003 and FY 2005, Federal building energy intensity fell from 105,200 Btu per square foot to 98,200 Btu per square foot, a decrease of 7%. (4.1.3) However, estimates of energy intensity after FY 2005 are not comparable with estimates before FY 2005. With the passage of the Energy Policy Act, classification of Federal buildings was revised to include energy-intensive facilities not previously considered. This resulted in a higher overall energy intensity of 113,900 Btu per square foot in FY 2006. In FY 2007, energy intensity decreased by only 0.83% compared to the previous year. (4.1.3)



4.1.1 FY 2007 Federal Primary Energy Consumption (Quadrillion Btu)

Buildings and Facilities	**0.88**
Vehicles/Equipment	0.69 (mostly jet fuel and diesel)
Total Federal Government Consumption	1.57

Source(s): DOE/FEMP, Annual Report to Congress on FEMP FY 2007, Jan. 2010, Table A-1, p. 90 for total consumption and Table A-7, p. 95 for vehicle and equipment operations.

4.1.2 FY 2007 Federal Building Energy Use Shares, by Fuel Type and Agency

Fuel Type	*Site* Percent	Primary Percent	Agency	Primary Percent		FY 2007 (10^15 Btu)
Electricity	49.4%	77.3%	DOD	53.8%	Total Delivered	
Natural Gas	33.5%	14.9%	USPS	9.8%	Energy Consumption =	0.39
Fuel Oil	7.3%	3.3%	DOE	8.2%	Total Primary	
Coal	5.2%	2.3%	VA	6.4%	Energy Consumption =	0.88
Other	4.9%	2.2%	GSA	5.1%		
Total	100%	100%	Other	16.8%		
			Total	100%		

Note(s): See Table 2.3.1 for floorspace.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP FY 2007, Jan. 2010, Table A-4, p. 93 and Table A-6, p. 94 for fuel types, and Table A-1, p. 90 and Table A-7, p. 95 for agency consumption.

4.1.3 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	123.0	FY 1997	111.9
FY 1986	131.3	FY 1998	107.7
FY 1987	136.9	FY 1999	106.7
FY 1988	136.3	FY 2000	104.8
FY 1989	132.6	FY 2001	105.9
FY 1990	128.6	FY 2002	104.6
FY 1991	122.9	FY 2003	105.2
FY 1992	125.5	FY 2004	104.9
FY 1993	122.3	FY 2005	98.2
FY 1994	120.2	FY 2006 (2)	113.9
FY 1995	117.3	FY 2007 (3)	112.9
FY 1996	115.0	FY 2015 (4)	89.5

Note(s): 1) See Table 4.3.1 for floorspace. 2) Increase due to change in categorization of Federal buildings. 3) Adjusted for renewable energy purchases and source savings. 4) Executive Order 13423 goal.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP FY 2007, Jan. 2010, Table 1, p. 13; DOE/FEMP, Annual Report to Congress on FEMP, Sept. 2006, Table A-12, p. 158 for 1985-2005 energy consumption; DOE/FEMP, Annual Report on FEMP, Jan. 2001, Table 7-A, p. 55 for 1999, Dec. 2002, Table 8-A, p. 61 for 2000, Feb. 2004, Table 8-A, p. 66 for 2001, Sep. 2004, Table 8-A, p. 65 for 2002, Aug. 2005, Table 6-A, P. A-10 for 2003, Feb. 2006, Table 6-A, p. A-10 for 2004, Sep. 2006, Table 2, p. 13 for 2005, Nov. 2008, Table 1, p. 12 for 2006 and DOE/FEMP for remaining years for floorspace.

4.1.4 Federal Agency Progress Toward the Renewable Energy Goal (Trillion Btu) (1)

	Total Renewable Energy Usage	Total Facility Electricity Use		RE as % of Electricity Use
DOD	5.6	101.2		6%
EPA	0.7	0.4	(2)	154%
DOE	0.7	16.7		4%
GSA	0.8	10.0		8%
NASA	0.2	5.5		4%
DOI	0.4	2.1		18%
Others	1.1	56.5		2%
All Agencies	**9.5**	**192.8**		**5%**

Note(s): 1) In July 2000, in accordance with Section 503 of Executive Order 13123, the Secretary of Energy approved a goal that the equivalent of 2.5 percent of electricity consumption from Federal facilities should come from new renewable energy sources by 2005. 2) EPA's renewable energy use is 154% of its electricity use due to its purchases of renewable electricity for leased space.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP FY 2007, Jan. 2010, Table 4, p. 17.

4.2.1 Federal Building Gross Floorspace, by Year and Agency

Fiscal Year	Floorspace (10^9 SF)
FY 1985	3.37
FY 1986	3.38
FY 1987	3.40
FY 1988	3.23
FY 1989	3.30
FY 1990	3.40
FY 1991	3.21
FY 1992	3.20
FY 1993	3.20
FY 1994	3.11
FY 1995	3.04
FY 1996	3.03
FY 1997	3.02
FY 1998	3.07
FY 1999	3.07
FY 2000	3.06
FY 2001	3.07
FY 2002	3.03
FY 2003	3.04
FY 2004	2.97
FY 2005	2.96
FY 2006	3.10
FY 2007	3.01

Agency	2007 Percent of Total Floorspace
DOD	63%
USPS	10%
GSA	6%
VA	5%
DOE	3%
Other	13%
Total	100%

Note(s): The Federal Government owns/operates over 500,000 buildings, including 422,000 housing structures (for the military) and 51,000 nonresidential buildings.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP FY 2007, Jan. 2010, Table 1, p. 13; DOE/FEMP, Annual Report to Congress on FEMP, Nov. 2008, Table 1, p. 12 for floorspace by agency. DOE/FEMP, Annual Report on FEMP, Jan. 2001, Table 7-A, p. 55 for 1999, Dec. 2002, Table 8-A, p. 61 for 2000, Feb. 2004, Table 8-A, p. 66 for 2001, Sep. 2004, Table 8-A, p. 65 for 2002, Aug. 2005, Table 6-A, P. A-10 for 2003, Feb. 2006, Table 6-A, p. A-10 for 2004, Sep. 2006, Table 2, p. 13 for 2005, Nov. 2008, Table 1, p. 12 for 2006 and DOE/FEMP for remaining years for floorspace by year.

4.3.1 FY 2007 Federal Buildings Energy Prices and Expenditures, by Fuel Type ($2010)

Fuel Type	Average Fuel Prices ($/million BTU)		Total Expenditures ($ million) (2)
Electricity	23.68 (1)		4,009
Natural Gas	9.37		1,138
Fuel Oil	15.25		419
Coal	3.62		63
Purchased Steam	24.30		318
LPG/Propane	17.06		44
Other	16.19		37
Average	17.05	**Total**	6,029

Note(s): Prices and expenditures are for Goal-Subject buildings. 1) $0.0776/kWh. 2) Energy used in Goal-Subject buildings in FY 2007 accounted for 33.8% of the total Federal energy bill.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP FY 2007, Jan. 2010, Table A-4, p. 93 for prices and expenditures, and Table A-9, p. 97 for total energy expenditures; EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators.

4.3.2 Annual Energy Expenditures per Gross Square Foot of Federal Floorspace Stock, by Year ($2010)

FY 1985	2.13
FY 2000	1.36
FY 2001	1.58
FY 2002	1.49
FY 2003	1.45
FY 2004	1.54
FY 2005	1.59
FY 2006	2.01 (1)
FY 2007	2.01

Note(s): Total Federal buildings and facilities energy expenditures in FY 2006 were $5.79 billion (in $2010). 1) Increase due to change in FEMP categorization of Federal buildings.

Source(s): DOE/FEMP, Annual Report to Congress on FEMP FY 2007, Jan. 2010, Table A-9, p. 97 and Table 1, p. 13; DOE/FEMP, Annual Report to Congress on FEMP, Nov. 2008, Table A-9, p. 78 for energy costs, and Table 1, p. 12 for floorspace for 2006; DOE/FEMP, Annual Report to Congress on FEMP, Sep. 2006, Table A-12, p. 158 for energy costs for 1985-2005; DOE/FEMP, Annual Report on FEMP, Dec. 2002, Table 8-A, p. 61 for 2000; Feb. 2004, Table 8-A, p. 66 for 2001; Sep. 2004, Table 8-A, p. 65 for 2002; Aug. 2005, Table 6-A, P. A-10 for 2003; Feb. 2006, Table 6-A, p. A-10 for 2004; EIA, Annual Energy Review 2009, August 2010, Appendix D, p. 383 for price deflators

4.3.3 Direct Appropriations on Federal Buildings Energy Conservation Retrofits and Capital Equipment ($2010 Million)

FY 1985	522,821	FY 1991	169,061	FY 1997	261,324	FY 2003	201,156
FY 1986	342,653	FY 1992	209,973	FY 1998	340,074	FY 2004	198,588
FY 1987	98,708	FY 1993	170,826	FY 1999	261,784	FY 2005	321,686
FY 1988	108,705	FY 1994	318,739	FY 2000	150,900	FY 2006	301,222
FY 1989	83,340	FY 1995	438,943	FY 2001	162,488	FY 2007	349,350
FY 1990	102,135	FY 1996	238,232	FY 2002	147,895		

Source(s): DOE/FEMP, Annual Report to Congress on FEMP FY 2007, Jan. 2010, Table 11-B, p. 31; DOE/FEMP, Annual Report to Congress on FEMP, Nov. 2007, Table 9-B, p. 26 for 1985, 1990, 1995, 2000-2006. DOE/FEMP, Annual Report to Congress on FEMP, Sep. 2004, Table 4-B, p. 38 for 1986-1989, 1991-1994, 1996-1999. EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators.

4.4.1 Energy Policy Act of 2005, Provisions Affecting Energy Consumption in Federal Buildings

Energy Management Requirements - Amended reduction goals set by the National Energy Conservation Policy Act, and requires increasing percentage reductions in energy consumption through FY 2015, with a final energy consumption reduction goal of 20 percent savings in FY 2015, as compared to the baseline energy consumption of Federal buildings in FY 2003. (These goals were superseded by Section 431 of the Energy Independence and Security Act of 2007.) [Section 102]

Energy Use Measurement and Accountability - Requires that all Federal buildings be metered to measure electricity use by 2012. [Section 103]

Procurement of Energy Efficient Products - Requires all Federal agencies to procure ENERGY STAR qualified products, for product categories covered by the ENERGY STAR program, or FEMP designated products, unless such products are not available, or if such products are not cost-effective. [Section 104]

Federal Building Performance Standards - Requires that new Federal buildings be designed to achieve savings of at least 30% below ASHRAE Standard 90.1-2004 or 2004 IECC if cost-effective. [Section 109]

Federal Renewable Energy Purchase Requirement - Requires that the Federal government obtain at least 3 percent of electrical energy consumed in FY 2007, 2008 and 2009 from renewable energy sources. This requirement increases to 5 percent in FY 2010, 2011, and 2012, and to 7.5 percent for FY 2013 and all fiscal years after.

Source(s): Energy Policy Act of 2005, Enacted August 8, 2005

4.4.2 Executive Order 13423, Provisions Affecting Energy Consumption in Federal Buildings

-- Requires Federal agencies to improve energy efficiency and reduce greenhouse gas emissions by either 3 percent annual reductions through FY 2015, or by 30 percent by 2015, as compared to FY 2003.

-- Requires Federal agencies to obtain at least half of required renewable energy from new renewable sources.

Source(s): Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management, Issued January 24, 2007

4.4.3 Energy Independence and Security Act of 2007, Provisions Affecting Energy Consumption in Federal Buildings

Energy Reduction Goals for Federal Buildings - Amended reduction goals set by the National Energy Conservation Policy Act, and requires increasing percentage reductions in energy consumption through FY 2015, with a final energy consumption reduction goal of 30 percent savings in FY 2015, as compared to the baseline energy consumption of Federal buildings in FY 2003. The goals specified in Section 431 of EISA 2007 supersede those from Section 102 of EPACT 2005. [Section 431]

Management of Energy and Water Efficiency in Federal Buildings - Requires each Federal agency to designate an energy manager, requires that energy manager to evaluate all facilities of that agency for energy and water saving measures once every four years, and requires agencies. Authorizes the Office of Management and Budget to evaluate progress by each agency on energy and water savings measures through semiannual scorecards. [Section 432]

Federal Building Energy Efficiency Performance Standards - Requires that new Federal buildings built after 2010, and Federal building undergoing major renovations after 2010, be designed to reduce fossil fuel consumption, as compared to FY 2003. This reduction requirement increases each 5 years. [Section 433]

Management of Federal Building Efficiency - Requires that Federal agencies select the most energy-efficient designs, systems, equipment, and controls that are life-cycle cost effective, when performing any replacement of installed equipment within a Federal building. [Section 434]

Leasing - Requires that Federal agencies lease space in buildings that have earned the ENERGY STAR label in the most recent year, unless no available space exists. [Section 435]

High Performance Green Federal Buildings - Establishes the Office of Federal High-Performance Green Buildings within the General Services Administration. This office is authorized to coordinate all efforts related to green practices within Federal buildings. [Section 436]

Standard Relating to Solar Hot Water - Requires new Federal buildings, or Federal buildings undergoing major renovations, to meet at least 30 percent of hot water demand through the use of solar hot water heaters, if cost-effective. [Section 523]

Federally-Procured Appliances with Standby Power - Requires all Federal agencies to procure appliances with standby power consumption of less than 1 watt, if available and cost-effective. [Section 524]

Source(s): Energy Independence and Security Act of 2007, Enacted December 19, 2007

Chapter 5: Building Envelope & Equipment

Chapter 5 contains market and technology data on building materials and equipment. Sections 5.1 and 5.2 cover the building envelope, including building assemblies, insulation, windows, and roofing. Sections 5.3 through 5.7 cover equipment used in buildings, including space heating, water heating, space cooling, lighting, thermal distribution (ventilation and hydronics), and appliances. Sections 5.8 and 5.9 focus on energy production from on-site power equipment. The main points from this chapter are summarized below:

- In 2010, shipments of heat pumps and furnaces increased 3% and 12%, respectively, compared to the previous year, reversing a five-year downward trend. (5.3.1).
- New solar photovoltaic capacity in 2010 doubled from the previous year, resulting in cumulative capacity of 2150 MW in the U.S. (5.8.8)
- Residential window sales for new construction dropped 66% from 34.1 million units in 2005 to just 11.4 million units in 2009. (5.2.1) In commercial buildings, low-e glass continued to take market share from clear and tinted glass. (5.2.7)

From 1990 to 2009, the window industry saw major shifts in glazing and framing materials. In the residential market, vinyl frames took a quarter of the market from wood frames, while double-pane sealed insulated glass units took market share from single-pane and unsealed double-pane windows. (5.2.1, 5.2.4, 5.2.5) In the commercial market, tinted and reflective glazing, which together accounted for 47% of the market in 1995, accounted for only 13% in 2009. Low-e coatings increased their share from 17% to 54%, and clear glazing held on to about one-third of the market. (5.2.7)

In the residential HVAC market, heat pumps have been increasing in popularity relative to furnaces, the most commonly purchased type of heating equipment. In 1990, manufacturers shipped only one-third as many heat pumps as furnaces. By 2010, that proportion had increased to nearly three-quarters. (5.3.1)

Seven companies manufactured most of the furnaces, heat pumps, and central air conditioners shipped in 2008 for installation in the United States. UTC/Carrier held the largest market share (32% of gas furnaces and 27% of heat pumps and central air conditioners). (5.3.6, 5.3.7) This equipment was, on the whole, more efficient than the equipment sold in previous years. (5.3.2, 5.3.4) However, the efficiency of the installed base lags behind the efficiency of new equipment due to long service lifetimes, which in the residential sector average between 11 and 20 years, depending on equipment type. (5.3.4, 5.3.8)

In 2005, 52% of households mainly used natural gas to heat their homes. The proportion of households using natural gas changed little over the previous 20 years, while the proportion using electricity increased from 20% to 30%, and the proportion using fuel oil decreased from 12% to 7%. Ten percent of households used other fuels, such as wood and propane. (5.3.11) The proportions were similar for water heating in 2005: 53% used natural gas to heat water, 39% used electricity, and the remainder used other fuels. (5.4.1)

Virtually all U.S. households own a refrigerator and a range or cooktop. Nine out of ten have a microwave oven, four out of ten have a standalone freezer, and three out of ten have one or more room air conditioners. (5.7.3) An estimated 65 million major appliances, including refrigerators,

microwaves, ranges, clothes washers and dryers, water heaters, and room air-conditioners were replaced in 2011. (5.7.15)

In 2008, just three companies—A.O. Smith, Rheem Manufacturing, and Bradford-White—manufactured 96% of the water heaters shipped. (5.4.3) Three manufacturers—GE, Electrolux, and Whirlpool—controlled 83% of the refrigerator market and 84% of the range market. (5.7.4, 5.7.10) Whirlpool manufactured nearly two-thirds of the clothes washers and more than two-thirds of the clothes dryers sold in 2008 (5.7.8, 5.7.9). The Korean manufacturer LG Electronics led the room air conditioner and microwave markets, holding one-third of the market of each. (5.7.6, 5.7.11)

A growing number of consumers in the buildings sector generate electricity on site. Excess generation can often be sold back to the grid during times of peak demand. Solar and wind are particularly well suited for this application because they are intermittent, though non-renewable sources are also common. Of the latter, 4,355 MW of combined heat and power capacity were installed by 2011, mostly in colleges and universities (63%) and hospitals (17%). (5.9.3)

Solar power technology consists of solar thermal collectors, which convert solar radiation into thermal energy, and solar PV cells, which convert solar radiation to electric energy. Nearly 14 million square feet of solar thermal collectors were sold domestically in 2009, a 19% drop from 2008 sales. Most of the solar collectors were sold to Florida (27%) and California (26). (5.8.1, 5.8.3) The majority of solar thermal collectors were used for pool heating (71%) and hot water (14%). (5.8.2) The peak capacity of domestic PV sales in 2009 reached more than 600 MW, 84% of which was used in the buildings sector. (5.8.5)

Grid-tied solar PV capacity more than tripled between 2007 and 2010, reaching a total of 2167 MW. Almost 47% of this capacity was located in California. (5.8.9) Small-scale wind power—installations with no more than 100 kW of capacity—also continued to grow. Another 5.2 MW of small wind capacity was added in 2010, bringing the total capacity to 25.6 MW. (5.9.1)

5.1.1 U.S. Insulation Demand, by Type (Million Pounds) (1)

Insulation Type	1992		2001		2006 (1)	
Fiberglass	2,938	55%	3,760	54%	4,085	53%
Foamed Plastic	1,223	23%	1,775	25%	1,955	26%
Cellulose	485	9%	665	9%	730	10%
Mineral Wool	402	8%	445	6%	480	6%
Other	309	6%	370	5%	395	5%
Total	**5,357**	100%	**7,015**	100%	**7,645**	100%

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

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

	1997	1999	2001	2003	2004	2005
Insulating Buildings (2)	70%	71%	72%	65%	64%	63%
Industrial, Equipment, and Appliance Insulation	27%	26%	25%	28%	30%	31%
Unknown	3%	3%	3%	7%	6%	5%
Total	100%	100%	100%	100%	100%	100%

Note(s): 1) Based on value of shipments. 2) Including industrial.
Source(s): DOC, Annual Survey of Manufacturers: Value of Product Shipments 2005, Nov. 2006, Table 1, p. 54 for 2003-2005; and DOC, 2001 Annual Survey of Manufacturers: Value of Product Shipments, Dec. 2002, p. 65 for 1997-2001.

5.1.3 Thermal Performance of Insulation

	R-Value per Inch (1)			R-Value per Inch (1)
Fiberglass (2)			Perlite/Vermiculite	
Batts	3.1 - 4.3	(3)	Loose-Fill	2.1 - 3.7
Loose-Fill	2.5 - 3.7		Foam Boards	
Spray-Applied	3.7 - 3.9		Expanded Polystyrene	3.9 - 4.4
Rock Wool (2)			Polyisocyanurate/Polyurethane	5.6 - 7.0
Loose-Fill	2.5 - 3.7		Phenolic	4.4 - 8.2
Cellulose			Reflective Insulation	2 - 17
Loose-Fill	3.1 - 3.7		Vacuum Powder Insulation	25 - 30
Spray-Applied	2.9 - 3.5		Vacuum Insulation Panel	20 - 100

Note(s): 1) Hr-SF-F/Btu-in. Does not include the effects of aging and settling. 2) Mineral fiber. 3) System R-Value depends on heat-flow direction and number of air spaces.
Source(s): ASHRAE, 1997 ASHRAE Handbook: Fundamentals, p. 24-4, 22-5; DOE, Insulation Fact Sheet, Jan. 1988, p. 6; Journal of Thermal Insulation, 1987, p. 81-95; ORNL, ORNL/SUB/88-SA835/1, 1990; ORNL, Science and Technology for a Sustainable Energy Future, Mar. 1995, p. 17; and ORNL for vacuum insulation panel.

5.1.4 "Green Roofs" Completed by Year (Thousand SF)

North America

	Extensive	Intensive	Mixed	**Total**
2004	917	406	4.9	1,327
2005	1,785	488	198.7	2,472
2006	1,957	1,033	73.8	3,064
2007	-	-	-	2,408
2008	-	-	-	3,182
2009	-	-	-	-
2010	3,109	172	312	4,341

United States

	Extensive	Intensive	Mixed	**Total**
2004	777.1	405.8	3.924	1,187
2005	1,570	476.4	102.9	2,150
2006	-	-	-	-
2007	-	-	-	1,953
2008	-	-	-	2,647

Note(s): 1) Extensive: soil depth of less than 6 inches. 2) Intensive: soil depth greater than 6 inches. 3) Mixed: at least 25% break up between extensive and intensive. 4) These data are best used as a gauge of activity in this market rather than actual amount of green roofs.

Source(s): Green Roof Industry Survey, Green Roof Infrastructure Monitor

5.1.5 Properties of Cool Roofing Materials (1)

	Solar Reflectance (2)	Infrared Emittance (3)
Asphalt Shingles		
Shasta White	0.26	0.91
Generic White	0.25	0.91
Generic Grey	0.22	0.91
Light Brown	0.19	0.91
Medium Brown	0.12	0.91
Generic Black	0.05	0.91
White Coatings		
White Coating (1 coat, 8 mil)	0.80	0.91
White Coating (2 coats, 20 mil)	0.85	0.91
Aluminum Coatings		
Aluminum	0.61	0.25
Fibered on Black	0.40	0.56
Membranes		
Gray EPDM (4)	0.23	0.87
White EPDM (4)	0.69	0.87
T-EPDM (4)	0.81	0.92
Light Gravel on Built-Up Roof	0.34	0.90
Metal Roof		
New, Bare Galvanized Steel	0.61	0.04
Tiles		
Red Clay	0.33	0.90
White Concrete	0.73	0.90
Fiber Cement, Pewter Gray	0.25	0.90

Note(s): 1) A good cool-roofing material has high solar reflectance and high infrared emittance. 2) Solar Relectance is the percentage of incident solar radiation that is reflected by the material. 3) A number between 0 and 1 that describes the ability of a material to shed heat. The lower the value, the more heat the material retains. 4) Ethylene propylene diene monomer rubber material.

Source(s): Lawernce Berkley National Laboratory, Cool Roofing Materials Database, http://eetd.lbl.gov/coolroofs/.

5.1.6 ENERGY STAR Cool Roofing Product Shipments (Billion SF) and Penetration Rate

	Commercial Roofing	Residential Roofing	Total	ENERGY STAR Penetration
1999	0.0	0.1	0.1	0.5%
2000	0.0	0.1	0.1	0.4%
2001	0.0	0.1	0.1	0.3%
2002	4.4	0.0	4.5	23.6%
2003	1.0	0.1	1.0	5.4%
2004	1.2	0.3	1.4	7.4%
2005	3.5	0.2	3.7	18.7%
2006	4.1	0.5	4.5	22.5%

Note(s): N/A: Year is before date of ENERGY STAR specification.

Source(s): LBNL, Climate Change Action Plan spreadsheet (updated 2007).

5.2.1 Residential Prime Window Sales, by Frame Type (Million Units) (1)

	Aluminum (2)	Wood (3)	Vinyl	Other	**Total (4)**
New Construction					
1990	5.9	9.4	1.2	0.1	**16.6**
1995	4.7	11.6	4.8	0.3	**21.4**
2000	3.7	12.8	9.0	0.4	**25.8**
2005	6.5	9.2	17.4	1.0	**34.1**
2007	4.4	6.2	13.2	1.0	**24.8**
2009	1.9	2.5	6.3	0.7	**11.4**
Remodeling/Replacement					
1990	3.6	7.6	7.1	0.1	**18.4**
1995	3.9	9.4	9.6	0.2	**23.1**
2000	4.0	10.2	14.8	0.2	**29.2**
2005	2.4	10.0	23.2	0.9	**36.4**
2007	1.9	8.9	22.5	1.0	**34.3**
2009	1.0	6.1	19.1	1.3	**27.5**
Total Construction					
1990	9.5	17.0	8.3	0.2	**35.0**
1995	8.6	21.0	14.4	0.5	**44.5**
2000	7.7	23.0	23.8	0.6	**55.0**
2005	8.9	19.2	40.6	1.9	**70.5**
2007	6.3	15.1	35.7	2.0	**59.1**
2009	2.9	8.6	25.5	1.9	**38.9**

Note(s): 1) Average window life span is 35-45 years. 2) In 1993, 65% of aluminum-framed windows were thermally broken. 3) Includes vinyl-clad and metal-clad units. 4) Due to rounding, sums may not add up to totals.

Source(s): AAMA, Industry Statistical Review and Forecast 1992, 1993 for Note 2; AAMA/NWWDA, Industry Statistical Review and Forecast 1996, 1997, Table 6, p. 6 for 1990; AAMA/WDMA, 2000 AAMA/WDMA Industry Statistical Review and Forecast, Feb. 2001, p. 6 for 1995; 2003 AAMA/WDMA Industry Statistical Review and Forecast, June 2004, p. 6 for 2000 and 2003; and LBNL, Savings from Energy Efficient Windows, Apr. 1993, p. 6 for window life span; AAMA/WDMA, Study of U.S. Market For Windows, Doors, and Skylights, Apr. 2006, p. 41 for 2005; AAMA/WDMA, U.S. Industry Statistical Review and Forecast, Mar. 2008, p. 6 for 2007; AAMA/WDMA, U.S. Industry Statistical Review and Forecast, May 2010, p. 6 for 2009.

5.2.2 Residential Storm Window and Door Shipments, by Frame Type (Million Units)

	Windows				Doors				Total			
Type	1990	2000	2005	2008	1990	2000	2005	2008	1990	2000	2005	2008
Aluminum	10	8	7	N/A	2	4	4	3	12	12	11	N/A
Wood	0	0	0	N/A	0	0	0	0	0	0	0	N/A
Other (1)	1	2	2	N/A	0	1	2	1	1	4	4	N/A
Total (2)	**11**	**11**	**9**	**N/A**	**2**	**6**	**6**	**4**	**13**	**16**	**15**	**N/A**

Note(s): 1) Other includes metal over wood/foam core or vinyl, etc. 2) Due to rounding, sums may not add up to totals.

Source(s): AAMA/NWWDA, Industry Statistical Review and Forecast 1996, 1997, Table 7, p. 7 for 1990; 2003 AAMA/WDMA Industry Statistical Review and Forecast, June 2004, p. 6 for 2000; AAMA/WDMA, Study of U.S. Market for Windows, Doors, and Skylights, Apr. 2006, p. 101, Exhibit G.2 for 2005; AAMA/WDMA, U.S. Industry Statistical Review and Forecast, May 2010, p. 7 for 2008.

5.2.3 Nonresidential Window Sales, by Type and Census Region (Million Square Feet of Vision Area) (1)

	Northeast		Midwest		South		West		Total	
Type	1995	2009	1995	2009	1995	2009	1995	2009	1995	2009
New Construction										
Commercial Windows (2)	4	15	16	22	21	58	13	25	54	120
Curtain Wall	3	10	6	16	16	41	8	18	33	84
Store Front	7	10	11	16	14	41	11	18	43	85
Total (3)	**14**	**36**	**33**	**53**	**51**	**140**	**32**	**60**	**130**	**289**
Remodeling/Replacement										
Commercial Windows (2)	18	12	25	17	46	45	27	19	116	93
Curtain Wall	4	2	6	3	8	7	10	3	28	15
Store Front	12	5	18	8	24	20	22	9	76	41
Total (3)	**34**	**18**	**49**	**27**	**78**	**72**	**59**	**31**	**220**	**148**
Total										
Commercial Windows (2)	22	27	41	40	67	103	40	45	170	213
Curtain Wall	7	12	12	18	24	48	18	21	61	99
Store Front	19	15	29	23	38	61	33	26	119	125
Total (3)	**48**	**54**	**82**	**80**	**129**	**211**	**91**	**91**	**350**	**437**

Note(s): 1) Usage is a good indication of sales. 2) Formerly referred to as Architectural. Includes both shop-fabricated (true architectural) and site-fabricated products. 3) Due to rounding, sums may not add up to totals.

Source(s): AAMA/Ducker Research, Industry Statistical Review and Forecast 1996, Mar. 1997, p. 17 for 1995; AAMA/WDMA, U.S. Industry Statistical Review and Forecast, May 2010, p. 17 for 2009.

5.2.4 Insulating Glass Historical Penetration, by Sector (Percent of New Sales) (1)

Sector	1985	1990	1995	2000	2005	2009
Residential	73%	86%	89%	92%	94%	95%
Nonresidential	63%	80%	84%	86%	88%	89%

Note(s): 1) Usage is a good indication of sales. Includes double- and triple-pane sealed units.

Source(s): Ducker Research, Industry Statistical Review and Forecast 1992-1993 for 1985; AAMA/Ducker Research, Industry Statistical Review and Forecast 1993 for 1990; AAMA/WDMA, 2000 AAMA/WDMA Industry Statistical Review and Forecast, Feb. 2001, p. 12 for 1995; AAMA/WDMA, 2003 AAMA/WDMA Industry Statistical Review and Forecast, June 2004, p.12 for 2000; AAMA/WDMA, U.S. Industry Statistical Review and Forecast, May 2010, p. 12 for 2005 and 2009.

5.2.5 Residential Prime Window Sales, by Glass Type (Million Units)

	Single Pane		Double Pane Sealed IG (1)		Other		Total	
1980	8.6	34%	0.0	0%	16.6	66%	25.2	100%
1990	4.9	14%	12.0	34%	18.7	53%	35.6	100%
1993	2.8	14%	17.2	84%	0.4	2%	20.4	100%
1995	5.5	12%	37.8	85%	1.3	3%	44.5	100%
1999	4.8	8%	55.2	89%	2.0	3%	62.0	100%
2001	3.9	7%	50.9	90%	1.5	3%	56.3	100%
2003	4.7	7%	55.9	89%	2.2	4%	62.8	100%
2005	4.2	6%	63.8	91%	2.5	3%	70.5	100%
2007	2.7	5%	55.0	93%	1.4	2%	59.1	100%
2009	1.6	4%	36.2	93%	1.2	3%	38.9	100%

Note(s): 1) IG = insulated glazing.

Source(s): AAMA/NWWDA, Study of the U.S. Market for Windows and Doors, 1996, Table 22, p.49; AAMA/WDMA, Study of U.S. and Canadian Market for Windows and Doors, Apr. 2000, Exhibit E.7, p. 55; AAMA/WDMA, Study of the Market for U.S. Doors, Windows and Skylights, Apr. 2004, Exhibit D.4, p. 46; AAMA/WDMA, Study of U.S. Market for Windows, Doors, and Skylights, Apr. 2006, Exhibit D.8 Conventional Window Glass Usage, p. 50; AAMA/WDMA, Study of U.S. Market For Windows, Doors, and Skylights, Mar. 2008, Exhibit D.8 Conventional Window Glass Usage, p. 49; AAMA/WDMA/Ducker, Study of the U.S. Market For Windows, Doors, and Skylights, Executive Report, May 2010, Exhibit D.8 Conventional Residential Window Glass Usage, p. 52.

5.2.6 2005 Residential Prime Window Stock (Million Households)

Census Division	Single Pane	Double Pane			Total Households (1)
		Without Low-e	With Low-e	Total	
New England	2.1	2.8	0.4	3.2	5.3
Middle Atlantic	4.7	9.4	0.9	10.3	15.0
East North Central	5.6	9.7	2.0	11.7	17.3
West North Central	2.9	3.9	0.9	4.8	7.7
South Atlantic	12.3	7.9	1.1	9.0	21.3
East South Central	3.4	3.1	0.3	3.4	6.8
West South Central	8.0	3.8	0.3	4.1	12.1
Mountain	2.8	3.6	0.9	4.5	7.3
Pacific	8.9	6.4	1.1	7.5	16.4
United States	**50.7**	**50.6**	**7.9**	**58.5**	**109.2**
Selected States					
New York	2.2	4.2	0.6	4.8	7.0
Florida	5.4	1.3	N.A.	1.3	6.7
Texas	5.1	2.5	N.A.	2.5	7.6
California	7.6	3.7	0.7	4.4	12.0

Note(s): 1) Respondents were shown pictures of different types of window glass and were asked "Which picture best describes the type of glass in the windows of your home/apartment?" 2) An additional 1.3 million households not counted here use other types of windows such as triple-pane

Source(s): EIA, 2005 Residential Energy Consumption Survey, Tables HC 11.5, HC 12.5, HC 13.5, HC 14.5, and HC 15.5, April 2008.

5.2.7 Nonresidential Window Stock and Sales, by Glass Type

Type	Existing U.S. Stock (% of buildings)	Vision Area of New Windows (Million Square Feet)					
		1995	2001	2003	2005	2007	2009
Single Pane	53%	56	57	48	56	60	48
Insulating Glass (1)	47%	294	415	373	407	476	389
Total	100%	**350**	**472**	**421**	**463**	**536**	**437**
Clear	65%	36%	49%	43%	44%	38%	33%
Tinted	28%	40%	24%	17%	15%	11%	10%
Reflective	7%	7%	8%	6%	4%	3%	3%
Low-e	(2)	17%	19%	34%	37%	48%	54%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Note(s): 1) Includes double- and triple-pane sealed units and stock glazing with storm windows. 2) Included as part of the Tinted category.

Source(s): EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, June 2006, Table B1 for stock data; AAMA/NWWDA, 1996 Study of the U.S. Market for Windows and Doors, Table 27, p. 60 for 1995 usage values; 2003 AAMA/WDMA Study of the U.S. Market for Windows, Doors and Skylights, Exhibits D.31 and D.32 for 2001; AAMA/WDMA/Ducker, Study of U.S. Market For Windows, Doors, and Skylights, Apr. 2006, Exhibit D.31 and Exhibit D.32, p. 73 for 2003 and 2005.; AAMA/WDMA/Ducker, Study of U.S. Market For Windows, Doors, and Skylights, Mar. 2008, Exhibit D.31 and Exhibit D.32, p. 72 for 2007; AAMA/WDMA/Ducker, Study of U.S. Market For Windows, Doors, and Skylights, May 2010, Exhibit D.31 and Exhibit D.32, p. 75 for 2009.

5.2.8 Typical Thermal Performance of Residential Windows, by Type

	U-Factor	Solar Heat Gain Coefficient	Visual Transmittance
Single-Glazed Clear	0.84-1.16	0.64-0.76	0.65-0.75
Single-Glazed with Bronze Tint	0.84-1.16	0.54-0.65	0.49-0.56
Double-Glazed Clear	0.44-0.76	0.56-0.68	0.59-0.68
Double-Glazed with grey/Bronze Tint	0.44-0.76	0.47-0.56	0.44-0.51
Double-Glazed with High Performance Tint	0.44-0.76	0.39-0.47	0.50-0.57
Double-Glazed with High-Solar Gain Low-e Glass, Argon/Krypton Gas	0.29-0.61	0.53-0.64	0.54-0.62
Double-Glazed with Moderate-Solar Gain Low-e Glass, Argon/Krypton Gas	0.27-0.60	0.44-0.53	0.55-0.65
Double-Glazed with Low-Solar Gain Low-e (1) Glass, Argon/Krypton Gas	0.26-0.59	0.30-0.37	0.51-0.59
Triple-Glazed (2) with High-Solar Gain Low-e Glass, Argon/Krypton Gas (3)	0.15	0.51	0.65
Triple-Glazed (2) with Low-Solar Gain Low-e (1) Glass, Argon/Krypton Gas (3)	0.14	0.33	0.56

Note(s): 1) Spectrally selective. 2) Includes double glazing with suspended film. 3) Center of glass properties, does not include frame or installation
Source(s): The Efficient Windows Collaborative (http://www.efficientwindows.org)

5.3.1 U.S. Heating and Air-Conditioning System Manufacturer Shipments, by Type (Including Exports)

Equipment Type	2000 (1,000s)	2005 (1,000s)	2007 (1,000s)	2009 (1,000s)	2010 (1,000s)	2005 Value of Shipments ($million) (7)
Air-Conditioners (1)	**5,346**	**6,472**	**4,508**	**3,516**	**3419**	**5,837**
Heat Pumps	**1,539**	**2,336**	**1,899**	**1,642**	**1,748**	**2,226**
Air-to-Air Heat Pumps	1,339	2,114	1,899	1,642	1748	1,869
Water-Source Heat Pumps (2)	200	222	N.A.	N.A.	N.A.	357
Chillers	**38**	**37**	**37**	**25**	**29**	**1,093**
Reciprocating	25	24	30	20	24	462
Centrifugal/Screw	8	6	7	5	5	566
Absorption (3)	5	7	N.A.	N.A.	N.A.	64
Furnaces	**3,681**	**3,624**	**2,866**	**2,231**	**2,509**	**2,144**
Gas-Fired (4)	3,104	3,512	2,782	2,175	2453	2,081
Electric	455	N.A.	N.A.	N.A.	N.A.	N.A.
Oil-Fired (5)	121	111	84	56	56	63
Boilers (6)	**368**	**370**	**N.A.**	**N.A.**	**N.A.**	**N.A.**

Note(s): 1) Includes exports and gas air conditioners (gas units <10,000 units/yr) and rooftop equipment. Excludes heat pumps, packaged terminal air conditioner units, and room air conditioners. Approximately 95% of unitary air conditioners shipped are 5.5 tons or less (65,000 Btu/hr). ~70% residential and ~30% commercial applications. 2) Includes ground-source heat pumps, which numbered around 80,600 units shipped in 2005. 3) DOC did not report absorption chiller shipments for 2007, 2009, and 2010. 4) Gas-fired furnace value of shipments are based on Census unit shipment data, which is about 873,500 units higher than the industry data shown. 5) Oil-fired furnace value of shipments are based on Census unit shipment data, which is approximately 33,600 units lower than the industry data shown. 6) 61% of shipments were gas-fired and 39% were oil-fired. 96% of shipments are cast iron and 4% are steel. 7) Total 2005 value of shipments for heating, ventilation, and air conditioning (HVAC) and refrigeration was $24.7 billion, including industrial and excluding boilers and electric furnaces.

Source(s): ARI, Statistical Profile, Oct. 7, 2004, Table 17, p. 24, Table 18, p. 25, and Table 22, p. 30 for air conditioner, air-to-air heat pump, and 1990 centrifugal/screw chiller shipments; AHRI, ARI Koldfax, Feb. 2005, p. 1 for 2004 air conditioner shipments; GAMA, GAMA Statistical Highlights: Ten Year Summary, 1987-1996; GAMA, GAMA Statistical Highlights: Ten Year Summary, 1994-2000 for furnace and boiler shipments; GAMA, GAMA News Release, Jan. 2005 for 2004 boiler shipments; GAMA, Statistical Highlights, Mar. 2005, p. 4 for 2004 furnace shipments; Appliance Manufacturer, Feb. 1998 for electric furnace; DOC, Current Industrial Reports: Refrigeration, Air Conditioning and Warm Air Heating Equipment, MA333M(06)-1, July 2007, Table 2, for water-source heat pumps, chillers, and value of shipments; Appliance Magazine Appliance Statistical Review, 54th Annual Report, May 2007, p. S1 - S4 for 2005 boiler data; AHRI, "Historical Statistical Data: Central Air Conditioners and Air-Source Heat Pumps," 2010, accessed March 15, 2011 at <http://www.ahrinet.org/historical+data.aspx> for 2007, 2009, and 2010 A/C and heat pump shipments; AHRI, "Historical Statistical Data: Furnaces," 2010, accessed March 15, 2011 at <http://www.ahrinet.org/historical+data.aspx> for 2007, 2009 and 2010 furnace shipments; DOC, Current Industrial Reports, MA333M - Refrigeration, Air Conditioning, and Warm Air Heating Equipment, 2008 Annual report for 2007 and 2010 Annual report for 2009 and 2010 shipments of chillers; and GAMA News Release, Jan. 2007 for note 6.

5.3.2 Residential Furnace Efficiencies (Percent of Units Shipped) (1)

Gas-Fired			
AFUE Range	1985	AFUE Range	2006
Below 65%	15%	75% to 88%	64%
65% to 71%	44%	88% or More	36%
71% to 80%	10%	Total	100%
80% to 86%	19%		
More than 86%	12%		
Total	100%		

Oil-Fired	
AFUE Range	1985
Below 75%	10%
75% to 80%	56%
More Than 80%	35%
Total	100%

Average shipped in 1985 (2):	74% AFUE
Average shipped in 1995:	84% AFUE
Best Available in 1981:	85% AFUE
Best Available in 2007:	97% AFUE

Average shipped in 1985 (2):	79% AFUE
Average shipped in 1995:	81% AFUE
Best Available in 1981:	85% AFUE
Best Available in 2007:	95% AFUE

Note(s): 1) Federal appliance standards effective Jan. 1, 1992, require a minimum of 78% AFUE for furnaces. 3) Includes boilers.

Source(s): GAMA's Internet Home Page for 2006 AFUE ranges; GAMA News, Feb. 24, 1987, for 1985 AFUE ranges; LBNL for average shipped AFUE; GAMA, Consumer's Directory of Certified Efficiency Ratings, May 2004, p. 12 and 72-73 for 2004 best-available AFUEs; GAMA Consumer's Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment, May 2007; GAMA Tax Credit Eligible Equipment: Gas- and Oil-Fired Furnaces 95% AFUE or Greater, May 2007; and GAMA AFUE press release 2006: U.S. shipments of gas warm-air central furnaces.

5.3.3 Residential Boiler Efficiencies (1)

Gas-Fired Boilers	
Average shipped in 1985 (2):	74% AFUE
Best Available in 1981:	81% AFUE
Best Available in 2007:	96% AFUE

Oil-Fired Boilers	
Average shipped in 1985 (2):	79% AFUE
Best Available in 1981:	86% AFUE
Best Available in 2007:	89% AFUE

Note(s): 1) Federal appliance standards effective Jan. 1, 1992, require a minimum of 80% AFUE (except gas-fired steam boiler, which must have a 75% AFUE or higher). 2) Includes furnaces.

Source(s): GAMA, Consumer's Directory of Certified Efficiency Ratings for Residential Heating and Water Heating Equipment, Aug. 2005, p. 88 and 106 for best-available AFUE; and GAMA for 1985 average AFUEs; GAMA Tax Credit Eligible Equipment: Gas- and Oil-Fired Boilers 95% AFUE or Greater, May 2007; and GAMA Consumer's Directory of Certified Efficiency Ratings for Heating and Water Heating Equipment, May 2007.

5.3.4 Residential Air Conditioner and Heat Pump Cooling Efficiencies

Equipment Type	Efficiency Parameter	2005 Stock Efficiency	2007 U.S. Average New Efficiency	2007 Best-Available New Efficiency
Air Conditioners	SEER	10.2	13.0	21.0
Heat Pump - Cooling				
Air-Source	SEER	10.0	13.0	17.0
Ground-Source	EER	13.8	16.0	30.0
Heat Pump - Heating				
Air-Source	HSPF	6.8	7.7	10.6
Ground-Source	COP	3.4	3.4	5.0

Source(s): EIA/Navigant Consulting, EIA - Technology Forecast Updates - Residential and Commercial Buildings Technologies Reference Case, Second Edition (Revised), Sept. 2007, p. 26-31.

5.3.5 Commercial Equipment Efficiencies

Equipment Type	Efficiency Parameter	2007 Stock Efficiency	2010 U.S. Average New Efficiency	2010 Best-Available New Efficiency
Chiller				
Screw	COP(full-load / IPLV)	2.80 / 3.05	2.80 / 3.05	3.02 / 4.45
Scroll	COP	2.80 / 3.06	2.96 / 4.40	N.A.
Reciprocating	COP(full-load / IPLV)	2.80 / 3.05	2.80 / 3.05	3.52 / 4.40
Centrifugal	COP(full-load / IPLV)	5.0 / 5.2	6.1 / 6.4	7.3 / 9.0
Gas-Fired Absorption	COP	1.0	1.1	N.A.
Gas-Fired Engine Driven	COP	1.5	1.8	N.A.
Rooftop A/C	EER	10.1	11.2	13.9
Rooftop Heat Pump	EER (cooling)	9.8	11.0	12.0
	COP (heating)	3.2	3.3	3.4
Boilers				
Gas-Fired	Combustion Efficiency	77	80	98
Oil-Fired	Thermal Efficiency	80	84	98
Electric	Thermal Efficiency	98	98	98
Furnace	AFUE	77	80	82
Water Heater				
Gas-Fired	Thermal Efficiency	78	80	96
Oil-Fired	Thermal Efficiency	79	80	85
Electric Resistance	Thermal Efficiency	98	98	98
Gas-Fired Instantaneous	Thermal Efficiency	77	84	89

Source(s): EIA/Navigant Consulting, EIA - Technology Forecast Updates - Residential and Commercial Buildings Technologies - Reference Case, Oct. 2011, p. 58-98.

5.3.6 2008 Unitary Air-Conditioner/Heat Pump Manufacturer Market Shares (Percent of Products Produced)

Company	Market Share (%)
UTC/Carrier	27%
Goodman (Amana)	14%
American Standard (Trane)	14%
York	12%
Nordyne	12%
Rheem	9%
Lennox	9%
Others	3%
Total	100%

Total Units Shipped: 5,833,354 (1)

Note(s): 1) Does not include water-source or ground-source heat pumps.

Source(s): Appliance Magazine, U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturaation Levels, January 2010, p. 5.

5.3.7 2008 Gas Furnace Manufacturer Market Shares (Percent of Products Produced)

Company	Market Share (%)
UTC/Carrier	32%
Goodman (Amana)	15%
Lennox	13%
American Standard (Trane)	13%
Rheem	12%
York	9%
Nordyne	5%
Others	1%
Total	**100%**

Total Units Shipped: 2,300,000

Source(s): Appliance Magazine, U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturaation Levels, January 2010, p. 5.

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

Equipment Type	Typical Service Lifetime Range	Average Lifetime	2005 Average Stock Age	Units to be Replaced During 2010 (1,000s)
Central Air Conditioners	8 - 14	11	8	5,354
Heat Pumps	9 - 15	12	8	1,260
Furnaces				
Electric	10 - 20	15	11	N.A.
Gas-Fired	12 - 17	15	11	2,601
Oil-Fired	15 - 19	17	N.A.	149
Gas-Fired Boilers (1)	17 - 24	20	17	204

Note(s): Lifetimes based on use by the first owner of the product, and do not necessarily indicate that the product stops working after this period. A replaced unit may be discarded or used elsewhere. 1) 2005 average stock age is for gas- and oil-fired steam and hot water boilers.

Source(s): Appliance Magazine, U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturation Levels, January 2010, p. 10 for service and average lifetimes, and units to be replaced; ASHRAE, 1999 ASHRAE Handbook: HVAC Applications, Table 3, p. 35.3 for boilers service lifetimes; and EIA, Housing Characteristics 1990, May 1992, Table 7, p. 24 for 1990 average stock ages.

5.3.9 Major Commercial HVAC Equipment Lifetimes and Ages

Equipment Type	Median Lifetime	
Air Conditioners		
Through-the-Wall	15	
Water-CooledPackage	24	(1)
Roof-Top	15	
Chillers		
Reciprocating	20	
Centrifugal	25	(1)
Absorption	23	
Heat Pumps		
Air-to-Air	15	
Water-to-Air	24	(1)
Furnaces (gas or oil)	18	
Boilers (gas or oil)		
Hot-Water	24 - 35	
Steam	25 - 30	
Unit Heaters		
Gas-Fired or Electric	13	
Hot-Water or Steam	20	
Cooling Towers (metal or wood)		
Metal	22	(1)
Wood	20	

Note(s): 1) Data from 2005. All other data is from 1978.
Source(s): ASHRAE, 2007 ASHRAE Handbook: HVAC Applications, Table 4, p. 36.3 for median service lifetimes.

5.3.10 Main Residential Heating Fuel, by Vintage, as of 2005 (Percent of Total Households)

Heating Fuel	1949 or Before	1950 to 1959	1960 to 1969	1970 to 1979	1980 to 1989	1990 to 1999	2000 to 2005
Natural Gas	56%	57%	55%	46%	45%	45%	45%
Electricity	8%	18%	26%	36%	42%	42%	43%
Fuel Oil	14%	10%	7%	5%	2%	2%	2%
LPG	5%	3%	2%	5%	6%	8%	8%
Other (1)	17%	12%	10%	8%	4%	3%	2%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Note(s): 1) Other includes wood and kerosene.
Source(s): EIA, Residential Energy Consumption Survey 2005 , June 2008, Table HC 5.4.

5.3.11 Main Residential Heating Equipment as of 1987, 1993, 1997, 2001, and 2005 (Percent of Total Households)

Equipment Type	1987	1993	1997	2001	2005
Natural Gas	**55%**	**53%**	**53%**	**55%**	**52%**
Central Warm-Air Furnace	35%	36%	38%	42%	40%
Steam or Hot-Water System	10%	9%	7%	7%	7%
Floor/Wall/Pipeless Furnace	6%	4%	4%	3%	2%
Room Heater/Other	4%	3%	4%	3%	3%
Electricity	**20%**	**26%**	**29%**	**29%**	**30%**
Central Warm-Air Furnace	8%	10%	11%	12%	14%
Heat Pump	5%	8%	10%	10%	8%
Built-In Electric Units	6%	7%	7%	6%	5%
Other	1%	1%	2%	2%	1%
Fuel Oil	**12%**	**11%**	**9%**	**7%**	**7%**
Steam or Hot-Water System	7%	6%	5%	4%	4%
Central Warm-Air Furnace	4%	5%	4%	3%	3%
Other	1%	0%	0%	0%	0%
Other	**13%**	**11%**	**9%**	**8%**	**10%**
Total	100%	100%	100%	100%	100%

Note(s): Other equipment includes wood, LPG, kerosene, other fuels, and none.

Source(s): EIA, A Look at Residential Consumption in 2005, June 2008, Table HC2-4; EIA, A Look at Residential Energy Consumption in 2001, Apr. 2004, 'Table HC3-2a; EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999,Table HC3-2a, p. 55; EIA, Housing Characteristics 1993, June 1995, Table 3.7b, p. 63; and EIA, Housing Characteristics 1987, May 1989, Table 14, p. 33.

5.3.12 Main Commercial Heating and Cooling Equipment as of 1995, 1999, and 2003 (Percent of Total Floorspace) (1)

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

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

Note(s): 1) Heating and cooling equipment percentages of floorspace total more than 100% since equipment shares floorspace. 2) Malls are no longer included in most CBECs tables; therefore, some data is not directly comparable to past CBECs.

Source(s): EIA, Commercial Building Characteristics 1995, Oct. 1998, Tables B34 and B36 for 1995, and EIA, Commercial Building Characteristics 1999, Aug. 2002, Tables B33 and B34 for 1999; and EIA, 2003 Commercial Buildings Energy Consumption and Expenditures: Consumption and Expenditures Tables, June 2006, Tables B39 and B41 for 2003.

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

Heating Equipment		Cooling Equipment	
Packaged Heating Units	25%	Packaged Air Conditioning Units	54%
Boilers	21%	Room Air Conditioning	5%
Individual Space Heaters	2%	PTAC (2)	3%
Furnaces	20%	Centrifugal Chillers	14%
Heat Pumps	5%	Reciprocating Chillers	12%
District Heat	7%	Rotary Screw Chillers	3%
Unit Heater	18%	Absorption Chillers	2%
PTHP & WLHP (1)	2%	Heat Pumps	7%
	100%		100%

Note(s): 1) PTHP = Packaged Terminal Heat Pump, WLHP = Water Loop Heat Pump. 2) PTAC = Packaged Terminal Air Conditioner

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

5.3.14 Halocarbon Environmental Coefficients and Principal Uses

Compound	100-Year Global Warming Potential (CO2 = 1)	Ozone Depletion Potential (ODP) (Relative to CFC-11)	Principal Uses
Chlorofluorocarbons			
CFC-11	4,600	1.00	Blowing Agent, Chillers
CFC-12 (1)	10,600	1.00	Auto A/C, Chillers, & Blowing Agent
CFC-113	6,000	0.80	Solvent
CFC-114	9,800	1.00	Solvent
CFC-115 (2)	7,200	0.60	Solvent, Refrigerant
Hydrochlorofluorocarbons			
HCFC-22 (2)	1,700	0.06	Residential A/C
HCFC-123	120	0.02	Refrigerant
HCFC-124	620	0.02	Sterilant
HCFC-141b	700	0.11	CFC Replacement
HCFC-142b	2,400	0.07	CFC Replacement
Bromofluorocarbons			
Halon-1211	1,300	3.00	Fire Extinguishers
Halon-1301	6,900	10.00	Fire Extinguishers
Hydrofluorocarbons			
HFC-23	12,000	0.00	HCFC Byproduct
HFC-125	3,400	0.00	CFC/HCFC Replacement
HFC-134a	1,300	0.00	Auto A/C, Refrigeration
HFC-152a (1)	140	0.00	Aerosol Propellant
HFC-227ea	2,900	0.00	CFC Replacement

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

Source(s): Intergovernmental Panel for Climate Change, Climate Change 2001: The Scientific Basis, Jan. 2001, Table 3, p. 47 for global warming potentials and uses; EPA for halon ODPs; AFEAS Internet Homepage, Atmospheric Chlorine: CFCs and Alternative Fluorocarbons, Feb. 1997 for remaining ODPs; and ASHRAE, 1993 ASHRAE Handbook: Fundamental, p. 16.3 for Notes 1 and 2; EPA, Emissions of Greenhouse Gases in the U.S. 2005, Table ES-1, p. ES-3 for GWP of HFCs.

5.3.15 Conversion and Replacements of Centrifugal CFC Chillers

	Conversions	Replacements	Total	Cumulative Percent of 1992 Chillers (1)
Pre-1995	2,304	7,208	9,512	12%
1995	1,198	3,915	5,113	18%
1996	1,311	3,045	4,356	24%
1997	815	3,913	4,728	30%
1998	905	3,326	4,231	35%
1999	491	3,085	3,576	39%
2000	913	3,235	4,148	45%
2001	452	3,324	3,776	49%
2002	360	3,433	3,793	54%
2003	334	2,549	2,883	55%
2004	165	2,883	3,048	59%
2005 (2)	155	2,674	2,829	62%
2006 (2)	130	2,860	2,990	66%
2007 (2)	108	3,002	3,110	70%
Total	**9,641**	**48,452**	**58,093**	

Note(s): 1) In 1992, approximately 80,000 centrifugal CFC chillers were in service, 82% of which used CFC-11, 12% CFC-12, and 6% CFC-113, CFC-114, or R-500. 2) Projected.

Source(s): ARI, Replacement and Conversion of CFC for a Decade Chillers Slower Than Expected Assuring Steady Demand for Non-CFC Units, Apr. 25, 2005; ARI, New Legislation Would Spur Replacement of CFC Chillers, Mar. 31, 2004; ARI, Economy Affects CFC Chiller Phase-out, Apr. 2, 2003; ARI, Half way Mark in Sight for Replacement and Conversion of CFC Chiller Used for Air Conditioning of Buildings, Apr. 11, 2001; ARI, Replacement and Conversion of CFC Chillers Dipped in 1999 Assuring Steady Demand for Non-CFC Units for a Decade, Mar. 29, 2000; ARI, Survey Estimates Long Use of CFC Chillers Nearly Two-Thirds of Units Still in Place, Apr. 15, 1999; ARI, CFCs Widely Used to Cool Buildings Despite 28-Month Ban on Production, Apr. 8, 1998; ARI, 1997 Chiller Survey, Apr. 9, 1997; Air Conditioning, Heating and Refrigeration News, Apr. 1996, p. 1; and ARI's web site, www.ari.org, Chiller Manufacturer Survey Confirms Slow Pace of Conversion and Replacements of CFC Chillers, Apr. 12, 1995.

5.4.1 Water Heater Stock for Residential Buildings, By Fuel Type

	Households in 2005 (millions)	Percent
Electric	43.1	39.2%
Natural Gas	58.7	53.4%
Fuel Oil	4.0	3.6%
Propane/LPG	4.0	3.6%
Other	0.2	0.2%
Total (1)	**110.0**	**100.0%**

Note(s): According to RECS, 1.1 million households did not use hot water.The total only includes those households that used hot water.
Souce(s): EIA, Residential Energy Consumption Survey 2005, Table HC 2.8, June 2008.

5.4.2 Water Heater Stock for Residential Buildings, By Storage Type

	Number and Percent of Households in 2005					
	Used by One Unit		Used by Multiple Units		Total	
Small (30 gallons or less)	17.1	17%	1.4	14%	18.5	17%
Medium (31 to 49 gallons)	52.4	53%	2.4	24%	54.8	50%
Large (50 gallons or more)	27.1	27%	2.8	27%	29.9	27%
Tankless water heater	1.1	1%	0.2	2%	1.3	1%
No Separate Water Heater	1.9	2%	3.4	33%	5.3	5%
Total (1)	**99.6**	100%	**10.2**	100%	**109.8**	100%

Note(s): According to RECS, 1.1 million households did not use hot water.The total only includes those households that used hot water.
Souce(s): EIA, Residential Energy Consumption Survey 2005, Table HC 2.8, June 2008.

5.4.3 Water Heater Manufacturer Market Shares

	2006	2008
A.O. Smith/State Industries	23%	46%
Rheem Manufacturing	37%	37%
Bradford-White	14%	13%
American Water Heater	14%	(1)
Others	12%	4%
Total	100%	100%
Total Units Shipped (2)	9,446,076	8,190,043

Note(s): 1) Included in A.O. Smith/State Industries. 2) Excludes exports.
Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2007, p. 63 for 2006; Appliance Magazine, U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturation Levels, January 2010, p. 6 for 2008.

5.4.4 Water Heater Stock for Commercial Buildings, By Fuel Type

Fuel Type	Percent of Buildings in 2003 (1)
Electric	41%
Natural Gas	31%
Fuel Oil	2%
Propane/LPG	3%
District Heat	1%
No Water Heating	25%

Note(s): (1) Percentages add to 103% because some buildings use more than one fuel for water heating.
Souce(s): EIA, 2003 Commercial Buildings Energy Consumption Survey: Buildings Characteristics, June 2006, Table B31, p. 175.

5.4.5 Water Heater Efficiencies

Residential Type	Efficiency Parameter (1)	2005 Stock Efficiency	Minimum New Efficiency	2010 Best-Available New Efficiency
Electric Storage	EF	0.90	0.90 (2)	0.95 (2)
Electric Instantaneous	EF	0.82	0.82	0.98
Electric Heat Pump	EF	2.00	2.00	2.35
Gas-Fired Storage	EF	0.60	0.59 (3)	0.85 (3)
Gas-Fired Instantaneous	EF	0.82	0.82	0.98
Oil-Fired Storage	EF	0.50	0.53 (4)	0.68 (4)
Solar	SEF	2.50	N.A.	2.50

Commercial Type	Efficiency Parameter (1)	2007 Stock Efficiency	Minimum New Efficiency	2010 Best-Available New Efficiency
Electric Storage	Thermal Efficiency	0.98	0.98 (5)	0.98 (5)
Electric Instantaneous	Thermal Efficiency	0.98	0.98	0.98
Gas-Fired Storage	Thermal Efficiency	0.78	0.80 (6)	0.96 (6)
Gas-Fired Instantaneous	Thermal Efficiency	0.77	0.80	0.85
Oil-Fired Storage	Thermal Efficiency	0.79	0.78 (7)	0.85 (7)

Note(s): 1) EF = energy factor and SEF = solar energy factor, which is the hot water energy delivered by the solar system divided by the electric or gas energy input to the system. 2) Based on a 50-gallon tank. 3) Based on a 40-gallon tank. 4) Based on a 30-gallon tank. 5) Based on a 120-gallon tank. 6) Based on a 100-gallon tank. 7) Based on a 70-gallon tank.

Source(s): EIA, EIA - Technology Forecast Updates – Residential and Commercial Building Technologies – Reference Case, Oct. 2011.

5.5.1 Market Share of Major HVAC Equipment Manufacturers ($2009 Million)

	Total Market Size
Air-Handling Units	1032
Cooling Towers	533
Pumps	333
Central System Terminal Boxes	192
Classroom Unit Ventilator	160
Fan Coil Units	123

Source(s): BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, Table 4-1, p. 4-4; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators.

5.5.2 U.S. Commercial Buildings Conditioned Floorspace, Building Type and System Type (Million SF)

	Individual AC	Packaged	Central VAV	Central FCU	Central CAV	Not Cooled	Total
Education	805	2,204	551	466	212	3,522	7,760
Food Sales	0	534	0	0	0	20	554
Food Service	83	1,100	0	0	0	64	1,247
Health Care	134	557	401	334	802	159	2,387
Lodging	1,669	283	85	707	85	779	3,608
Mercantile and Service	333	5,820	1,081	831	249	2,507	10,821
Office	1,257	4,450	2,322	484	1,161	561	10,235
Public Buildings	371	3,337	847	0	741	2,168	7,464
Warehouse/Storage	119	1,482	0	0	102	2,285	3,988
Total	**4,771**	**19,767**	**5,287**	**2,822**	**3,352**	**12,065**	**48,064**

Source(s): BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, Table A2-12, p. B2-1.

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

	Design Load Intensity (W/SF)	End Use Intensity (kWh/SF)
Education	0.5	1.3
Food Sales	1.1	6.4
Food Service	1.5	6.4
Health Care	1.5	5.6
Lodging	0.5	1.9
Mercantile and Service	0.9	2.7
Office	1.3	3.3
Public Assembly	1.2	3.0
Warehouse	0.4	1.8
All Buildings	**1.0**	**2.8**

Source(s): BTS/A.D. Little, Energy Consumption Characteristics of Commercial Building HVAC Systems, Volume II: Thermal Distribution, Auxiliary Equipment, and Ventilation, Oct. 1999, Table 5-11, p. 5-27.

5.5.4 Thermal Distribution Equipment Design Load and Electricity Intensities, by System Type

	Design Load Intensity (W/SF)			End Use Intensity (kWh/SF)		
	Central VAV	Central CAV	Packaged CAV	Central VAV	Central CAV	Packaged CAV
Condenser Fan			0.3			0.2
Cooling Tower Fan	0.2	0.2		0.1	0.2	0.0
Condenser Water Pump	0.2	0.2		0.3	0.3	0.0
Chilled Water Pump	0.2	0.2		0.1	0.2	0.0
Supply & Return Fans	0.7	0.5	0.6	1.2	1.9	1.9
Chiller/Compressor	1.9	1.8	3.3	1.7	2.3	4.0

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

5.5.5 Typical Commercial Building Thermal Energy Distribution Design Load Intensities (Watts per SF)

Distribution System Fans		**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.

5.5.6 1999 Energy Efficient Motors, Replacements and Sales, by Horsepower Class

	Existing		Replacements	
Horsepower Range	Units in Use (thousands)	Horsepower (10^6)	% Retired	Energy Efficient Share of New Motors
1 - 5	20,784	59.6	2.5%	17%
5.1 - 20	6,927	81.8	2.0%	29%
21 - 50	2,376	78.2	1.5%	45%
51 - 100	738	59.6	1.0%	52%
101 - 200	412	56.5	0.8%	65%

Source(s): Electrical Apparatus Service Association, Past Trends and Probable Future Changes in the Electric Motor Industry 1990-1999, 2001, p. 18 for existing stock and retirements and p. 28 for energy efficient motor sales.

5.5.7 1999 AC Adjustable-Speed Drive Population

Horsepower Range	
1 - 5	70%
5.1 - 20	23%
21 - 50	4%
51 - 100	1%
101 - 200	1%
200 +	1%
Total	100%

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

5.6.1 Selected Fluorescent and Incandescent Lamp Sales (thousands)

Commercial Trends	2001	2002	2003	2004	2005
T12 Rapid-Start Fluorescent (Mainly 4')	213	206	182	176	163
T8 Medium Bi-Pin Fluorescent (Mainly 4')	164	164	172	196	216
Total (mainly) 4'	**377**	**370**	**354**	**372**	**378**
2' U-Shaped T12	10	9	9	7	9
2' U-Shaped T8	8	7	7	9	9
Total 2' U lamp	**18**	**16**	**16**	**16**	**17**
8' Slimline T12 (Mainly 8')	43	41	37	36	34
8' Slimline T8 (Mainly 8')	4	5	5	6	5
Total Slimline (Mainly 8')	**48**	**47**	**42**	**42**	**39**
8' HO T12 (Mainly 8')	24	24	24	25	25
8' HO T8 (Mainly 8')	1	1	0	1	0
Total HO (Mainly 8')	**25**	**25**	**25**	**25**	**26**
Residential Trends					
Incandescent A-line	1,568	1,526	1,542	1,470	1,410
Screw-Based Compact Fluorescent- Census	69	52	66	93	102
Total Medium Screw-Based Market	**1,637**	**1,577**	**1,608**	**1,563**	**1,512**
Commerical and Residential Trends					
PAR Incandescent	9	7	5	5	15
R Incandescent	89	96	103	112	125
PAR 38 Halogen	41	46	46	50	46
PAR30 and PAR20 Halogen	33	27	31	36	40
Total Reflector Lamps	**172**	**176**	**185**	**203**	**226**

Note(s): 2001-2005 growth rate for A-line Incandescent was -2.62% while Screw-based Compact Fluorescent had a growth rate of 10.17% over the
Source(s): National Electrical Manufactors Association, Special Bulletin for the Lamp Section (2-LL), June 2006, page 1.

5.6.2 Value of Electric Lighting Fixture Shipments ($Million)

Lighting Fixture Type	1985	1990	1995	2000	2001
Residential	786.8	827.6	983.8	1,296.5	983.9
Commercial/Institutional (except spotlight)	1,832.3	2,379.7	2,797.3	3,506.7	3,239.1
Industrial	389.2	529.4	676.3	718.3	628.1
Vehicular (1)	1,001.2	1,620.7	N.A.	N.A.	N.A.
Outdoor	905.5	1,061.5	1,473.0	1,957.4	1,923.2

Note(s): 1) Data for vehicular lighting fixtures was discontinued in 1992.
Source(s): DOC, Electric Lighting Fixtures MA 335L(01)-1, Jan. 2003 for 2000 and 2001; DOC, Current Industrial Reports: Electric Lighting Fixtures, MA335L(99)-1, Dec. 2000, Table 1 for 1990-1999; and DOC, Current Industrial Reports: Electric Lighting Fixtures, MA36L, Oct. 1995, Table 1 for 1985.

5.6.3 Shipments of Fluorescent Lamp Ballasts

	Standard Magnetic Type (1)		Electronic Type		Total		
Year	Quantity (million)	Value ($million)	Quantity (million)	Value ($million)	Quantity (million)	Value ($million)	Electronic Type as a % of Total Units Shipped
1985	70.1	398.9	N.A	N.A.	70.1	398.9	N.A.
1986	69.4	396.1	0.4	11.8	69.8	407.9	1%
1988	74.6	450.9	1.1	25.5	75.7	476.4	1%
1990	78.4	546.3	3.0	69.3	81.4	615.6	4%
1992	83.7	537.7	13.3	274.6	97.0	812.3	14%
1994	83.5	550.0	24.6	390.8	108.1	940.7	23%
1996	67.0	457.8	30.3	451.4	97.3	909.2	31%
1998	63.9	401.4	39.8	512.8	103.7	914.3	38%
2000	55.4	343.0	49.3	555.5	104.8	898.5	47%
2002	40.7	263.3	53.8	573.1	94.5	836.4	57%
2004	30.5	218.4	59.2	579.4	89.7	797.8	66%
2005	22.2	175.1	61.3	594.6	83.5	769.8	73%

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

Source(s): DOC Current Industrial Reports: Fluorescent Lamp Ballasts, MQ335C(05)-5, July 2006 for 2000-2005; DOC, Current Industrial Reports: Fluorescent Lamp Ballasts MQ36C(99)-5, July 2000, Table 1 for 1990-1999; and DOC, Current Industrial Reports: Fluorescent Lamp Ballasts, MQ36C(95), 1996, Table 1 for 1985-1989.

5.6.4 2010 Total Lighting Technology Electricity Consumption, by Sector (TWh per Year) (1)

	Residential		Commercial		Industrial		Other (2)		Total	
Incandescent	**136**	**78%**	**15**	**4%**	**0**	**0%**	**4**	**4%**	**156**	**22%**
General (A-type, Decorative)	112	64%	9	3%	0	0%	-	-	122	17%
Reflector	19	11%	5	2%	0	0%	-	-	24	3%
Miscellaneous	5	3%	0	0%	0	0%	4	4%	9	1%
Halogen	**12**	**7%**	**15**	**4%**	**0**	**0%**	**1**	**1%**	**28**	**4%**
General	1	1%	0	0%	0	0%	-	-	1	0%
Reflector	8	5%	7	2%	0	0%	-	-	15	2%
Low Voltage Display	1	0%	7	2%	-	-	-	-	8	1%
Miscellaneous	2	1%	1	0%	0	0%	1	1%	4	1%
Compact Fluorescent	**15**	**9%**	**16**	**5%**	**0**	**0%**	**1**	**1%**	**32**	**5%**
General (Screw, Pin)	13	7%	13	4%	0	0%	-	-	26	4%
Reflector	1	1%	3	1%	0	0%	-	-	4	1%
Miscellaneous	1	1%	-	-	0	0%	1	1%	2	0%
Linear Fluorescent	**10**	**6%**	**250**	**72%**	**23**	**40%**	**10**	**9%**	**294**	**42%**
T5	0	0%	16	5%	2	4%	-	-	19	3%
T8	1	1%	124	35%	12	21%	-	-	137	20%
T12	7	4%	109	31%	9	15%	-	-	124	18%
Miscellaneous	2	1%	2	0%	0	0%	10	9%	14	2%
High Intensity Discharge	**0**	**0%**	**49**	**14%**	**35**	**60%**	**98**	**83%**	**183**	**26%**
Mercury Vapor	0	0%	1	0%	4	7%	4	3%	9	1%
Metal Halide	0	0%	43	12%	25	42%	29	25%	97	14%
High Pressure Sodium	0	0%	5	1%	6	11%	65	55%	76	11%
Low Pressure Sodium	0	0%	0	0%	0	0%	1	1%	1	0%
Other	**1**	**1%**	**3**	**1%**	**0**	**0%**	**3**	**3%**	**8**	**1%**
LED	0	0%	3	1%	0	0%	2	1%	5	1%
Miscellaneous	1	1%	0	0%	-	-	1	1%	3	0%
Total	**175**	**100%**	**349**	**100%**	**58**	**100%**	**118**	**100%**	**700**	**100%**

Note(s): 1) Lumens-hour is a measure of lighting output; Watt-hour is a measure of electrical input for lighting. A value of zero indicates less than 0.5 billion kWh/year. 2) Accounts for the remainder of lamps not installed inside buildings, including parking lot, stadium, stationary aviation, billboard, and traffic and street lighting.

Source(s): DOE/EERE, 2010 U.S. Lighting Market Characterization, Jan. 2012, Table 4-8, p. 34.

5.6.5 2010 Total Lighting Technology Light Output, by Sector (Trillion Lumen-Hour per Year)(1)

	Residential		Commercial		Industrial		Other (2)		Total	
Incandescent	**1640**	**49%**	**180**	**1%**	**0**	**0%**	**50**	**1%**	**1870**	**5%**
General (A-type, Decorative)	1390	42%	120	0%	0	0%	-	-	1510	4%
Reflector	190	6%	60	0%	0	0%	-	-	250	1%
Miscellaneous	60	2%	0	0%	-	-	50	1%	110	0%
Halogen	**170**	**5%**	**240**	**1%**	**0**	**0%**	**20**	**0%**	**430**	**1%**
General	20	1%	0	0%	0	0%	-	-	20	0%
Reflector	110	3%	100	0%	0	0%	-	-	210	1%
Low Voltage Display	10	0%	130	1%	-	-	-	-	140	0%
Miscellaneous	30	1%	10	0%	0	0%	20	0%	70	0%
Compact Fluorescent	**780**	**23%**	**880**	**4%**	**0**	**0%**	**50**	**1%**	**1710**	**4%**
General (Screw, Pin)	670	20%	760	3%	0	0%	-	-	1430	4%
Reflector	60	2%	130	1%	0	0%	-	-	180	0%
Miscellaneous	50	2%	-	-	-	-	50	1%	100	0%
Linear Fluorescent	**670**	**20%**	**19180**	**79%**	**1800**	**40%**	**750**	**9%**	**22400**	**55%**
T5	0	0%	1480	6%	210	5%	-	-	1700	4%
T8	80	2%	9690	40%	960	21%	-	-	10740	26%
T12	470	14%	7880	32%	640	14%	-	-	8980	22%
Miscellaneous	100	3%	120	0%	10	0%	750	9%	980	2%
High Intensity Discharge	**10**	**0%**	**3720**	**15%**	**2680**	**60%**	**7320**	**87%**	**13720**	**34%**
Mercury Vapor	0	0%	60	0%	150	3%	120	1%	330	1%
Metal Halide	0	0%	3130	13%	1860	42%	1730	21%	6730	17%
High Pressure Sodium	10	0%	520	2%	660	15%	5410	65%	6610	16%
Low Pressure Sodium	0	0%	10	0%	-	-	60	1%	60	0%
Other	**50**	**2%**	**180**	**1%**	**0**	**0%**	**180**	**2%**	**410**	**1%**
LED	0	0%	180	1%	0	0%	80	1%	270	1%
Miscellaneous	50	2%	0	0%	-	-	100	1%	150	0%
Total	**3320**	**100%**	**24380**	**100%**	**4480**	**100%**	**8370**	**100%**	**40550**	**100%**

Note(s): 1) Lumens-hour is a measure of lighting output; Watt-hour is a measure of electrical input for lighting. A value of zero indicates less than 0.5 billion kWh/year. 2) Accounts for the remainder of lamps not installed inside buildings, including parking lot, stadium, stationary aviation, billboard, and traffic and street lighting.

Source(s): DOE/EERE, 2010 U.S. Lighting Market Characterization, Jan. 2012, Table 4-9, p. 36.

5.6.6 2010 Lamp Wattage, Number of Lamps, and Hours of Usage

	Lamp Wattage (Watts per lamp)				Number of Lamps per Building				Hours of Usage per Day			
	Res	Com	Ind	Other (1)	Res	Com	Ind		Res	Com	Ind	Other
Incandescent	**56**	**53**	**46**	**68**	**32**	**14**	**1**		**2**	**10**	**13**	**9**
General (A-type, Decorative) (2)	58	58	46	N/A	27	8	1		2	10	13	N/A
Reflector	69	79	65	N/A	4	4	0	(3)	2	10	12	N/A
Miscellaneous	45	7	0	68	1	3	N/A		2	11	0	9
Halogen	**65**	**68**	**68**	**149**	**2**	**9**	**0**		**2**	**12**	**12**	**11**
General	50	46	36	N/A	0	0	0		2	12	12	N/A
Reflector	68	78	64	N/A	1	4	0		2	12	12	N/A
Low Voltage Display	44	60	0	N/A	0	5	N/A		2	13	0	N/A
Miscellaneous	82	99	145	149	0	0	0		2	10	12	11
Compact Fluorescent	**16**	**19**	**31**	**22**	**12**	**39**	**1**		**2**	**10**	**13**	**9**
General (Screw, Pin)	17	19	36	N/A	10	32	1		2	10	13	N/A
Reflector	17	20	16	N/A	1	7	0		2	10	13	N/A
Miscellaneous	18	0	0	22	1	N/A	N/A		2	0	0	9
Linear Fluorescent	**24**	**37**	**39**	**63**	**5**	**301**	**283**		**2**	**11**	**13**	**14**
T5	19	36	58	N/A	0	20	20		2	12	13	N/A
T8	26	31	32	N/A	1	181	182		2	11	13	N/A
T12	28	50	53	N/A	3	98	79		2	11	12	N/A
Miscellaneous	16	31	42	63	1	2	1		2	11	12	14
High Intensity Discharge	**126**	**350**	**403**	**240**	**0**	**6**	**31**		**2**	**11**	**17**	**12**
Mercury Vapor	193	362	451	219	0	0	3		2	11	17	11
Metal Halide	79	349	434	247	0	6	21		2	11	17	12
High Pressure Sodium	150	356	295	241	0	1	7		2	11	18	13
Low Pressure Sodium	0	185	0	107	N/A	0	N/A		0	11	0	11
Other	**47**	**12**	**11**	**30**	**0**	**7**	**1**		**2**	**21**	**22**	**10**
LED	11	12	11	20	0	7	1		2	21	22	9
Miscellaneous	54	11	0	93	0	0	N/A		1	15	0	13
Total	**46**	**42**	**75**	**151**	**51**	**376**	**317**		**2**	**11**	**13**	**12**

Note(s): 1) Accounts for the remainder of lamps not installed inside buildings, including parking lot, stadium, stationary aviation, billboard, and traffic and street lighting. 2) Values for general incandescent, general compact fluorescent, T5 fluorescent, T8 fluorescent, and T12 fluorescent lamps are weighted-averages calculated using the estimated inventory of different lamps that fit within that category. 3) A value of zero

Source(s): DOE/EERE, 2010 U.S. Lighting Market Characterization, Jan. 2012, Tables 4-1, 4-3, 4-5, 4-7, p. 22, 26, 29, 32.

5.6.7 2003 Lighted Floorspace for the Stock of Commercial Buildings, by Type of Lamp (1)

Total Lighted Floorspace: 62.06 Billion SF

Type of Lamp	Lighted Floorspace (Billion SF) (2)	Percent of Lighted Floorspace
Standard Fluorescent	59.7	96%
Incandescent	38.5	62%
Compact Fluorescent	27.6	44%
High-Intensity Discharge	20.6	33%
Halogen	17.7	29%

Note(s): 1) Mall buildings are no longer included in most CBECs tables; therefore, some data are not directly comparable to past CBECs. 2) The percentages of lighted floorspace total more than 100% since most floorspace is lighted by more than one type of lamp.

Source(s): EIA, 2003 Commercial Buildings Energy Consumption Survey: Building Characteristics Tables, June 2006, Table B44, p. 220.

5.6.8 2003 Lighting Consumption and Energy Intensities, by Commercial Building Type

Building Type	Percent of Total Lighted Floorspace	Total Annual Lighting Energy (billion KWh)		Annual Lighting End-Use Intensity (kWh/SF)
Education	14%	33.1	8.4%	3.4
Food Sales	2%	13.5	3.4%	10.8
Food Service	2%	12.3	3.1%	7.4
Health Care	5%	30.8	7.8%	9.7
Inpatient	3%	22.3	5.7%	11.8
Outpatient	2%	8.2	2.1%	6.6
Lodging	7%	36.3	9.3%	7.1
Mercantile	16%	90.3	23.0%	8.1
Retail (Other Than Mall)	6%	32.5	8.3%	7.5
Enclosed and Strip Malls	10%	57.7	14.7%	8.4
Office	18%	82.4	21.0%	6.8
Public Assembly	6%	7.9	2.0%	2.1
Public Order and Safety	2%	5.3	1.3%	4.8
Religious Worship	5%	5.0	1.3%	1.3
Service	6%	18.5	4.7%	4.6
Warehouse and Storage	13%	38.7	9.9%	3.8
Other	2%	17.3	4.4%	10.0
Vacant	1%	1.2	0.3%	0.5
Total (1)		**392.4**	**100%**	

Source(s): EIA, 2003 Commericial Buildings Energy Consumption Survey Characteristics and End-Uses, Oct. 2006 and Sept. 2008, Table A1 and Table E1A.

5.6.9 Typical Efficacies and Lifetimes of Lamps (1)

Current Technology	Efficacy (lumens/Watt)	Typical Rated Lifetime (hours)	CRI (2)
Incandescent	10 - 19	750 - 2,500	97
Halogen	14 - 20	2,000 - 3,500	99
Fluorescent - T5	25 - 55	6,000 - 7,500	52 - 75
Fluorescent - T8	35 - 87	7,500 - 20,000	52 - 90
Fluorescent - T12	35 - 92	7,500 - 20,000	50 - 92
Compact Fluorescent	40 - 70	10,000	82
Mercury Vapor	25 - 50	29,000	15 - 50
Metal Halide	50 - 115	3,000 - 20,000	65 - 70
High-Pressure Sodium	50 - 124	29,000	22
Low-Pressure Sodium	18 - 180	18,000	0
Solid State Lighting	20 - 100	15,000 - 50,000	33-97

Note(s): 1) Theoretical maximum luminous efficacy of white light is 220 lumens/Watt. 2) CRI = Color Rendering Index, which indicates a lamp's ability to show natural colors. 3) The DOE Solid State Lighting program has set an efficacy goal twice that of fluorescent lights (160 lumen per Watt).

Source(s): DOE, EERE, Building Technology Program/Navigant Consulting, U.S. Lighting Market Characterization, Volume I: National Lighting Inventory and Energy Consumption Estimate, Sept. 2002, Appendix A, p. 74; DOE/Navigant Consulting, Solid State Lighting Research and Development Portfolio, Mar. 2006, p 55; ENERGY STAR LED Light Bulb Program, Qualified Product List, Accessed 3/15/2011; LightingFacts.com Product List, accessed March 15, 2011.

5.7.1 Refrigeration System Shipments, by Type (Including Exports)

Appliance Type	1990 (thousands)	2000 (thousands)	2005 (thousands)	2010 (thousands)	2010 Value of Shipments ($million)
Refrigerator-Freezers (1)	7,317	9,462	10,665	9,369 (2)	5,466
Freezers (chest and upright)	1,328	2,007	2,274	1,958	N/A
Refrigerated Display Cases	359	347	177	N/A	N/A
Unit Coolers (3)	178	207	209	N/A	205
Ice-Making Machines (4)	171	385	373	246	636
Water Cooler	253	348	N/A	N/A	N/A
Beverage Vending Machine	229	353	N/A	N/A	N/A

Note(s): 1) Does not include commercial products value. 2) Standard sized refrigerator-freezers 6.5 cubic feet and over. 3) Includes heat transfer coolers (refrigeration), ceiling, wall-mounted, and floor-mounted unit coolers. 4) Includes self-contained and not self-contained ice-making machines and combination ice/drink dispensers.

Source(s): Appliance Magazine, 48th Annual Statistical Review, May 2001, p. 51-54; The Air Conditioning, Heating and Refrigeration News, Nov. 11, 1995, p. 3, 19; Appliance Magazine, 50th Annual Statistical Review, May 2003; DOC, Current Industrial Reports: Air Conditioning and Refrigeration Equipment, MA333M(00)-1, Sept. 2001, Table 2; Appliance Magazine, 54th Annual Statistical Review, May 2007, p. S1-S4; DOC, Current Industrial Reports: Refrigeration, Air Conditioning, and Warm Air Heating Equipment, MA333M(06)-1, July 2007; Appliance Magazine, 2010 U.S. Appliance Shipment Statistics, April 2011, p. 3; DOC, Current Industrial Reports: Refrigeration, Air Conditioning, and Warm Air Heating Equipment, MA333M(10)-1, July 2011, Table 2; DOC, Current Industrial Reports: Major Household Appliances, MA335F(10)-1, May 2011, Table 2.

5.7.2 Other Major Appliance Shipments, by Type (Including Exports)

Appliance Type	1990 (thousands)	2000 (thousands)	2009 (thousands)	2009 Value of Shipments (4) ($million)
Room Air Conditioners	**3,799**	**6,496**	**6,418**	**129**
Ranges (total)	5,873	8,202	5,941	3,158
Electric Ranges	3,350	5,026	3,509	2,041
Gas Ranges	2,354	3,176	2,433	1,117
Microwave Ovens/Ranges	**7,693**	**12,644**	**9,333**	N.A.
Clothes Washers	**5,591**	**7,495**	**7,999**	**4,820**
Clothes Dryers (total)	**4,160**	**6,575**	**6,547**	**N.A. (5)**
Electric Dryers	3,190	5,095	5,261	N.A.
Gas Dryers	970	1,480	1,286	N.A.
Water Heaters (total)	**7,252**	**9,329**	**9,120**	**2,321**
Electric (1)	3,246	4,299	4,017	869
Gas and Oil (1)	4,005	5,006	5,104	1,452
Solar (2)	N.A.	24	N.A.	N.A.
Office Equipment				
Personal Computers (3)	N.A.	47,168	47,073	26,060
Copiers	N.A.	1,989	N.A.	N.A.
Printers	N.A.	27,945	20,627	3,109
Scanners	N.A.	9,400	N.A.	N.A.

Note(s): 1) Includes residential and small commercial units. 2) Shipments and value of shipments of entire systems. 3) Includes workstations, laptops, and notebooks. 4) Value of shipments (except for office equipment and microwaves) are based on Census unit shipment data, which are about 588 thousand units lower than industry data shown. 5) Included in clothes washers value of shipments.

Source(s): AHAM, AHAM Fact Book 2000, 2000, Tables 7 and 8, for 1990 data except water heaters; AHAM, AHAM 2005 Fact Book, 2006, Table 7 for 2000 shipments and Table 6, p. 19 for value of shipments of ranges, microwave ovens, laundry equipment, and room air conditioners; GAMA, Statistical Highlights: Ten Year Summary, 1987-1996; GAMA, Statistical Highlights: Ten Year Summary, 1994- 2003 for water heater shipments; Appliance Magazine, 2010 U.S. Appliance Shipment Statistics, April 2011, p. 3; DOC, Current Industrial Reports: Major Household Appliances, MA335F(10)-1, May 2011, Table 2; DOC, Current Industrial Reports: Refrigeration, Air Conditioning, and Warm Air Heating Equipment, MA333M(10)-1, July 2011, Table 2; DOC, Current Industrial Reports: Major Household Appliances, MA335F(02)-1, July 2003, Table 2 for value of water heater shipments; EIA, 2000 Solar Thermal and Photovoltaic Collector Manufacturing Activities, July 2001, Table 17, p. 20 for solar water heater data; Appliance Magazine, 52nd Annual Statistical Review, May 2005, p. S1-S4 for office equipment shipments; Appliance Magazine, U.S. Appliance Industry Statistical Review: 2000 to YTD 2010, p. 4 and p. 6 for appliance shipments; and Consumer Electronics Association, U.S. Consumer Electronics Sales & Forecasts 2006-2011, July 2010 for 2010 office equipment.

5.7.3 Major Appliance Ownership (Millions of Households and Percent of U.S. Households)

	1990		1996		2001		2005		2008	
Appliance Type	Households		Households		Households		Households		Households	
Room Air Conditioners	30.2	32%	30.4	31%	26.9	26%	27.4	25%	32.7	29%
Refrigerators	91.2	98%	96.8	98%	100.0	96%	104.7	96%	111.6	99%
Freezers	42.4	45%	41.9	42%	42.8	41%	36.1	33%	48.5	43%
Electric Ranges/Cooktops	58.4	63%	65.3	66%	69.2	66%	71.0	65%	68.8	61%
Gas Ranges/Cooktops	36.1	39%	38.3	39%	39.4	38%	42.2	39%	45.1	40%
Microwave Ovens	77.2	83%	89.5	91%	94.6	91%	97.2	89%	102.6	91%
Clothes Washers	86.4	93%	94.3	95%	96.9	93%	90.1	83%	107.1	95%
Electric Clothes Dryers	56.1	60%	60.4	61%	61.8	59%	67.6	62%	69.9	62%
Gas Clothes Dryers	19.1	21%	21.1	21%	19.8	19%	20.7	19%	22.6	20%
Personal Computers	N.A.	N.A.	43.5	44%	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Number of U.S. Households	**94.0**		**98.9**		**107.0**		**108.8**		**112.8**	

Source(s): Appliance Magazine, U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturation Levels, January 2010, p. 11; AHAM, AHAM 2005 Fact Book, 2006, Table 93, p. 28 for 1990, 2001 and 2005; AHAM, 2000 Major Home Appliance Industry Fact Book, Nov. 2000, Table 13, p. 21 for 1996; Consumer Electronic Manufacturers Association's Home Page, 1999 for 1997 personal computers; EIA, AEO 2011 Early Release, Table A4, p. 9-10 for 2008 households; EIA, AEO 1995, Jan. 1995, Table B4, p. 104 for 1990 households; EIA, AEO 2004, Jan. 2004, Table A4 for 2001 households.

5.7.4 2008 Refrigerator Manufacturer Market Shares (Percent of Products Produced)

Company	Market Share (%)
GE	27%
Electrolux (Frigidaire)	23%
Whirlpool	33%
Maytag (Admiral)	(1)
Haier	6%
W.C. Wood	1%
Others	10%
Total	100%

Total Units Shipped: 9,310,000

Note(s): 1) Included in Whirpool shipments

Source(s): Appliance Magazine, U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturation Levels, January 2010, p. 5.

5.7.5 Refrigerator-Freezer Sizes and Energy Factors (Shipment-Weighted Averages)

	Average Volume (cu. ft.) (1)	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.
1995	20.0	649	555
2000	21.9	704	523
2001	21.9	565	438
2002	22.2	520	428
2003	22.3	514	428
2004	21.5	500	402
2005	20.7	490	417
2006	22.3	506	464
2007	21.9	498	459
2008	21.4	483	N.A.
2009 (2)	21.0	460	334
2010	22.5	462	311

Note(s): The average stock energy uses for refrigerator-freezers was 1,220 kWh/yr in 1990, 1,319 kWh/yr in 1997, and 1,462 kWh/yr in 2001. 1) Represents the average adjusted volume, which is defined as the fresh volume plus 1.63 times the freezer volume. 2) Based on refrigerator-freezer units with adjusted volumes approximately equal to the average adjusted volume.

Source(s): AHAM, Energy Efficiency and Consumption Trends 2010; AHAM, Efficiency and Consumption Trends 2009; AHAM, 2000 Major Home Appliance Industry Fact Book, 2000, Table 25, p. 30 for 1972-1985; AHAM, 2005 AHAM Fact Book, 2006, Table 17, p. 40 for 1990-2004; AHAM, 1991, 1993-1999 Directory of Certified Refrigerators and Freezers for 1993-1999 best-available data (at 19.6 or more cu. ft.); LBNL, Center for Building Science News, Summer 1995, p. 6 for 1990 portion of note; EIA, A Look at Residential Energy Consumption in 2001; Apr. 2004, Table CE5-1c for 2001 portion of note; EIA, A Look at Residential Energy Consumption in 1997, Nov. 1999, Table CE5-2c, p. 205 for 1997 portion of note; and ENERGY STAR certified products lists for 2001-2010 best available, http://www.energystar.gov/index.cfm?fuseaction=refrig.display_products_excel.

5.7.6 2008 Room Air Conditioner Manufacturer Market Shares (Percent of Products Produced)

Company	Market Share (%)
LG Electronics (Goldstar)	32%
Fedders	12%
Electrolux (Frigidaire)	13%
Whirlpool	13%
Haier	8%
Samsung	5%
Sharp	4%
Friedrich	4%
UTC/Carrier	3%
Matsushita	2%
Others	4%
Total	100%

Total Units Shipped: 9,085,500

Source(s): Appliance Magazine, U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturation Levels, January 2010, p. 5.

5.7.7 Room Air Conditioner Capacities and Energy Efficiencies (Shipment-Weighted Averages)

	Average Capacity (Btu/hr)	EER	Best-Available (EER)
1972	10227	5.98	N.A.
1980	10,607	7.02	N.A.
1985	10,287	7.70	N.A.
1990	10,034	8.73	N.A.
1995	10,099	9.03	12.0
2000	9,739	9.30	11.7
2001	9,874	9.63	11.7
2002	9,800	9.75	11.7
2003	9,203	9.75	11.7
2004	9,735	9.71	11.7
2005	7,916	9.95	12.0
2006	9,197	10.02	12.0
2007	8,518	9.81	12.0
2008	8,760	9.93	12.0
2009	9,287	10.05	12.0
2010	8,737	10.18	12.0

Source(s): AHAM, Energy Efficiency and Consumption Trends 2010; AHAM, Efficiency and Consumption Trends 2009; AHAM, 1997 Major Appliance Industry Fact Book, Oct. 1997, Table 27, p. 32 for 1972; AHAM, AHAM 2003 Fact Book, 2003, Table 25, p. 45 for 1980-1985 average capacity and EER; AHAM, AHAM 2005 Fact Book, 2006, Table 19, p. 42 for 1990-2004 average capacity and EER; AHAM, 1994-1999 Directory of Certified Room Air Conditioners, Mar. 2000 for 1994-2000 best available; and ENERGY STAR certified products lists for 2001-2010 best available, http://www.energystar.gov/index.cfm?fuseaction=roomac.display_products_excel.

5.7.8 2008 Clothes Washer Manufacturer Market Shares (Percent of Products Produced)

Company	Market Share (%)
Whirlpool	64%
Maytag	(1)
GE	16%
Electrolux (Frigidaire)	6%
LG Electronics	6%
Others	8%
Total	100%

Total Units Shipped: 8,292,000

Note(s): 1) Included in Whirlpool shipments.

Source(s): Appliance Magazine, U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturation Levels, January 2010, p. 6.

5.7.9 2008 Clothes Dryer Manufacturer Market Shares (Percent of Products Produced)

Company	Electric Market Share (%)	Gas Market Share (%)
Whirlpool	70%	74%
Maytag	(1)	(1)
GE	16%	10%
Electrolux (Frigidaire)	8%	5%
Others	6%	11%
Total	100%	100%

Total Electric Units Shipped: 5,620,000

Total Gas Units Shipped: 1,353,000

Note(s): 1) Included in Whirlpool shipments.

Source(s): Appliance Magazine, U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturation Levels, January 2010, p. 6.

5.7.10 2008 Range Manufacturer Market Shares (Percent of Products Produced)

Company	Electric Market Share (%)	Gas Market Share (%)
GE	47%	37%
Whirlpool	29%	25%
Electrolux (Frigidaire)	8%	23%
Maytag	(1)	(1)
Others	16%	15%
Total	100%	100%

Total Electric Units Shipped: 5,106,000

Total Gas Units Shipped: 2,842,400

Note(s): 1) Included in Whirlpool shipments

Source(s): Appliance Magazine, U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturation Levels, January 2010, p. 6.

5.7.11 2008 Microwave Oven Manufacturer Market Shares (Percent of Products Produced)

Company	Market Share (%)
LG Electronics (Goldstar)	33%
Sharp	15%
Samsung	15%
Daewoo	7%
Matsushita	10%
Whirlpool	3%
Sanyo	9%
Others	8%
Total	100%

Total Units Shipped: 11,340,000

Source(s): Appliance Magazine, U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturation Levels, January 2010, p. 6.

5.7.12 2007 Copier Machine Manufacturer Market Shares (Percent of Products Produced)

	Copier Market Share (%)
Canon	31%
Konica Minolta	21%
Ricoh	16%
Xerox	10%
Sharp	4%
Kyocera Mita	4%
Others	14%
Total	100%

Total Copier Units Shipped: 247,763

Note(s): Data has not been updated because market share for these products is no longer reported in Appliance Magazine.

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 41.

5.7.13 2007 Personal Computer Manufacturer Market Shares (Percent of Products Produced)

Company	Desktop Computer Market Share (%)	Portable Computer Market Share (%)
Dell	32%	25%
Hewlett-Packard	24%	26%
Gateway	5%	4%
Apple	4%	9%
Acer America	3%	N/A
IBM	1%	N/A
Micron	0%	N/A
Toshiba	N/A	12%
Levono (IBM)	N/A	6%
Sony	N/A	5%
Fujitsu Siemens	N/A	1%
Others	30%	13%
Total	100%	100%

Total Desktop Computer Units Shipped: 34,211,601

Total Portable Computer Units Shipped: 30,023,844

Note(s): Data has not been updated because market share for these products is no longer reported in Appliance Magazine.

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 41.

5.7.14 2007 Printer Manufacturer Market Shares (Percent of Products Produced)

Company	Ink Jet Printer Market Share (%)	Laser Printer Market Share (%)	Dot Matrix Market Share (%)
Hewlett-Packard	58%	56%	N/A
Canon	16%	N/A	N/A
Epson	11%	N/A	27%
Lexmark	15%	10%	11%
Dell	0%	11%	N/A
Samsung	N/A	6%	N/A
Brother	N/A	4%	N/A
Oki Data	N/A	3%	46%
Konica Minolta	N/A	1%	N/A
Panasonic	N/A	N/A	6%
TallyGenicom	N/A	N/A	5%
Others	0%	9%	6%
Total	100%	100%	100%

Total Ink Jet Units Shipped: 6,392,177

Total Laser Units Shipped: 3,356,556

Total Dot Matrix Units Shipped: 231,547

Note(s): Data has not been updated because market share for these products is no longer reported in Appliance Magazine.

Source(s): Appliance Magazine, A Portrait of the U.S. Appliance Industry, Sept. 2008, p. 41.

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

Appliance Type	Typical Service Lifetime Range (years)	Average Lifetime (years)	2005 Average Stock Age (years)	Units to be Replaced During 2011 (thousands)
Refrigerators (1)	10 - 16	12	7.8	9,217
Freezers	8 - 16	11	11.3	2,215
Microwave Ovens	7 - 10	9	N.A.	14,625
Ranges (2)				
Electric	12 - 19	16	N.A.	4,281
Gas	14 - 22	17	N.A.	2,854
Clothes Washers	7 - 14	11	N.A.	7,362
Clothes Dryers				
Electric	8 - 15	12	N.A.	5,095
Gas	8 - 15	12	N.A.	1,480
Water Heaters				
Electric	4 - 20	13	8.1	4,281
Gas	7 - 15	11	8.1	4,931
Room Air Conditioners	7 - 13	9	6.5	8,216
Facsimile Machines (3)	3 - 5	4	N.A.	3,133
Portable Computers (3)	2 - 4	3	N.A.	31,600

Note(s): Lifetimes based on use by the first owner of the product, and do not necessarily indicate that the product stops working after this period. A replaced unit may be discarded or used elsewhere. 1) Standard-size refrigerators only. 2) Ranges include free-standing, built-in, high-oven and cooktop/oven combination units. 3) Data for facsimile machines and portable computers is from 2010.

Source(s): Appliance Magazine, U.S. Appliance Industry: Market Value, Life Expectancy & Replacement Picture for 2005-2012, Jan. 2011, p. 11-12 for service and average lifetimes and units to be replaced; Appliance Magazine, U.S. Appliance Industry: Market Share, Life Expectancy & Replacement Market, and Saturation Levels, January 2010, p. 10 ; EIA, 2005 Residential Energy Consumption Survey, Apr. 2008, Table HC 2.6, Table HC 2.8 and Table HC 2.9 for average stock ages

5.7.16 Other Major Appliance Efficiencies

Residential Appliance Type	Efficiency Parameter (1)	2005 Stock Efficiency	2010 U.S. Average New Efficiency	2010 Best Available New Efficiency
Dishwashers	EF	0.30	0.61	1.13
Clothes Washers (2)	MEF	2.00	2.00	3.88
Clothes Dryers (electric)	EF	3.01	3.10	3.16
Clothes Dryers (gas)	EF	2.67	2.75	3.02
Cooktop (Gas)	Cooking Efficiency	0.38	0.40	0.42

Commercial Appliance Type	Efficiency Parameter (1)	2010 Stock Efficiency	U.S. Average New Efficiency	1992 Best Available New Efficiency
Cooking Equipment:				
Electric Appliances	EF	0.74	N.A.	N.A.
Gas Appliances	EF	0.53	N.A.	N.A.
Laundry Equipment:				
Electric Drying	EF/COP	N.A.	N.A.	0.98
Gas Drying	EF	N.A.	N.A.	0.36
Motors	EF	N.A.	N.A.	0.65
Office Equipment:				
Linear Power Supplies	EF	N.A.	N.A.	0.30 - 0.60
Switching Power Supplies	EF	N.A.	N.A.	0.80 - 0.95
Motors	EF	N.A.	N.A.	0.60 - 0.70

Note(s): 1) EF = Energy Factor. MEF = Modified Energy Factor. COP = Coefficient of Performance. 2) EF does not include remaining moisture content (RMC) of clothes. MEF includes RMC which shows how much the clothes dryer will be needed.

Source(s): EIA/Navigant Consulting, EIA - Technology Forecast Updates - Residential and Commercial Building Technologies - Reference Case, Oct. 2011, p. 46-57 for residential stock; EIA, Supplement to the AEO 2012 - Early Release, Jan. 2012, Table 32 for commercial cooking data; and BTS/OBE, Characterization of Commercial Building Appliances, Aug. 1993 for commercial efficiencies.

5.7.17 Commercial Refrigeration - Annual Primary Energy Consumption

Equipment Type	Percent of Total
Supermarket Refrigeration	56%
Walk-Ins	12%
Reach-Ins	9%
Refrigerated Vending Machines	8%
Ice Machines	7%
Beverage Merchandisers	4%
Food Service Equipment	4%
Total	**1.23 Quad**

Source(s): DOE/EERE/Navigant Consulting, Energy Savings Potential and R&D Opportunities for Commercial Refrigeration, Sept. 2009, Figure 1-2, p. 17.

5.7.18 Commercial Refrigeration - Installed Base and Total Energy Consumption by Type

Equipment	Installed Base (thousand)	Total Energy Consumption (TWh/yr)
Supermarket Refrigeration Systems		
Display Cases	2,100	214
Compressor Racks	140	373
Condensers	140	50
Walk-Ins	245	51
Walk-In Coolers and Freezers (Non-Supermarket)	755	148
Food Preperation and Service Equipment	1,516	55
Reach-In Refrigerators and Freezers	2,712	106
Beverage Merchandisers	920	45
Ice Machines	1,491	84
Refrigerated Vending Machines	3,816	100
Total		**1225**

Note(s): Energy consumption values have been rounded to the nearest whole number, and therefore the total does not exactly equal the sum of the energy consumption values for each equipment type.

Source(s): DOE/EERE/Navigant Consulting, Energy Savings Potential and R&D Opportunities for Commercial Refrigeration, Sept. 2009, Table 3-1, p. 26.

5.7.19 Commercial Refrigeration - Unit Inventory and Energy Consumption

Application	Estimated Inventory (thousand)	Unit Energy Consumption (kWh/yr)	Total Energy Consumption (TWh/yr)	Primary Energy Consumption (Tbtu/yr)
Walk-In Coolers and Freezers				
Non-Supermarket, Cooler	468	16,200	7.6	78.9
Non-Supermarket, Freezer	234	21,400	5.0	52.1
Non-Supermarket, Combination	53	30,200	1.6	16.6
Supermarket	245	varies	4.9	51.0
Beverage Merchandisers (1)				
One-Door	460	3,076	1.4	14.7
Two-Door	414	6,080	2.5	26.2
Three-Door	46	8,960	0.4	4.3
Reach-In Refrigerators and Freezers (2)				
Freezers	1,156	4,158	4.8	56.0
Refrigerators	1,556	3,455	5.4	50.0
Ice Machine	1,491	5,429	8.1	84.2
Beverage Vending Machine (3)				
Fully-cooled	496	2,743	1.4	14.2
Zone-cooled	3,320	2,483	8.2	85.8

Note(s): 1) Beverage merchandisers are self-contained, upright, refrigerated cabinets that are designed to hold and/or display refrigerated beverage items for purchase without an automatic vending feature.Typically they have glass doors and bright lighting. These cases are commonly used in convenience stores, aisle locations in supermarkets, and some retail stores.Because the refrigeration system is self-contained, the heat is rejected to the building interior, and their energy use is not included in the supermarket refrigeration sections. 2) Commercial reach-in cabinets are upright, self-contained refrigerated cases with solid or glass doors whose purpose is to hold frozen and/or refrigerated food products. These cases are commonly used in commercial and institutional food-service establishments.These are self-contained units, i.e., the entire refrigeration system is built into the reach-in unit and heat is rejected to the surrounding interior air. 3) In a fully cooled beverage vending machine, all beverages enclosed within the machine are visible to the customer and, therefore, the entire internal volume is refrigerated. The zone-cooled packaged beverage vending machine only cools the beverage that are soon-to-be-vended, meaning only a small portion, or zone, of the internal volume is refrigerated.

Source(s): DOE/EERE/Navigant Consulting, Energy Savings Potential and R&D Opportunities for Commercial Refrigeration, Sept. 2009, Table 3-5, p. 31 for walk-in coolers and freezers, Table 3-12, p. 37 for beverage merchandiser, Table 3-11, p. 35 for reach-in freezers and refrigerators, Table 3-15, p. 41 for ice machines, and Table 3-16, p. 44 for beverage vending machine.

5.7.20 Commercial Refrigeration - Display Case Shipments

Year	Shipments
1999	340,453
2000	347,262
2001	175,000
2002	183,300
2003	191,549
2004	185,000
2005	170,000
2006	175,500
2007	181,000
2008	185,000

Source(s): DOE/EERE/Navigant Consulting, Energy Savings Potential and R&D Opportunities for Commercial Refrigeration, Sept. 2009, Table 3-3, p. 28.

5.8.1 Solar Collector Shipments, by Type and Market (Thousand SF, unless noted) (1)

Type	1980	1990	2000	2009
Solar Thermal Collectors (2)	**19,398**	**11,409**	**8,354**	**13,798**
Residential	N.A.	5,851	7,473	10,239
Commercial	N.A.	295	810	974
Industrial	N.A.	(3)	57	634
Utility	N.A.	5,236	5	374
Other	N.A.	26	10	1,577 (4)
Photovoltaics (kW) (5)	(6) 6,897	13,837	88,221	1,282,560

Note(s): 1) Shipments for 1980-2000 include imports and exports; 2008 shipments are domestic only. 2) Solar thermal collectors: receive solar radiation, convert it to thermal energy, and are typically used forspace heating, water heating, and heating swimming pools. 3) Industrial is included in Other. 4) Other includes all exports. 5) Generate electricity by the conversion of solar radiation to electrical energy; shipments for all years include imports and exports. 6) Value from 1982.

Source(s): EIA, Annual Energy Review 2010, Oct. 2011, Table 10.6, p. 305 for total thermal collector shipments 1980-2009, Table 10.7, p. 307 for solar thermal shipments by market, Table 10.8, p. 309 for photovoltaic shipments; EIA, Annual Energy Review 1991, June 1992, Table 111, p. 251 for 1990 collector sector data; EIA, Renewable Energy Annual 2001, Nov. 2002, Table 18, p. 19 for 2000 collector sector data.

5.8.2 Thermal Solar Collector Shipments, by End Use (Thousand SF) (1)

Type	2000	2005	2006	2007	2008	2009
Pool Heating	7,863	15,041	15,362	12,076	11,973	8934
Hot Water	367	640	1,136	1,393	1,978	1992
Space Heating	99	228	330	189	186	150
Space Cooling	0	2	3	13	18	10
Combined Space/Water Heating	2	16	66	73	148	137
Process Heating	20	0	0	27	50	608
Electricity Generation	3	114 (2)	3,847	6	361	389
Total	**8,354**	**16,041**	**20,744**	**15,153**	**16,963**	**13,798**

Note(s): 1) Total shipments include imports and exports for all years.For 2007 to 2009, end-use values only include domestic shipments. 2) 2005 to 2006 increase in electricity generation due to shipment to the Nevada Solar One Project.

Source(s): EIA, Renewable Energy Annual 2010, Oct. 2011, Table 10.6, p. 305 for 2000-2009 total collector shipments, and Table 10.7, p. 307 for 2007-2009 end-use shipments; EIA, Renewable Energy Annual 2001, Nov. 2002, Table 18, p. 19 for 2000 end-use shipments; EIA, Renewable Energy Annual 2003, June 2005, Table 18, p. 10 for 2003 end-use shipments; EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2005, Aug. 2006, Table 38, p. 22 for 2004-2005 end-use shipments; and EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2006, Table 2.10, p. 21 for 2006 end-use shipments.

5.8.3 2009 Top Five Destinations of Thermal Solar Collector Shipments

State	Percent of Domestic U.S. Shipments	Thousand SF
Florida	27%	3,771
California	26%	3,537
Arizona	5%	745
Hawaii	4%	520
Oregon	3%	387

Note(s):

Source(s): EIA, Solar Thermal Collector Manufacturing Activities 2009, Dec. 2010, Table 2.4, p. 10.

5.8.4 Thermal Solar Collector Manufacturer Statistics

-	Number of Manufacturers in 2008:	88
-	Companies with 90% of their revenue coming from solar collector sales:	56
-	Percentage of shipped solar collectors produced by top 5 manufacturers:	79%

Source(s): EIA, Solar Thermal Collector Manufacturing Activities 2009, Dec. 2010, p. 2, Table 2.17, p. 24, Table 2.20, p. 27.

5.8.5 Shipments of Photovoltaic Cells and Modules, by Market (thousand Peak Kilowatts)(1)

	Residential	**Commercial**	Industrial	Transportation	Utility	Government	Other	Total
1995	**6.3**	**8.1**	7.2	2.4	3.8	2.0	1.3	31.1
2000	**24.8**	**13.7**	28.8	5.5	6.3	4.4	4.7	88.2
2002	**29.3**	**20.6**	32.2	12.9	7.6	8.6	0.8	112.1
2003	**23.4**	**32.6**	28.0	11.1	8.5	5.5	0.3	109.4
2004	**53.9**	**74.5**	30.5	1.4	3.2	3.3	14.3	181.1
2005	**75.0**	**89.5**	22.2	1.6	0.1	28.7	9.8	226.9
2006	**95.8**	**180.9**	28.6	2.5	4.0	7.7	17.9	337.3
2007	**68.4**	**140.4**	32.7	3.6	35.3	(2)	0.0	280.5
2008	**174.0**	**253.9**	51.5	9.1	35.8	(2)	0.0	524.3
2009	**221.2**	**282.3**	43.4	0.5	53.6	(2)	0.0	601.1

Note(s): 1) Includes imports and exports for 2000-2006. 2007-2009 only includes domestic shipments. 2) Beginning in 2007, the government sector is included in "Commercial".

Source(s): EIA, Annual Energy Review 2010, Oct. 2011, Table 10.9, p. 311 for 2009; EIA, Renewable Energy Annual 2008, Aug. 2010, Table 3.7, p. 85 for 2007-2008; EIA, Renewable Energy Annual 2006, Aug. 2008, Table 2.23 for 2006; EIA, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2005, Aug.

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

Year	Number of Companies	Domestic	Exports	Total
1996	25	13,016	22,448	35,464
1997	21	12,561	33,793	46,354
1998	21	15,069	35,493	50,562
1999	19	21,225	55,562	76,787
2000	21	19,838	68,382	88,220
2001	19	36,310	61,356	97,666
2002	19	45,313	66,778	112,091
2003	20	48,664	60,693	109,357
2004	19	78,346	102,770	181,116
2005	29	134,465	92,451	226,916
2006	41	206,511	130,757	337,268
2007	46	280,475	237,209	517,684
2008	66	524,252	462,252	986,504
2009	101	601,133	681,427	1,282,560

Source(s): EIA, Annual Energy Review 2010, Oct. 2011, Tables 10.8 and 10.9, p. 309-311.

5.8.7 2009 Top 10 Destinations of U.S. Photovoltaic Cell and Module Export Shipments, by Country

Country	Peak Kilowatts	Percent of U.S. Exports
Germany	309,147	45%
Italy	108,187	16%
France	47,271	7%
Canada	43,458	6%
Belgium	27,247	4%
Spain	23,460	3%
China	18,297	3%
India	14,806	2%
South Korea	12,581	2%
Australia	8,368	1%
Total U.S. Exports	681,427	100%

Note(s): Total U.S. exports of photovoltaic cells and modules increased by 47% from 2008 to 2009.
Source(s): EIA, Solar Photovoltaic Cell/Module Manufacturing Activities, Dec. 2010, Table 3.14.

5.8.8 Annual New Installations of Grid-Tied Photovoltaic Cells and Modules, by Market (MW)

Peak Capacity by Use	2004	2005	2006	2007	2008	2009	2010
Residential	**23.4**	**26.2**	**36.3**	**55.9**	**74.5**	**150.4**	**260.9**
Non-Residential	**30.6**	**49.0**	**64.2**	**96.5**	**202.4**	**202.4**	**343.8**
Utility	1.8	0.6	0.2	8.7	21.3	66.6	286.0
Unknown	1.8	3.2	4.0	7.7	12.7	17.7	3.7
Total New Capacity	57.6	79.0	104.7	168.8	310.9	437.1	894.4
Cumulative Capacity	155.1	234.2	338.9	507.7	818.6	1256.7	2150.0
Number of Installations	6,873	7,718	9,576	14,597	18,970	34,243	50,314

Source(s): Sherwood, Larry. Interstate Renewable Energy Council. Personal Communication. Febuary, 13, 2012.

5.8.9 Total Grid-Tied PV Capacity, by State

	PV Capacity as of 2007 (MW)				Net Metering Utility (2006)		
State	Total (1)	Residential	Non-Res.	Unknown	Utility Participants (2)	Residential Customers	Non-Res. Customers
California	328.8	118.3	193.7	16.8	19	24,160	1,972
New Jersey	43.6	14.5	27.6	1.5	5	1,789	203
Arizona	18.9	3.2	13.1	2.6	4	185	3
Nevada	18.8	1.2	17.6	-	2	213	23
New York	15.4	9.7	5.2	0.5	5	1,088	119
Colorado	14.6	4.8	9.6	0.2	17	380	25
Massachusetts	4.6	1.5	3.2	-	5	454	104
Hawaii	4.5	1.3	2.4	0.8	4	184	23
Texas	3.2	1.6	1.7	-	9	375	56
All Other States	8.3	9.4	22.6	17.7	180	2,495	617
Total (3)	**475.0**	**164.4**	**283.5**	**22.4**	**232**	**31,323**	**3,146**

Note(s): 1) Projections totals may not add due to rounding. 2) Includes entities with participants in more than one state. 3) Arizona does not have state-wide net metering provisions. 3) Estimated total grid-tied capacity differs from Table 6.3.10.
Source(s): Sherwood, Larry. Interstate Renewable Energy Council (IREC). Personal Communication July, 2008; EIA. Green Pricing and Net Metering Programs, 2006. July 2008. Table 4.2, p. 10.

5.8.10 Annual Installed Capacity of Photovoltaic Cells and Modules, Off-Grid and On-Grid (DC MW)

	On-Grid	Off-Grid	Total
1997	1.4	9.0	10.4
1998	1.8	9.7	11.5
1999	2.6	12.0	14.6
2000	3.7	13.5	17.2
2001	11.1	16.0	27.1
2002	22.5	21.4	43.9
2003	43.4	25.0	68.4
2004	54.7	28.0	82.7
2005	67.4	33.0	100.4
2006	103.2	0.0	103.2
2007	150.1	55.0	205.1
Cumulative (1)	**469.9**	**282.0**	**751.9**

Note(s): 1) Cumulative grid-tied capacity as of 2007 differs from total estimate in Table 6.3.9.
Source(s): Sherwood, Larry. Interstate Renewable Energy Council. Personal Communication. July, 2008.

5.9.1 United States Small Wind Units and Capacity

	Units	On-Grid Units	Off-Grid Units	Capacity kW	On-Grid kW	Off-Grid kW	Sales ($ Million)
2001 (1)	2100	-	-	2,100	-	-	-
2002 (1)	3100	-	-	3,100	-	-	-
2003 (1)	3200	-	-	3,200	-	-	-
2004	4671	-	-	4,878	-	-	17.2
2005	4324	-	-	3,285	-	-	11.1
2006	8330	1	7,876	8,565	4,522	4,043	35.8
2007	9102	1	7,800	9,748	5,720	4,017	43.1
2008	10386	1	7,402	17,374	13,610	3,764	73.5
2009	9820	-	-	20,375	-	-	91.0
2010	7811	-	-	25,618	-	-	139.2

	Remote Off-Grid(2) (< 1 kW)	Residential-Scale (1 - 10 kW)	Commericial Scale (11 - 100 kW)
% 2008 Units	65%	34%	2%
% 2008 Capacity	16%	44%	40%

Note(s): 1) Estimates. 2) Turbines under 1 kW are often used on marine vehicles to charge batteries and to pump water for irrigation or ranching.

Source(s): American Wind Energy Association (AWEA), Stimmel, Ron, 2008 AWEA Small Wind Turbine Global Market Study, June 2008 for 2006 and 2007 detail; AWEA, Stimmel, Ron, 2009 AWEA Small Wind Turbine Global Market Study for 2008 detail; and AWEA, Stimmel, Ron, 2011 AWEA Small Wind Turbine Global Market Study for 2001-2009 units and capacities.

5.9.2 Average Combined Heat and Power Capacity as of 2011, Selected Building Type and Prime Mover (kW)

	Combustion Turbine	Reciprocating Engine	Fuel Cell	Microturbine	Boiler/Steam Turbine	Other
Multifamily Buildings	-	236	365	223	19,000	37,700
Colleges/Univ	15,918	2,039	223	202	18,342	40,659
Restaurants	-	222	-	120	-	-
Hospitals/Healthcare	5,399	1,280	264	298	10,097	22,407
Hotels	5,291	650	444	149	-	400
Justice/Public Order	10,304	1,568	521	58	11,050	28,800
General Merch. Stores	-	2,167	800	360	-	-
Nursing Homes	-	154	-	434	1,000	-
Office	4,533	1,172	440	219	14,025	450
General Gov't	7,957	1,043	285	197	2,686	14,558
Schools K-12	-	322	200	93	1,500	-
Community Services	-	124	200	-	-	-

Source(s): Energy and Environmental Analysis Inc, The Combined Heat and Power Database, http://www.eea-inc.com/chpdata/index.html

5.9.3 Installed Combined Heat and Power Capacity as of 2011, Selected Building Type and Prime Mover (MW)

	Combustion Turbine	Reciprocating Engine	Fuel Cell	Microturbine	Boiler/Steam Turbine	Other	**Total**
Multifamily Buildings	-	35	1	3	38	38	115
Colleges/Univ	828	160	3	4	1009	732	2736
Restaurants	-	2	-	0	-	-	2
Hospitals/Healthcare	184	143	2	2	202	224	757
Hotels	41	57	4	3	-	0	105
Justice/Public Order	52	24	3	0	55	58	191
General Merch. Stores	-	22	1	0	-	-	23
Nursing Homes	-	18	-	3	1	-	22
Office	41	95	2	3	28	0	170
General Gov't	56	28	2	2	19	58	165
Schools K-12	-	64	1	3	2	-	70
Community Services	-	1	0	-	-	-	1
Total	1201	649	18	23	1353	1110	**4355**

Source(s): Energy and Environmental Analysis Inc, The Combined Heat and Power Database, http://www.eea-inc.com/chpdata/index.html

5.9.4 Installed Combined Heat and Power Capacity as of 2011, Selected Building Type and Census Region (MW)

	Northeast	South	Midwest	West	**Total**
Multifamily Buildings	112	-	-	2	115
Colleges/Univ	570	522	1,128	516	2,736
Restaurants	0	2	-	0	2
Hospitals/Healthcare	316	126	108	206	757
Hotels	34	9	0	62	105
Justice/Public Order	59	8	9	115	191
General Merch. Stores	18	-	5	0	23
Nursing Homes	17	0	4	2	22
Office	82	34	15	39	170
General Gov't	3	82	36	44	165
Schools K-12	27	0	21	21	70
Community Services	1	-	-	1	1
Total	**1,238**	**783**	**1,326**	**1,008**	**4,355**

Source(s): Energy and Environmental Analysis Inc, The Combined Heat and Power Database, http://www.eea-inc.com/chpdata/index.html

5.9.5 Installed Combined Heat and Power Capacity as of 2011, Prime Mover and Census Region (MW)

Prime Mover	Northeast	South	Midwest	West	**Total**
Combustion Turbine	359	324	266	251	1,201
Reciprocating Engine	251	121	112	165	649
Fuel Cell	9	0	0	8	18
Microturbine	11	1	1	10	23
Boiler/Steam Turbine	466	182	624	82	1,353
Other	141	156	323	491	1,110
Total	**1,238**	**783**	**1,326**	**1,008**	**4,355**

Source(s): Energy and Environmental Analysis Inc, The Combined Heat and Power Database, http://www.eea-inc.com/chpdata/index.html

5.9.6 Characteristics of Commercial Distributed Generating Technologies, by Plant Type as of 2006

	Efficiency (HHV)		Typicall Installed Capital Costs			Service
		Electrical	Price	Size	Cost	Life
New Plant Type	Electrical	+ Thermal	($2010 per kW)	(kW)	($2010 thousand)	(years)
Solar Photovoltaic	0.15	N.A.	6,939	32	222	30
Wind	0.13	N.A.	5,274	32	169	30
Fuel Cell	0.42	0.65	7,187	200	1,437	20
Natural Gas Engine	0.30	0.82	1,797	334	600	20
Oil-Fired Engine	0.34	0.73	1,801	300	540	20
Natural Gas Turbine	0.25	0.76	1,908	3510	6,697	20
Natural Gas Microturbine	0.32	0.61	2,437	200	487	20

Source(s): EIA, Assumptions to the Annual Energy Outlook 2011, July 2011, Table 5.3, p. 42 ; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353.

Chapter 6: Energy Supply

Chapter 6 focuses on the U.S. energy supply. Sections 6.1 and 6.2 contain data on electric utilities, including generation capacity, primary fuel consumption, transmission and distribution losses, and electricity prices. Section 6.3 addresses the production, consumption, and storage of natural gas and petroleum. Section 6.4 covers emissions from the utility sector. Section 6.5 provides data on how utilities spend public and system benefit funds. The main points from this chapter are summarized below:

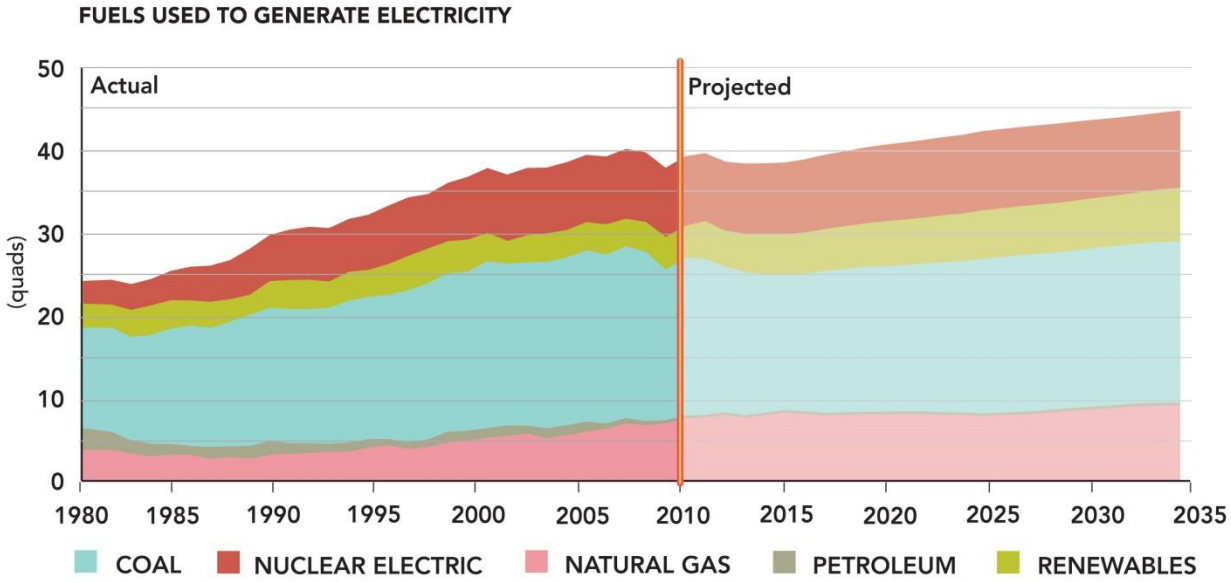
- Total primary energy consumption in the United States increased from 78 quads in 1980 to more than 98 quads in 2010. (1.1.3)
- Electricity consumption in the buildings sector has more than doubled since 1980, increasing from 4.4 quads of delivered energy to 9.5 quads in 2010. (6.1.1)
- The average capacity factor of nuclear plants increased from 66% in 1990 to 91% in 2010, while the average capacity factor for coal plants increased from 59% to only 65%.
- From 2000 to 2010, the number of natural gas wells increased from about 276,000 to 510,000 nationwide, allowing 89% of gas consumed in the United States to be produced domestically in 2010.

Total primary energy consumption in the United States increased from 78 quads in 1980 to more than 98 quads in 2010. (1.1.3) Much of this growth has been driven by a 79% increase in electricity demand, from 7.2 quads of delivered energy in 1980 to 12.8 quads in 2010, or 2.0% annual increase during this period. To meet this demand, primary fuel consumption by electric utilities has increased from 24.3 quads to 39.6 quads over the same period. The Energy Information Administration (EIA) projects energy consumption from electricity will grow at a reduced rate to 15.3 quads of delivered energy and 45.1 quads of primary energy by 2035. (6.1.1), (6.1.3)

In 2010, the buildings sector consumed 40% of total primary energy but 74% of electricity. Electricity demand in the buildings sector has more than doubled since 1980, increasing from 4.4 quads of delivered energy to 9.5 quads in 2010. In comparison, buildings consumed 8.4 quads of natural gas, 1.9 quads of petroleum, and less than 1 quad of coal and renewable sources on site. Electricity accounted for 82% of energy expenditures ($302 billion) in the buildings sector in 2010. (6.1.1), (6.1.3)

Utilities rely on a variety of input fuels to generate electricity, including coal, nuclear, natural gas, petroleum, and renewable sources such as solar, wind, and hydroelectric dams. Coal has accounted for at least half of electricity generation from 1980 through 2008. Coal consumption has declined recently and is projected to continue its decline, accounting for only 43% of utilities' energy consumption in 2035. Nuclear generation also grew from 2.7 quads in 1980 to 8.4 quads, or 21% of total generation, in 2010. The use of natural gas and petroleum is very responsive to price, and use increases when prices become more competitive. As an overall trend, their shares of total generation decreased between 1980 and 1990, from 16% to 11% for natural gas and from 11% to 4% for petroleum. (6.1.2), (6.1.3)

Between 1990 and 2010, petroleum continued to fall as a share of total generation, while generation from natural gas doubled to 8.0 quads. The amount of electricity generated by nuclear power plants remained between 19% and 22% of total generation. As new nuclear capacity increases in the near future, nuclear-generated electricity will increase. After 2030 when nuclear capacity declines, nuclear-generated electricity declines. After 2030, coal's share of total generation is stable, while absolute generation from coal increases by 26% to 20.5 quads. EIA expects renewable sources to increase their share from 10% in 2008 to 14% in 2035, mostly as a result of increased wind capacity. (6.1.2), (6.1.3)

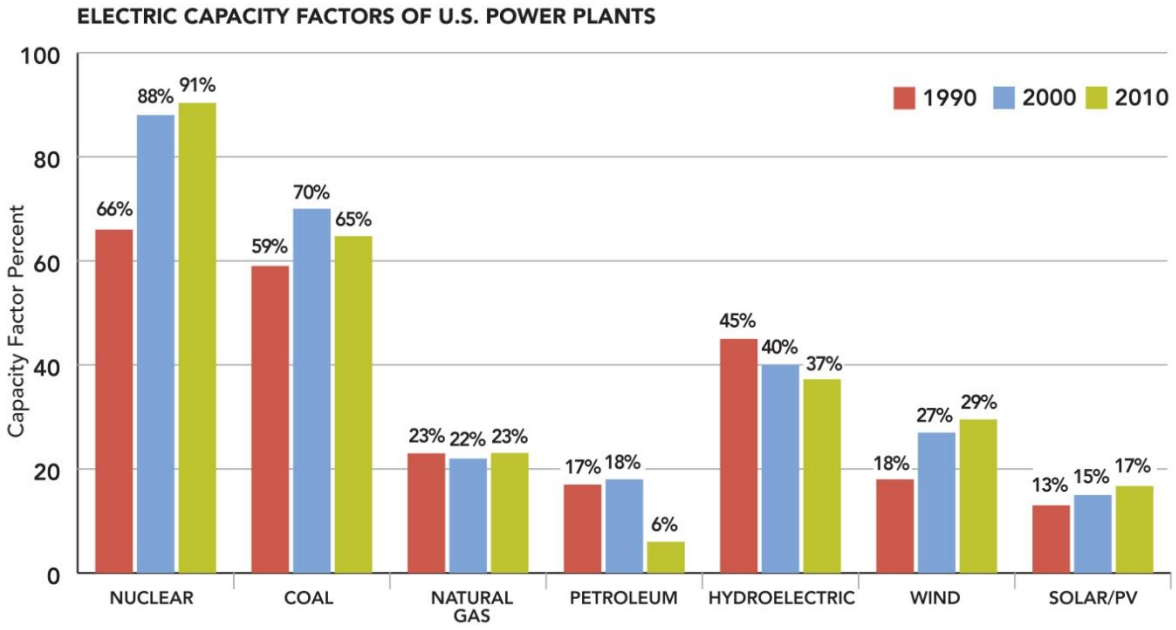


Electric utilities are major emitters of carbon dioxide and other greenhouse gases. Emissions increased from 1.83 billion metric tons in 1990 to 2.27 billion metric tons in 2010, equal to 40% of total U.S. emissions. (6.4.1) Coal accounted for 81% of emissions, and natural gas accounted for 18%, while petroleum used in electricity generation represents less than 2% of total emissions. A very small amount—about 12 million metric tons of carbon dioxide—can be attributed to geothermal and municipal solid waste. (6.4.2)

As of 2010, there were 18,150 power plants and other sources of electricity generation in the United States. The combined nameplate capacity—the maximum output of a plant operating at full load—of these generators was 1,139 GW. (6.2.1) Meeting the 2035 electricity demand projected by EIA will require an additional 1,041 power plants or 175 GW, including renewable energy power plants. EIA expects new fossil fuel plants to provide 122 GW of this capacity, 43 GW from renewable energy power plants, and 10 GW from nuclear power plants. (6.1.7),

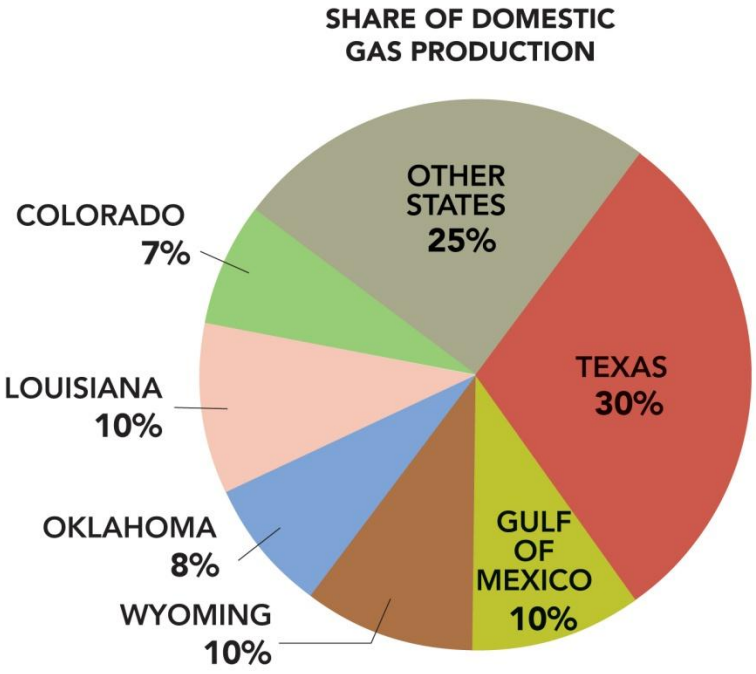
According to EIA, electric capacity factor is a measurement of the electrical energy produced by a generating unit over a period of time as a fraction of its full nameplate capacity. This metric is an indicator of how consistently a generator produces power. Coal and nuclear plants have low fuel costs but cannot be cycled on and off easily, thus most operate continuously at high outputs. On the other hand, petroleum and natural gas are more expensive but can be dispatched quickly if needed; therefore, such plants usually operate only during times of peak demand. This is known as operating in “load-following” mode. Renewable power has the lowest operating costs, but the fuel sources are intermittent. In the case of hydroelectric plants, operators can choose to reduce their capacity factor to provide higher outputs during peak times or to manage ecosystem concerns.

Improvements in fuel design and operating procedures have allowed nuclear plants to run more reliably and with fewer refueling outages. The average capacity factor of nuclear plants increased from 66% in 1990 to 91% in 2010. The average capacity factor for coal plants increased from 59% in 1990 to a high of 72% in 2007. However, since then the capacity factor for coal generation has been falling. (6.2.3) The capacity factor for natural gas plants has remained relatively stable over the last twenty years and is primarily dispatched for peak demand.



Only 32% of the primary energy utilities use is delivered to consumers. The majority (65%) of primary energy is lost as heat during fuel conversion or otherwise consumed by the electric generator. Transmission and distribution losses account for the remaining 3% of primary energy. The average delivery efficiency was only 29% in 1980, and EIA expects it to increase to 34% in 2035 as utilities deploy more efficient generation technologies. (6.2.4) (1.1.4)

The United States consumed 24.1 trillion cubic feet of natural gas in 2010, an increase of 21% over 1980. With the increased capacity of natural gas-fired generators built over the last 20 years, the electric utility sector now consumes twice as much natural gas as it did in 1980. The natural gas consumption now nearly matches the consumption of the buildings sector. In 1980, the buildings sector consumed 7.4 trillion cubic feet on site, while the electric power sector consumed only 3.7 trillion cubic feet. (6.3.5)



From 2000 to 2010, the number of producing wells increased from about 276,000 to 510,000 nationwide, allowing 89% of U.S. gas consumption to be produced domestically. (6.3.3) In 2010, 30% of the nation's natural gas came from Texas, and another 10% came from each of the Gulf of Mexico, Wyoming, and Louisiana. (6.3.6)

6.1.1 Buildings Share of U.S. Electricity Consumption/Sales (Percent)

	Buildings						Delivered Total
	Residential	Commercial	**Total**	Industry	Transportation	Total	(10^15 Btu)
1980	34.3%	26.7%	60.9%	38.9%	0.2%	100%	7.15
1990	34.1%	30.9%	65.0%	34.9%	0.2%	100%	9.26
2000	34.9%	33.9%	68.7%	31.1%	0.2%	100%	11.67
2005	37.1%	34.8%	72.0%	27.8%	0.2%	100%	12.49
2010 (1)	38.7%	35.5%	74.2%	25.7%	0.2%	100%	12.79
2015	37.2%	36.0%	73.2%	26.6%	0.2%	100%	12.88
2020	37.0%	36.3%	73.3%	26.4%	0.2%	100%	13.58
2025	37.5%	37.0%	74.5%	25.2%	0.3%	100%	14.13
2030	38.2%	37.7%	75.9%	23.7%	0.4%	100%	14.75
2035	38.8%	38.4%	77.2%	22.3%	0.5%	100%	15.32

Note(s): 1) Buildings accounted for 82% (or $302 billion) of total U.S. electricity expenditures.

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2 for 2010-2035 consumption, and Table A3 for expenditures.

6.1.2 U.S. Electricity Generation Input Fuel Shares (Percent)

				Renewables					
	Natural Gas	Petroleum	Coal	Hydro.	Oth(2)	Total	Nuclear	Other (3)	Total
1980	15.7%	10.8%	50.2%	11.8%	0.2%	12.1%	11.3%	(1)	100%
1990	10.7%	4.2%	53.4%	9.9%	1.7%	11.6%	20.0%	(1)	100%
2000	13.9%	3.0%	53.3%	7.3%	1.7%	9.0%	20.7%	(1)	100%
2005	15.1%	3.1%	52.5%	6.8%	1.9%	8.6%	20.7%	(1)	100%
2010	**19.0%**	**1.0%**	**48.3%**	**6.3%**	**3.4%**	**9.7%**	**21.3%**	**0.7%**	**100%**
2015	21.3%	0.8%	42.2%	7.4%	5.2%	12.6%	22.3%	0.8%	100%
2020	19.7%	0.8%	43.0%	7.1%	6.1%	13.3%	22.6%	0.7%	100%
2025	18.4%	0.8%	43.9%	6.9%	6.8%	13.8%	22.5%	0.6%	100%
2030	19.6%	0.8%	43.6%	6.8%	6.9%	13.8%	21.8%	0.6%	100%
2035	20.2%	0.8%	43.4%	6.7%	7.6%	14.4%	20.7%	0.5%	100%

Note(s): 1) Electric imports included in renewables. 2) Includes geothermal, municipal solid waste, biomass, solar thermal, solar PV, and wind. 3)

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2 for 2010-2035 consumption and Table A17 for renewables.

6.1.3 U.S. Electricity Generation Input Fuel Consumption (Quadrillion Btu)

				Renewables						Growth Rate
	Natural Gas	Petroleum	Coal	Hydro.	Oth(2)	Total	Nuclear	Other (3)	Total	2008-Year
1980	3.79	2.62	12.16	2.87	0.06	2.92	2.74	(1)	24.32	-
1990	3.27	1.29	16.26	3.01	0.51	3.52	6.10	(1)	30.51	-
2000	5.26	1.14	20.22	2.77	0.66	3.43	7.86	(1)	38.08	-
2005	5.96	1.23	20.74	2.67	0.74	3.41	8.16	(1)	39.65	-
2010	**7.54**	**0.38**	**19.13**	**2.49**	**1.36**	**3.85**	**8.44**	**0.29**	**39.63**	**-**
2015	8.27	0.31	16.42	2.88	2.01	4.89	8.68	0.30	38.88	-0.4%
2020	8.06	0.32	17.61	2.93	2.51	5.44	9.28	0.29	40.99	0.3%
2025	7.86	0.32	18.72	2.95	2.91	5.87	9.60	0.27	42.64	0.5%
2030	8.58	0.33	19.11	2.99	3.05	6.04	9.55	0.25	43.86	0.5%
2035	9.13	0.34	19.57	3.04	3.44	6.48	9.35	0.24	45.11	0.5%

Note(s): 1) Electric imports included in renewables. 2) Includes geothermal, municipal solid waste, biomass, solar thermal, solar PV, and wind. 3)

Source(s): EIA, State Energy Consumption Database, June 2011 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2 for 2010-2035 consumption, and Table A17 for renewables.

6.1.4 U.S. Electricity Net Generation, by Plant Type (Billion kWh)

				Renewables						Growth Rate
	Natural Gas	Petroleum	Coal	Hydr(1)	Oth(2)	Total	Nuclear	CHP (3)	Tot.(4)	2010-year
1980	346	246	1,162	276	6	282	251	N.A.	2,286	-
1990	265	118	1,560	290	35	324	577	61	2,905	-
2000	399	98	1,911	271	45	316	754	165	3,643	-
2005	553	111	1,956	267	53	320	782	180	3,903	-
2010	776	32	1,799	289	100	390	807	165	3,969	-
2015	906	26	1,560	297	197	494	830	160	3,977	0.0%
2020	876	27	1,674	298	246	544	887	161	4,169	0.5%
2025	854	28	1,779	298	288	586	917	160	4,325	0.6%
2030	970	28	1,815	299	306	605	913	161	4,492	0.6%
2035	1,068	29	1,857	299	353	652	894	159	4,659	0.6%

Note(s): 1) Electricity used for hydroelectric pumped storage is subtracted from this conventional hydroelectric generation. 2) Includes geothermal, municipal solid waste, wood, biomass, solar thermal, solar photovoltaic, and wind. 3) CHP = Combined heat and Power. Includes CHP plants whose primary business is to sell electricity and heat to the public. 4) Includes batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, distributed generation, and other miscellaneous technologies that are not listed individually.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A8 for 2010-2035; EIA, Annual Energy Review 2010, Oct. 2011, Table 8.2c, p. 240 for 1990-2009; and EIA, Annual Energy Review 2002, Oct. 2003, Table 8.2b, p. 149 for 1980-1988.

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

	Coal Steam	Other Fossil	Combine Cycle	Combustion Turbine	Nuclear	Pumped	Total
1980	N.A.	N.A.	N.A.	N.A.	51.8	0.0	495.9
1990	302.3	N.A.	N.A.	N.A.	99.6	19.5	628.4
2000	310.2	N.A.	N.A.	N.A.	97.9	19.5	693.3
2005	309.0	N.A.	N.A.	N.A.	100.0	21.3	855.6
2010	**308.1**	**107.4**	**171.7**	**134.84**	**101.2**	**22.2**	**845.4**
2015	288.9	97.2	186.5	141.68	103.6	22.2	840.1
2020	286.2	89.9	187.2	145.34	111.2	22.2	842.0
2025	285.6	89.0	194.5	154.88	114.7	22.2	860.8
2030	285.6	87.9	214.1	162.62	114.2	22.2	886.6
2035	285.8	86.7	241.5	167.40	112.0	22.2	915.7

Note(s): 1) Nuclear capacity includes 3 GW of uprates from 2005 to 2030. New nuclear plants are expected to come online 2013-2019.

Source(s): EIA, Annual Energy Review 2010, Oct. 2011, Table 8.11b for 1980-2009; and EIA, AEO 2012 Early Release, Jan. 2012, Table A9 and Table A16 for 2010-2035.

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

	Conv. Hydropower	Geothermal	Municipal Solid Waste	Biomass	Solar Thermal	Solar PV	Wind	Total
1980	81.7	0.9	0.0	0.1	0.0	N.A.	N.A.	82.7
1990	73.3	2.7	2.1	1.2	0.3	N.A.	1.8	81.4
2000	78.2	2.8	3.3	1.7	0.4	N.A.	2.4	88.8
2005	76.9	2.3	3.0	1.6	0.4	N.A.	8.7	92.9
2010	**78.0**	**2.4**	**3.3**	**2.4**	**0.5**	**0.4**	**39.1**	**126.1**
2015	78.4	2.8	3.4	2.7	1.4	2.0	51.6	142.4
2020	78.9	3.6	3.4	2.7	1.4	2.0	51.6	143.8
2025	79.6	4.4	3.4	2.7	1.4	2.3	54.6	148.4
2030	80.5	5.5	3.4	2.7	1.4	3.8	57.5	154.8
2035	81.7	6.4	3.4	2.7	1.4	8.2	65.4	169.2

Source(s): EIA, Annual Energy Review 2011, Oct. 2011, Table 8.11b for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A9 and Table A16 for 2010-2035.

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

Electric Generator	Typical New Plant Capacity (MW)	Number of New Power Plants to Meet Demand 2015	2020	2025	2030	2035
Coal Steam	1,300	7	8	8	8	8
Combined Cycle	540	28	29	43	79	130
Combustion Turbine/Diesel	148	62	105	174	250	284
Nuclear Power	2,236	1	3	3	3	4
Pumped Storage	147 (2)	0	0	0	0	0
Fuel Cells	10	0	0	0	0	0
Conventional Hydropower	20 (2)	20	47	81	125	185
Geothermal	50	9	26	41	62	81
Municipal Solid Waste	50	1	1	1	1	1
Wood and Other Biomass	50	5	5	5	5	6
Solar Thermal	100	9	9	9	9	9
Solar Photovoltaic	150	11	11	13	23	52
Wind	100	123	124	153	182	262
Total		**277**	**372**	**538**	**760**	**1,041**
Distributed Generation	148 (3)					

Note(s): 1) Cumulative additions after Dec. 31, 2010. 2) Based on current stock average capacity. 3) Combustion turbine/diesel data used.

Source(s): EIA, Annual Energy Outlook (AEO) 2012 Early Release, Jan. 2012, Table A9 and Table A16; EIA, Assumption to the AEO 2011, July 2011, Table 8.2, p. 97; and EIA, Electric Power Annual 2010, Feb. 2012, Table 1.2 for pumped storage and hydroelectric plant capacity.

6.2.1 2010 Existing Capacity, by Energy Source (GW)

Plant Fuel Type	Number of Generators	Generator Nameplate Capacity	Net Summer Capacity	Net Winter Capacity
Coal	1,396	342.3	316.8	319.2
Petroleum	3,779	62.5	55.6	59.6
Natural Gas	5,529	467.2	407.0	438.7
Other Gases	106	3.1	2.7	2.7
Nuclear	104	106.7	101.2	103.0
Hydroelectric Conventional	4,020	78.2	78.8	78.5
Wind	689	39.5	39.1	39.2
Solar Thermal and Photovoltaic	180	0.9	0.9	0.8
Wood and Wood Derived Fuels	346	7.9	7.0	7.1
Geothermal	225	3.5	2.4	2.6
Other Biomass	1,574	5.0	4.4	4.4
Pumped Storage	151	20.5	22.2	22.1
Other	51	1.0	0.9	0.9
Total	**18,150**	**1,138.6**	**1,039.1**	**1,078.7**

Source(s): EIA, Electric Power Annual 2010, Feb. 2012, Table 1.2.

6.2.2 Net Internal Demand, Capacity Resources, and Capacity Margins in the Contiguous United States (GW)

	Net Internal Demand (1)	Capacity Resources (2)	Capacity Margin (3)
1995	589.9	727.5	18.9%
1996	602.4	730.4	17.5%
1997	618.4	737.9	16.2%
1998	638.1	744.7	14.3%
1999	653.9	765.7	14.6%
2000	680.9	808.1	15.7%
2001	674.8	789.0	14.5%
2002	696.4	833.4	16.4%
2003	696.8	856.1	18.6%
2004	692.9	875.9	20.9%
2005	746.5	882.1	15.4%
2006	776.5	891.2	12.9%
2007	766.8	914.4	16.1%
2008	744.2	909.5	18.2%
2009	713.1	916.4	22.2%
2010	**747.8**	**924.9**	**19.1%**
2011	730.4	939.4	22.2%
2012	745.4	957.2	22.1%
2013	757.5	970.1	21.9%
2014	768.5	977.8	21.4%
2015	778.5	980.3	20.6%

Note(s): 1) Net internal demand represents the system demand that is planned for by the electric power industry`s reliability authority and is equal to internal demand less direct control load management and interruptible demand. Direct control load management: Customer demand that can be interrupted at the time of the seasonal peak by direct control of the system operator by interrupting power supply to individual appliances or equipment on customer premises. This type of control usually reduces the demand of residential customers. Interruptible demand: Customer demand that can be interrupted (through contractual agreement) during peak loads by direct control of the system operator or by the customer at direct request of the system operator. This type of control usually reduces the demand of large-volume commercial and industrial consumers. 2) Capacity Resources: Utility- and IPP-owned generating capacity that is existing or in various stages of planning or construction, less inoperable capacity, plus planned capacity purchases from other resources, less planned capacity sales. 3) Capacity Margin is the amount of unused available capability of an electric power system at peak load as a percentage of capacity resources.

Source(s): EIA, Electric Power Annual 2006, Oct. 2007, Table 3.2, p. 34 for 1995-1997; EIA, Electric Power Annual 2009, Nov. 2010, Table 4.2, p. 41 for 1998; and EIA, Electric Power Annual 2010, Nov. 2011, Table 4.3.A and Table 4.3.B for 1999-2015

6.2.3 Electric Capacity Factors, by Year and Fuel Type (1)

	Coal	Petroleum	Natural Gas	Nuclear	Conventional Hydroelectric	Solar/PV	Wind	Total
1990	59%	17%	23%	66%	45%	13%	18%	46%
1995	62%	11%	22%	77%	45%	17%	21%	47%
2000	70%	18%	22%	88%	40%	15%	27%	51%
2001	68%	20%	21%	89%	31%	16%	20%	48%
2002	69%	16%	18%	90%	38%	16%	27%	46%
2003	71%	21%	14%	88%	40%	15%	21%	44%
2004	71%	22%	16%	90%	39%	17%	25%	44%
2005	72%	22%	17%	89%	40%	15%	23%	45%
2006	71%	11%	19%	90%	42%	14%	27%	45%
2007	72%	12%	21%	92%	36%	14%	24%	45%
2008	71%	8%	20%	91%	37%	18%	26%	44%
2009	63%	7%	21%	90%	40%	16%	25%	42%
2010 (2)	65%	6%	23%	91%	37%	17%	29%	43%

Note(s): 1) EIA defines capacity factor to be "the ratio of the electrical energy produced by a generating unit for the period of time considered to the electrical energy that could have been produced at continuous full power operation during the same period. 2) Preliminary.

Source(s) EIA, Annual Energy Review 2010, Oct. 2011, 8.2c, p. 240 and Table 8.11b, p. 273.

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

	Average Utility Delivery Efficiency (1, 2)	Average Utility Delivery Ratio (Btu/kWh) (2, 3)	Growth Rate (2010-year)
1980	29.4%	11,614	-
1990	30.3%	10,754	-
2000	30.7%	10,600	-
2005	31.5%	10,405	-
2010	**32.3%**	**10,570**	**-**
2015	33.1%	10,300	0.5%
2020	33.1%	10,301	0.3%
2025	33.1%	10,294	0.2%
2030	33.6%	10,148	0.2%
2035	34.0%	10,045	0.2%

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

Percent of Electric Generator Fuel Input	2.6%
Percent of Net Electricity Generated (4)	7.4%

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 2012 Early Release, Jan. 2012, Table A2 for generator consumption and Table A8 for electricity sales; EIA, Annual Energy Review 2010, Oct. 2011, Figure 8.0, p. 233 for T&D losses; and EIA, State Energy Consumption Database, June 2011 for Electricity Consumption and Generator Fuel Consumption.

6.2.5 2010 Impacts of Saving an Electric Quad (1)

Plant Fuel Type	Utility Fuel Input Shares (%)	Average-Sized Utility Unit (MW) in 2010	Aggregate Number of Units to Provide the Fuel's Share of the Electric Quad (2)
Coal	49%	245	36
Petroleum	1%	17	96
Natural Gas	19%	85	141
Nuclear	22%	1,026	3
Renewable (3)	10%	22	184
Total	100%		**460**

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 2010. Use this table to estimate the avoided capacity implied by saving one electric quad. 2) Based on typical U.S. power plants operating less than full load throughout the year. 3) Includes pumped storage.

Source(s): EIA, Electric Power Annual 2010, Feb. 2012, Table 1.2; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2 for consumption and Table A8 for electricity supply.

6.2.6 Cost of an Electric Quad Used in the Buildings Sector ($2010 Billion)

	Residential	Commercial	**Buildings Sector**
1980	10.59	10.83	10.70
1990	10.57	9.76	10.19
2000	9.15	8.16	8.66
2005	9.56	8.77	9.18
2010	**11.92**	**10.52**	**11.25**
2015	12.06	10.19	11.14
2020	11.79	10.09	10.94
2025	11.74	10.08	10.91
2030	11.71	9.94	10.83

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 2012 Early Release, Jan. 2012, Table A2 and Table A3; EIA, State Energy Consumption Database, June 2011 for 1980-2009; EIA, State Energy Data Prices and Expenditures Database, June 2011 for 1980-2009; and EIA, Annual Energy Review 2010, Oct. 2011, Appendix D, p. 353 for price deflators.

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

New Plant Type	Heat rate (1) in 2010 (Btu/kWh)	Size (MW)	Overnight Costs (2) (2010 $/kW)	Total Capital Costs of Typical New Plant ($2010 million)
Scrubbed Coal	8,800	1300	2809	3652
Integrated Coal-Gasification Combined Cycle (IGCC)	8,700	1200	3182	3818
IGCC w/Carbon Sequestration	10,700	520	5287	2749
Conv. Gas/Oil Combined Cycle	7,050	540	967	522
Adv. Gas/Oil Combined Cycle	6,430	400	991	396
Conv. Combustion Turbine	10,745	85	961	82
Adv. Combustion Turbine	9,750	210	658	138
Fuel Cell	9,500	10	6752	68
Advanced Nuclear	10,453	2236	5275	11795
Municipal Solid Waste	13,648	50	8237	412
Conventional Hydropower (3)	9,854	500	2221	1111
Wind	9,854	100	2409	241

Stock Plant Type	2010	2015	2020	2025	2030	2035
Fossil Fuel Steam Heat Rate (Btu/kWh)	9,787	9,441	9,509	9,557	9,440	9,341
Nuclear Energy Heat Rate (Btu/kWh)	10,460	10,460	10,460	10,460	10,460	10,460

Note(s): 1) Plant use of electricity is included in heat rate calculations; however, transmission and distribution losses of the electric grid are excluded. 2) Overnight costs represent the capital costs of new projects initiated in 2009. Includes contingency factors and excludes interest charges. 3) Hydro costs and performance characteristics are site-specific. This table provides the cost of the least expensive plant that could be built in the Northwest Power Pool region, where most proposed sites are located.

Source(s): EIA, Assumptions to the AEO 2011, July 2011, Table 8.2. p. 97 for 2010 plant characteristics; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2 for consumption and Table A8 for electricity supply.

6.2.8 NERC Regions Map

Source(s): North American Reliability Corporation, NERC Regions Map Feb. 2012, http://www.nerc.com/fileUploads/File/AboutNERC/maps/NERC_Regions_color.jpg

6.2.9 2009 Peak Load and Capacity Margin, Summer and Winter by NERC Region (MW)

	Summer (1)		Winter (2)	
NERC Region	Peak Load	Capacity Margin	Peak Load	Capacity Margin
TRE	63,518	16.7%	56,191	19.1%
FRCC	46,550	6.0%	53,022	2.0%
MRO (U.S.)	37,963	24.6%	35,351	26.8%
NPCC (U.S.)	55,944	29.1%	44,864	43.2%
RFC	161,241	25.2%	143,827	33.3%
SERC	191,032	24.6%	193,135	26.2%
SPP	41,465	16.4%	32,863	34.6%
WECC	128,245	19.4%	109,565	29.6%
U.S. TOTAL	725,958	22.2%	668,818	28.5%

Note(s): 1) Summer Demand includes the months of June, July, August, and September. 2) Winter Demand includes December of the previous year and January-March of the current year. 3) Capacity Margin is the amount of unused available capability of an electric power system at peak load as a percentage of net capacity resources. Net Capacity Resources: Utility- and IPP-owned generating capacity that is existing or in various stages of planning or construction, less inoperable capacity, plus planned capacity purchases from other resources, less planned capacity sales.

Source(s): EIA, Electric Power Annual 2010, Nov. 2011, Table 4.1a for peak load, Table 4.3.a for summer capacity margin, and Table 4.4.a for winter capacity margin.

6.2.10 Top 10 U.S. States by Existing Wind Power Capacities

State	Existing Capacity (MW)	(%)	Capacity Under Construction (MW)
Texas	9,727	27%	350
Iowa	3,670	10%	0
California	2,739	7%	443
Oregon	2,095	6%	201
Washington	1,964	5%	735
Illinois	1,848	5%	587
Minnesota	1,818	5%	677
New York	1,274	3%	95
Colorado	1,248	3%	552
Indiana	1,238	3%	99
U.S. Total	**36,698**		**6,925**

Note(s): Estimates of existing capacity and capacity under construction are current as of September 2010. Does not include small wind projects, i.e. those with capacities of 100 kW or less. Data provided by AWEA member companies and updated quarterly.

Source(s): American Wind Energy Association (AWEA), U.S. Projects Database, accessed February 2011.

6.3.1 Natural Gas Overview (Trillion Cubic Feet)

	Production	Supplemental Gas	Net Import	Storage Withdrawal	Balancing Item (1)	Consumption (2)
1980	19.40	0.15	0.94	0.02	-0.64	19.88
1990	17.81	0.12	1.45	-0.51	0.31	19.17
2000	19.18	0.09	3.54	0.83	-0.31	23.33
2005	18.05	0.06	3.61	0.05	0.23	22.01
2010	**21.58**	**0.07**	**2.58**	**-0.18**	**0.09**	**24.13**
2015	23.67	0.06	1.70	-0.11	0.05	25.38
2020	25.21	0.06	0.29	-0.08	0.04	25.52
2025	26.00	0.06	-0.84	-0.05	0.03	25.20
2030	26.79	0.06	-0.97	-0.02	0.01	25.87
2035	27.84	0.06	-1.43	0.00	0.00	26.48

Note(s): 1) Quantities lost an imbalances in data due to differences among data sources. Excludes intransit shipments that cross the U.S.-Canada border. 2) Natural gas consumption statistics are compiled from surveys of natural gas production, transmission, and distribution companies and from surveys of electric power generation. Consumption by sector from these surveys is compiled on a national and individual State basis and then balanced with national and individual State supply data.

Source(s): EIA, Annual Energy Review 2010, Oct. 2011, Table 6.1 for 1980-2009; and EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A13 for 2010-2035.

6.3.2 Natural Gas in Underground Storage (Billion Cubic Feet)

	Base Gas	Working Gas	Total	Underground Storage Capacity	
1980	3,642	2,655	6,297	7,434	85%
1981	3,752	2,817	6,569	7,805	84%
1982	3,808	3,071	6,879	7,915	87%
1983	3,847	2,595	6,442	7,985	81%
1984	3,830	2,876	6,706	8,043	83%
1985	3,842	2,607	6,448	8,087	80%
1986	3,819	2,749	6,567	8,145	81%
1987	3,792	2,756	6,548	8,124	81%
1988	3,800	2,850	6,650	8,124	82%
1989	3,812	2,513	6,325	8,120	78%
1990	3,868	3,068	6,936	7,794	89%
1991	3,954	2,824	6,778	7,993	85%
1992	4,044	2,597	6,641	7,932	84%
1993	4,327	2,322	6,649	7,989	83%
1994	4,360	2,606	6,966	8,043	87%
1995	4,349	2,153	6,503	7,953	82%
1996	4,341	2,173	6,513	7,980	82%
1997	4,350	2,175	6,525	8,332	78%
1998	4,326	2,730	7,056	8,179	86%
1999	4,383	2,523	6,906	8,229	84%
2000	4,352	1,719	6,071	8,241	74%
2001	4,301	2,904	7,204	8,415	86%
2002	4,340	2,375	6,715	8,207	82%
2003	4,303	2,563	6,866	8,206	84%
2004	4,201	2,696	6,897	8,255	84%
2005	4,200	2,635	6,835	8,268	83%
2006	4,211	3,070	7,281	8,330	87%
2007	4,234	2,879	7,113	8,402	85%
2008	4,232	2,840	7,073	8,499	83%
2009	4,277	3,130	7,407	8,656	86%
2010	4,305	3,107	7,412	8,710	85%

Source(s): EIA, Annual Energy Review 2010, Oct. 2011, Table 6.6.

6.3.3 Natural Gas Well Productivity

	Gross Withdrawals from Wells (billion cubic feet)	Producing Wells (thousand)	Average Productivity (thousand cubic feet per day)
1980	17,573	182	96,550
1990	16,054	269	59,657
2000	17,726	276	57,964
2001	18,129	373	48,565
2002	17,795	388	45,890
2003	17,882	393	45,463
2004	17,885	406	44,036
2005	17,472	426	41,025
2006	17,996	441	40,851
2007	17,065	453	37,676
2008	15,618	477	32,767
2009	14,839	493	30,094
2010	14,760	510	28,934

Source(s): EIA, Annual Energy Review 2010, Oct. 2011, Table 6.4.

6.3.4 Natural Gas End-Use Deliveries by Type of Distributor for 1996, 2000, and 2006

	1996			2000			2006		
	Volume Delivered		Customers	Volume Delivered		Customers	Volume Delivered		Customers
Type of Distributor	(Tcf)	(Percent)	(millions)	(Tcf)	(Percent)	(millions)	(Tcf)	(Percent)	(millions)
Local Distribution Comp.	14.3	72%	58.7	14.2	67%	57.8	11.1	60%	61.4
Investor-Owned	13.3		54.0	13.2		4.3	0.8		4.9
Municipal	0.8		4.0	0.8		0.5	0.2		0.8
Privately-Owned	0.2		0.7	0.2		0.1	0.0		0.1
Cooperative	0.0		0.1	0.0		62.8	12.0		67.2
Interstate Pipeline	1.6	8%	0.0	2.5	12%	0.0	3.5	17%	0.0
Intrastate Pipeline	3.8	19%	1.4	4.3	20%	1.4	4.3	21%	2.7
Other	0.3	1%	0.0	0.2	1%	0.0	0.2	1%	0.0
Total	20.0	100%	60.2	21.2	100%	64.2	19.9	100%	69.9

Source(s): EIA, Distribution of Natural Gas: The Final Step in the Transmission Process, June 2008, Table 1, p. 6.

6.3.5 Natural Gas Consumption, by Sector (Trillion Cubic Feet)

	Residential	Commercial	Industrial	Transportation	Electric Power	Total
1980	4.75	2.61	8.20	0.63	3.68	19.88
1990	4.39	2.62	8.25	0.66	3.24	19.17
2000	5.00	3.18	9.29	0.65	5.21	23.33
2005	4.83	3.00	7.71	0.61	5.87	22.01
2010	**4.94**	**3.21**	**7.94**	**0.67**	**7.38**	**24.13**
2015	4.87	3.33	8.36	0.73	8.09	25.38
2020	4.82	3.40	8.66	0.76	7.89	25.52
2025	4.76	3.42	8.56	0.77	7.69	25.20
2030	4.72	3.49	8.46	0.80	8.40	25.87
2035	4.65	3.56	8.51	0.83	8.93	26.48

Source(s): EIA, Annual Energy Review 2010, Oct. 2011, Table 6.5 for 1980-2009; and EIA, AEO 2012 Early Release, Jan. 2012, Table A13 for 2010-2035.

6.3.6 Top 10 Natural Gas Producing States, 2009 and 2010 (1)

Gas Production in 2009

State	Marketed Production (2) (billion cubic feet)	Share of U.S. Production
1. Texas	6,819	30%
2. Wyoming	2,335	10%
3. Oklahoma	1,858	8%
4. Louisiana	1,549	7%
5. Colorado	1,499	7%
6. New Mexico	1,383	6%
7. Arkansas	680	3%
8. Utah	444	2%
9. Alaska	397	2%
10. Kansas	354	2%
		77%
Gulf of Mexico	2,429	11%
U.S Total	**21,604**	

Gas Production in 2010

State	Marketed Production (billion cubic feet)	Share of U.S. Production
1. Texas	6,715	30%
2. Wyoming	2,306	10%
3. Louisiana	2,210	10%
4. Oklahoma	1,827	8%
5. Colorado	1,578	7%
6. New Mexico	1,292	6%
7. Arkansas	927	4%
8. Pennsylvania (3)	573	3%
9. Utah	432	2%
10. Alaska	374	2%
		81%
Gulf of Mexico	2,245	10%
U.S. Total	**22,402**	

Note(s): 1) State production includes offshore production in state waters, where applicable. 2) Marketed production equals gross withdrawals less gas used for repressuring, quantities vented and flared, and nonhydrocarbon gases removed in treating or processing operations. Includes all quantities of gas used in field and processing plant operations. 3) Natural gas production in Pennsylvania more than doubled between 2009 and 2010 as a result the significant development of the Marcellus shale formation.

Source(s): EIA, Natural Gas Annual 2009, Dec. 2010, Table 2, p. 4. for gas production in 2009; EIA, Natural Gas Annual 2010, Dec. 2011, Table 2, p. 4. for gas production in 2010.

6.4.1 Emissions of Carbon Dioxide from Electric Utilities (Million Metric Tons)

1990	1,831
2000	2,310
2005	2,417
2010	**2,271**
2015	2,039
2020	2,136
2025	2,234
2030	2,311
2035	2,383

Source(s): EIA, Emissions of Green House Gases in the United States 2009, February 2011 for 1990-2009; EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A18 for 2010-2035.

6.4.2 Electric Quad Average Carbon Dioxide Emissions with Average Utility Fuel Mix (Million Metric Tons) (1)

	Petroleum	Natural Gas	Coal	Nuclear	Renewable	Total
2010	0.83	10.14	46.45	0.00	0.30	57.72
2011	0.00	0.21	0.00	0.00	0.00	0.21
2012	0.00	0.65	0.00	0.00	0.00	0.65
2013	0.00	0.16	0.00	0.00	0.00	0.16
2014	0.00	0.61	0.00	0.00	0.00	0.61
2015	0.00	1.04	0.00	0.00	0.00	1.04
2016	0.00	0.83	0.00	0.00	0.00	0.83
2017	0.00	0.58	0.00	0.00	0.00	0.58
2018	0.00	0.62	0.00	0.00	0.00	0.62
2019	0.00	0.70	0.00	0.00	0.00	0.70
2020	0.00	0.71	0.00	0.00	0.00	0.71
2021	0.00	0.76	0.00	0.00	0.00	0.76
2022	0.00	0.74	0.00	0.00	0.00	0.74
2023	0.00	0.60	0.00	0.00	0.00	0.60
2024	0.00	0.60	0.00	0.00	0.00	0.60
2025	0.00	0.43	0.00	0.00	0.00	0.43
2026	0.00	0.54	0.00	0.00	0.00	0.54
2027	0.00	0.63	0.00	0.00	0.00	0.63
2028	0.00	0.84	0.00	0.00	0.00	0.84
2029	0.00	1.05	0.00	0.00	0.00	1.05
2030	0.00	1.29	0.00	0.00	0.00	1.29
2031	0.00	1.46	0.08	0.00	0.00	1.54
2032	0.00	1.67	0.20	0.00	0.00	1.87
2033	0.00	1.82	0.38	0.00	0.00	2.20
2034	0.00	1.88	0.58	0.00	0.00	2.46
2035	0.00	1.88	0.76	0.00	0.00	2.65

Note(s): 1) This table provides estimates of the carbon emissions resulting from consumption of a primary quad at electric utilities. Projected (2011-2035) new marginal capacity emissions will result from natural gas- and coal-fired power plants. Electric generation capacity is projected to increase for biomass, wind, and nuclear power. Wind power, biomass, and hydroelectric power electric generation will increase 2010-2035. Nuclear electric generation capacity will increase 2014-2035. Electricity imports from utility consumption were ignored since this energy was produced outside of the U.S. "Average" means the weighted average of different fuels (e.g., petroleum is the average of residual and distillate fuel oils). The combustion of fossil fuels produces carbon in the form of carbon dioxide and carbon monoxide; however, carbon monoxide emissions oxidize in a relatively short time to form carbon dioxide. 2) Emissions from renewable energy include emissions released from geothermal power and non-biogenic emissions from municipal solid waste.

Source(s): EIA, Annual Energy Outlook 2012 Early Release, Jan. 2012, Table A2 and Table A18.

6.5.1 2009 Spending by Ratepayer-Funded Electric and Gas Efficiency Programs

Total Program Expenditures in 2009 by Customer Class ($millions)

	Efficiency Programs						
Region (1)	C&I (2)	Residential	Low Income	Other (3)	Total	Load Mgmt.	Grand Total
New England	203	135	49	12	399	8	406
Mid-Atlantic	338	139	139	24	640	13	653
Midwest	224	186	83	89	581	102	683
South Central	50	66	42	13	171	70	241
South Atlantic	37	131	7	30	205	277	481
Pacific NW	132	118	18	78	345	19	364
Pacific West	540	277	210	106	1,133	257	1,390
Southwest	84	143	15	13	255	48	302
Additional (4)	8	22	22	7	58	0	58
United States	1,615	1,217	583	371	3,786	793	4,579

Electric Program Expenditures in 2009 by Customer Class ($millions)

	Efficiency Programs						
Region (1)	C&I (2)	Residential	Low Income	Other (3)	Total	Load Mgmt.	Grand Total
New England	186	99	37	12	333	8	341
Mid-Atlantic	305	82	69	24	479	13	491
Midwest	190	125	26	64	404	102	505
South Central	50	64	42	13	168	70	238
South Atlantic	36	122	5	30	192	277	469
Pacific NW	122	100	15	76	312	19	331
Pacific West	476	239	106	84	904	257	1,161
Southwest	82	91	9	9	191	48	239
United States	1,445	921	308	311	2,983	793	3,776

Gas Program Expenditures in 2009 by Customer Class ($millions)

	Efficiency Programs				
Region (1)	C&I (2)	Residential	Low Income	Other (3)	Total
New England	17	37	12	0	66
Mid-Atlantic	34	57	71	0	162
Midwest	34	61	57	25	177
South Central	1	2	0	0	3
South Atlantic	1	9	2	1	12
Pacific NW	10	19	3	2	33
Pacific West	64	38	104	22	228
Southwest	2	52	6	4	63
Additional (4)	8	22	22	7	58
United States	170	296	276	61	803

Note(s): (1) Regions match Census divisions and Census regions except for "Pacific NW" (ID, MT, OR, WA), "Pacific West" (AK, CA, HI), and "Southwest" (AZ, CO, NV, NM, UT, WY). (2) Commercial and Industrial. (3) In cases in which EM&V is not allocated by customer class, it is included in "other." (4) Total of gas budgets from respondents that did not grant permission to release their data at the state level. This total includes data from CO, ID, IL, KY, MI, NY, OH, PA, TX, and WA.

Source(s): Consortium for Energy Efficiency, State of the Efficiency Program Industry: 2009 Expenditures, Impacts & 2010 Budgets, Dec. 2010, Tables 3, 5, and 8.

6.5.2 Funding Levels of Top 6 and Bottom 5 States with Active Public Benefit Efficiency Programs

	Total EE Budget ($million)		Total EE Budget per Capita ($)	
	2009	2010	2009	2010
Vermont	33	36	52	58
Massachusetts	222	386	34	58
Rhode Island	37	37	35	35
Minnesota	134	200	25	38
California	1,377	1,497	37	40
New York	421	632	22	32
Kansas	4	5	4	5
Mississippi	9	13	9	13
Alabama	0	0	0	0
North Dakota	0	1	0	1
West Virginia	0	0	0	0

Source(s): American Council for an Energy Efficient Economy, A National Survey of State Policies and Practices for the Evaluation of Ratepayer-Funded Energy Efficiency Programs, Feb. 2012, Table B-1, p. 52-53.

6.5.3 Demand-Side Management Funds Collected for Energy Efficiency Programs in 2000 (1)

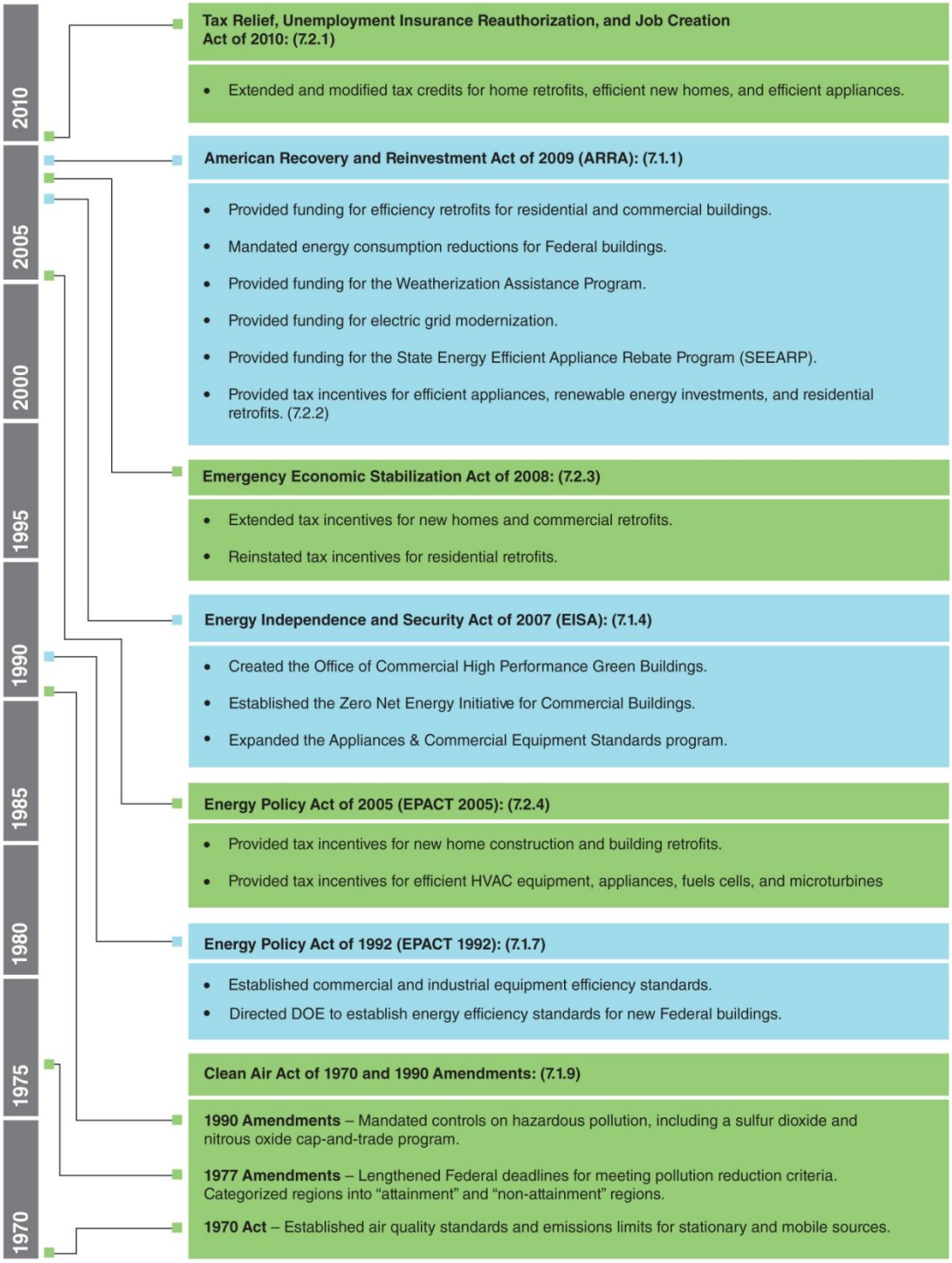
	Total Expenditures ($2009 million)	Per Capita Spending ($2009/person)
Connecticut	82.1	24.08
Massachusetts	122.7	19.29
Rhode Island	17.3	16.48
New Jersey	137.6	16.32
Vermont	7.8	12.74
Maine	15.6	12.21
Wisconsin	60.8	11.32
Hawaii	13.6	11.22
New York	201.3	10.60
California	354.5	10.43
National (2)	**1,354**	**4.80**

Note(s): 1) This table shows demand side management funds(including Public Benefit Funds) collected in 2000 that were spent of energy efficiency programs. 2) The top ten states in spending per capita represent 74.8% of total U.S. funds collected for energy efficiency programs.

Source(s): American Council for an Energy Efficient Economy; Five Years In: An Examination of the First Half Decade of Public Benefit Energy Efficiency Policies, April 2004, Table 3, p. 27; and EIA, Annual Energy Review 2009, August 2010, Appendix D, p. 383 for price inflators.

Chapter 7: Laws, Energy Codes, and Standards

Chapter 7 outlines national climate change legislation, tax incentives, Federal regulations, and State programs that have influenced building energy consumption. Section 7.1 summarizes the past 40 years of national energy legislation beginning with the Clean Air Act of 1970. Section 7.2 describes the energy efficiency-related Federal tax incentives created in the last 5 years. Sections 7.3 through 7.7 describe the energy and water efficiency standards currently or soon to be in effect for residential and commercial HVAC equipment, appliances, lighting, and water-consuming products. Section 7.8 covers building energy codes. Following is a summary of the energy legislation discussed in this chapter:



7.1.1 Buildings-Related Funding in the American Recovery and Reinvestment Act of 2009

Department of Education
-- $8.8 billion is provided to fund renovation, repair, and modernization of education facilites through the State Fiscal Stabilization Fund. These measures are to follow the guidelines of one of four recognized green building rating systems.
Department of Housing and Urban Development
--$3 billion to the Public Housing Capital Fund, awarded based on the existing formula to public housing agencies to improve or build new affordable housing.
--$1 billion to the Public Housing Capital Fund "for priority investments, including investments that leverage private sector funding or financing for renovations and energy conservation retrofit investments." This funding is awarded competitively.
--$2.25 billion for the HOME Investment Partnership Program to provide state grants to buy, renovate, and create affordable housing.
--$250 million in grants and loans available to HUD-assisted housing owners for energy retrofits and "green" investments.
General Services Administration (GSA)
--$4.5 billion to convert GSA facilities to high performance green buildings as defined in the Energy Independence and Security Act of 2007. By 2015, existing buildings must use 30% less fossil energy compared to 2005 levels. New buildings and major renovations must use 55% less fossil energy than 2003 levels by 2010, and use no fossil energy by 2030.
Department of Defense
--$3.69 billion for "energy efficiency projects and to repair and modernize" facililites.
Department of Interior
--$884 million to be used for construction activities and energy retrofits at the U.S. National Park Service, U.S. Fish and Wildlife Service, and the Bureau of Land Management.

Source(s): American Recovery and Reinvestment Act of 2009. February 17, 2009. Public Law 111-5; Congressional Research Service, American Recovery and Reinvestment Act of 2009, Public Law 111-5, February 2009; ACEEE, Summary of Energy Efficiency Provisions in ARRA 2009, October 2009.

7.1.2 Buildings-Related DOE Funding in the American Recovery and Reinvestment Act of 2009

Innovative Technology Loan Guarantee Program
--$6.0 billion to provide loans to the commercial sector for renewable energy and transmission projects. This program was originally created under the Energy Policy Act of 2005
Weatherization Assistance Program
--$5.0 billion for grants that are distributed to states and territories. Funding is used to improve the energy efficiency of homes owned by households earning less than 200% of the federal poverty level. Fiscal year 2008 funding was $227.2 million.
Electricity Delivery and Energy Reliability
--$4.5 billion provided to the Office of Electricity Delivery and Energy Reliability to modernize the electric grid, including deployment of smart meters and electricity storage systems.
Energy Efficiency and Conservation Block Grants
--$3.2 billion to be distributed to local governments for energy efficiency programs. Program was established under the Energy Independence and Security Act (EISA) and $2.8 billion will be allocated based on the formula provided in EISA. $400 million is to be allocated on a competitive basis.
State Energy Program
--$3.1 billion is available to states that put in place utility rate decoupling and improved building codes.
Appliance Rebate Program
--$300 million for consumer rebates to replace of old appliances with ENERGY STAR-qualified appliances.

Source(s): American Recovery and Reinvestment Act of 2009. February 17, 2009. Public Law 111-5; Congressional Research Service, American Recovery and Reinvestment Act of 2009, Public Law 111-5, February 2009; ACEEE, Summary of Energy Efficiency Provisions in ARRA 2009, October 2009.

7.1.3 State Energy Efficient Appliance Rebate Program

	2010			2011		
	Total Rebates	Rebates	Avg Rebate	Total Rebates	Rebates	Avg Rebate
Home Appliances	(Thousand)	($ Million)	($)	(Thousand)	($ Million)	($)
Air Conditioners (Room)	28	1.8	65	3	0.3	111
Clothes Washers	480	52.8	110	78	11.2	143
Dishwashers	245	22.2	91	55	5.6	101
Freezers	22	2.0	94	3	0.7	266
Refrigerators	488	64.8	133	104	18.9	182
HVAC						
Air Conditioners (Central)	31	12.4	403	17	13.0	767
Boiler Reset Controls	0	0.0	100	0	0.0	0
Boilers (Gas)	3	1.8	632	1	0.4	500
Boilers (Oil)	2	0.9	425	1	0.5	403
Boilers (Propane)	0	0.0	214	0	0.0	300
Furnaces (Gas)	61	24.2	396	8	3.3	415
Furnaces (Oil)	0	0.2	379	0	0.1	394
Furnaces (Propane)	1	0.3	314	0	0.0	340
Heat Pumps (Air Source)	33	16.2	487	17	9.2	546
Heat Pumps (Ground Source)	2	1.5	912	0	0.0	1,207
Water Heaters						
Electric Heat Pump	3	0.9	278	1	0.2	322
Gas Storage	15	0.0	123	1	0.2	337
Gas Tankless	9	1.8	263	1	0.5	335
Indirect	0	2.4	150	0	0.0	0
Propane Storage	0	0.0	151	0	0.0	25
Propane Tankless	0	0.0	192	0	0.0	300
Solar, Electric Backup	0	0.0	735	0	0.1	1,675
Solar, Gas Backup	0	0.2	1,267	0	0.0	1,262
Solar, Indirect Backup	0	0.1	1,107	0	0.2	2,000
All Products	**1424**	**206.6**	**145**	**291**	**64.7**	**223**

Note(s): Planned program totals based on state plans submitted to the U.S. Department of Energy. Actual results based on state reporting to the U.S. Department of Energy through 12/31/2011. This program was created under the Energy Policy Act of 2005 and received $300 million in funding through the American Recovery and Reinvestment Act of 2009. Under this program, eligible consumers may obtain rebates on the purchase of new energy-efficient appliances when they replace used appliances. Additional information at http://www.energy.gov.gov/financial/73000.html

Source(s): U.S. Department of Energy

7.1.4 Energy Independence and Security Act 2007, High Performance Commercial Buildings

Create the Office of Commercial High Performance Green Buildings
The Office of Commercial High Performance Green Buildings with The Office of Federal High Performance Green Buildings will establish a High Performance Green Buildings Clearinghouse to disseminate research through outreach, education, and technical assistance
Zero Net Energy Initiative for Commercial Buildings was also included establishing specific goals:
-- Net zero energy use in all new commercial buildings constructed by 2030
-- Net zero energy use in 50% of the United State commercial building stock by 2040
-- Net zero energy use in the entire United States commercial building stock by 2050

Source(s): The 110th Congress of the United States, The Energy Independence and Security Act of 2007, January 2007, Section 422.

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

			Montreal Protocol Reduction		U.S. Clean Air Act Reduction	
Gas	Manufacturing Base Level (2)	Manufacturing Freeze (3)	%	By	%	By
Chlorofluorocarbons (CFCs)	1986	1989	75% 100%	1994 1996 (4)	75% 100%	1994 1996
Bromofluorocarbons (Halons)	1986	1992	100%	1994 (4)	100%	1994
Hydrochlorofluorocarbons (HCFCs)	1989 HCFC consumption + 2.8 % of 1989 CFC consumption	1996	35.0% 75.0% 90.0% 99.5% 100%	2004 2010 2015 2020 2030 (4)	35% 75% 90% 99.5% 100%	2003 2010 2015 2020 2030
Hydrofluorocarbons (HFCs)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

Note(s): 1) The phase out of halocarbons is consistent with Title VI of the Clean Air Act and is in accordance with the Montreal Protocol and Amendments. 2) The amount of gas produced and consumed in this year is established and defined as the base level. To meet basic domestic needs, levels of production are allowed to exceed the base level by up to 10%. 3) After this year, levels of production are no longer permitted to exceed the base year level. 4) With possible essential use exemptions.

Source(s): Federal Register, Vol. 72, No. 123, June 2007, p. 35230, http://www.epa.gov/ozone/title6/phaseout; United Nations Ozone Environmental Programme, Ozone Secretariat, 2005, http://www.unep.ch/ozone/index.shtml; and Title VI, The Clean Air Act of 1990, S.1630, 101st Congress., 2nd Session.

7.1.6 Energy Policy Act of 1992, Building Energy Codes

--Each State must certify to the Secretary of Energy whether its energy efficiency standards with respect to residential and commercial building codes meet or exceed those of the Council of American Building Officials (CABO) Model Energy Code, 1992, and of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, respectively.
--Requires DOE to provide technical assistance and incentive funding to the States to promote increased use of energy efficiency codes for buildings.
--Directs the Secretary to: (1) establish standards that require energy efficiency measures that are technologically feasible and economically justified in new Federal buildings; and (2) review them every five years. Mandates Federal agency compliance with such standards.
--Prescribes guidelines under which DOE shall support the upgrading of voluntary building energy codes for new residential and commercial buildings.
--The Department of Housing and Urban Development (HUD) and Agriculture are to jointly establish energy efficiency standards for residential housing. Amends Federal law regarding veterans' readjustment benefits to condition a loan for new residential housing upon compliance with such standards.
--DOE is to: (1) issue voluntary building energy code guidelines for use by the private and public sectors to encourage the assignment of energy efficiency ratings for new residential buildings; (2) establish a technical assistance program for State and local organizations to encourage the use of residential energy efficiency rating systems consistent with such guidelines; (3) provide matching grants for the establishment of regional building energy efficiency centers in each of the regions served by a DOE regional support office; and (4) establish an advisory task force to evaluate grant activities.
--HUD is to: (1) assess the energy performance of manufactured housing and make recommendations to the National Commission on Manufactured Housing regarding thermal insulation and energy efficiency improvements; and (2) test the performance and determine the cost effectiveness of manufactured housing constructed in compliance with certain statutory standards. Authorizes the States to establish thermal insulation and energy efficiency standards for manufactured housing if the Secretary of HUD has not issued final regulations by October 1993.
--HUD is to promulgate a uniform affordable housing plan using energy efficient mortgages (mortgages that provide financing incentives either for the purchase of energy efficient homes, or for incorporating the cost of such improvements into the mortgage).
--DOE is to provide financial assistance to support a voluntary national window rating program that will develop energy ratings and labels for windows and window systems. Requires the National Fenestration Rating Council to develop such rating program according to specified procedures. Requires the Secretary to develop specified alternative rating systems if a national voluntary window rating program consistent with this Act has not been developed.

Source(s): U.S. Government, Energy Policy Act of 1992 Conference Report, Oct. 1992.

7.1.7 Energy Policy Act of 1992, Appliance and Equipment Efficiency Standards

--DOE is to: (1) detail energy conservation and labeling requirements for specified commercial and industrial equipment (including lamps and plumbing products); and (2) delineate standards for heating and air-conditioning equipment, electric motors, high intensity discharge lamps, and distribution transformers.
--DOE is to provide financial and technical assistance to support a voluntary national testing and information program for widely used commercial office equipment and luminaries with potential for significant energy savings.
--Requires DOE to report to the Congress on: (1) the potential for the development and commercialization of appliances which are substantially more efficient than required by Federal or State law; and (2) the energy savings and environmental benefits of early appliance replacement programs.

Source(s): U.S. Government, Energy Policy Act of 1992 Conference Report, Oct. 1992.

7.1.8 The Clean Air Act

1970 Amendments

- Established the National Ambient Air Quality Standards (NAAQS) for stationary sources and placed limits on mobile sources.
- Established the New Source Performance Standards (NSPS) which mandated a strict limit on emissions from new pollution sources.
- Expanded on the State Implemenation Plans (SIPs) to carry out mandates.

1977 Amendments

- Categorized regions into attinment and non-attainment regions.
- Non-attainment designation occurred if region emitted in excess of any federal standard.
- If a region complied with federal standards, it was designated as a PSD, which stands for "prevention of significant deterioration."
- Lengthened federal deadlines for meeting pollution reduction, particularly with regards to mobile emissions sources.

1990 Amendments

- Established a sulfur dioxide (Sox) and a nitrous oxide (Nox) cap and trade program. Under this program, an emissions cap is set and permits are issued. An emitter of Sox or Nox must have a permit for each unit of pollutant they release These emissions permits may be trade (bought and sold) amongst polluting parties to minimize cost.
- Mandated the control of 189 hazardous pollutants.
- Updated and expanded provisions of the NAAQS.

Source(s): The United States Congress, Public Law 108-201, The Clean Air Act as amended through February 24, 2004; EPA, The History of the Clean Air Act, accessed February 2011 at <http://www.epa.gov/air/caa/caa_history.html>

7.2.1 Tax Incentives of the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010

Energy Efficient Appliance Credit (modified and extended through 2011)
--$25-75 for efficient dishwashers.
--$175-225 for efficient clothes washers
--$150-200 for efficient refrigerators.

Credit for Efficiency Improvements to Existing Homes (modified and extended through 2011)
--Tax credit equal to 10% of the amount paid or incurred by the taxpayer for a qualifying energy efficiency improvement, up to a maximum of $500.
--This includes up to $50 for any advanced main air circulating fan, $150 for qualifying natural gas, propane, or oil furnaces or hot water boilers, and $300 for "any item of energy-efficient building property."

Efficient New Homes
--Extends the tax credit for new energy efficient homes through 2011.

Source(s): Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010. December 17, 2010. Public Law 111-312; and The United States Senate Committee on Finance, Summary of the Reid-McConnell Tax Relief, Unemployment Insurance Reauthorization and Job Creation Act of 2010. December 10, 2010.

7.2.2 Tax Incentive of the American Recovery and Reinvestment Act of 2009

Envelope Improvements to Existing Homes (1)
--Increases existing tax credit to 30% of costs up to $1,500 to upgrade building envelope to be compliant with codes for new construction. Upgrades to building shell, HVAC system, and windows and doors may qualify. Improvements must be installed between January 1, 2008 and December 31, 2010.

Renewable Energy Production Tax Credits
--Tax credit to 30% of costs for installation of on-site renewable energy equipment, with no caps on total investment. Tax credits for wind energy are available through 2012, while other renewables can receive a tax credit if placed into service through 2013.

Renewable Energy Investment Tax Credits
--Provides the option to take an investment tax credit in lieu of the production tax credit. This allows the full credit to be provided once a system is placed into service, rather than over the production period of the system. The goal of this option is to make financing a project less difficult.

Clean Renewable Energy Bonds
--$1.6 billion to finance renewable energy generation. Funds are to be available in equal proportion to state/local/tribal governments, municipal utilities, and electric cooperatives.

Energy Conservation Bonds
--$2.4 billion issued to states based on population. Bonds can be used to finance a variety of projects that reduce energy use.

Note(s): 1) Based on tax credit from Energy Policy Act of 2005. See the table "Tax Incentive of the Energy Policy Act of 2005."

Source(s): American Recovery and Reinvestment Act of 2009. February 17, 2009. Public Law 111-5; Sissine, et al. "American Recovery and Reinvestment Act of 2009. February 17, 2009. Public Law 111-5." Congressional Research Service. 2009; McDermott Will & Emory. "Energy Tax Provisions Included in American Recovery and Reinvestment Act of 2009." 2009.

7.2.3 Tax Incentives of the Emergency Economic Stabilization Act of 2008 (1)

New Homes
--Extends tax credits for efficient new homes to December 31, 2009.

Envelope Improvements to Existing Homes
--Reinstates 10% tax credit for building shell, HVAC and windows to include installations during 2009.

Commercial Buildings
--Extends tax deductions for efficiency upgrades in commercial buildings to December 31, 2013.

Note(s): 1) Tax incentives detailed are extensions to incentives found in the Energy Policy Act of 2005. See the table "Tax Incentive of the Energy Policy Act of 2005" for details.
Source(s): Emergency Economic Stabilization Act of 2008, Public Law 110-343, October 2008.

7.2.4 Tax Incentives of the Energy Policy Act of 2005

Appliance Manufacturers
--Refrigerator manufactures receive a $75 credit for each unit sold that uses 15-19.9% less energy than required by the 2001 Federal minimum efficiency; $125 for 20-24.9% less; and $175 for at least 25% less.
--Clothes washer manufacturers receive a $100 credit for each unit sold that meeting the 2007 ENERGY STAR criteria.
--Dishwasher manufacturers receive a $3 credit per percentage of energy savings greater than the current ENERGY STAR criteria for each unit sold. For example, a dishwasher is 15% more efficient than the current ENERGY STAR criteria, the credit is $3 X 15 = $45.
--Credits are only available for products manufactured in the U.S.
--Each manufacturer is capped at $75 million for available credits.
Stationary Fuel Cells and Microturbines
--Tax credit of 30%, up to $1000 per kW for fuel cells that at 500 kW or greater and have an efficiency of at least 30%. Residential applications do not have a capacity or efficiency requirement. Units must be put in place between January 1, 2006 and December 31, 2007.
--Tax credit of 10%, up to $200 per kW for microturbines that are less than 2,000 kW and have an efficiency of at least 26%. Units must be put in place between January 1, 2006 and December 31, 2007.

Source(s): ACEEE, The Federal Energy Policy Act of 2005 and its Implications for Energy Efficiency Program Efforts, Sept. 2005, p. 1-7.

7.2.5 Tax Incentives of the Energy Policy Act of 2005

New Homes
--Builders who build homes that use 50% less energy for space heating and cooling than the IECC 2003 are eligible for a $2,000 tax credit per home.
--Manufactured housing builder that either uses 30% less energy than this reference code or that meet the then-current ENERGY STAR criteria are eligible for $1,000 tax credit per home. At least 10% of energy savings must be obtained through building envelope improvements.

Envelope Improvements to Existing Homes
--10% tax credit up to $500 for upgrading building envelope to be compliant with codes for new construction. Window replacement is capped at $200. $500 is the cap for all for envelope and HVAC improvements. Improvements must be installed between January 1, 2006 and December 31, 2007.

Commercial Buildings
--Tax deduction up to $1.80/SF for new commercial buildings which are 50% more efficient than the requirements of ASHRAE 90.1-19XX.
--Tax deduction up to $0.60/SF for existing commercial buildings which upgrade the envelope, lighting, or HVAC building systems to 50% more efficient than ASHRAE 90.1-19XX. The deduction can be combined when improvements are made to two building components.
--Deductions apply to new buildings placed in service and improvements to existing buildings completed between August X, 2005 and December 31, 2007.

Source(s): ACEEE, The Federal Energy Policy Act of 2005 and its Implications for Energy Efficiency Program Efforts, Sept. 2005, p. 1-7.

7.2.6 HVAC Tax Incentives of the Energy Policy Act of 2005

Equipment Type	Qualifying Efficiency	Credit
Central air conditioner	15 SEER and 12.5 EER	300
Central air-source heat pump	15 SEER, 9 HSPF, and 13 EER	300
Ground-source heat pump		
Closed loop	14.1 EER and 3.3 COP	300
Open loop	16.2 EER and 3.6 COP	300
Direct expansion (DX)	15.0 EER and 3.5 COP	300
Gas, oil, or propane furnace or boiler	95% AFUE	150
Furnace Blower	Electricity use <2% of total furnace	50
	site energy consumption	300
Electric heat pump water heater	2.0 EF	300
Gas, oil, or propane water heater	0.80 EF	

Source(s): ACEEE, The Federal Energy Policy Act of 2005 and its Implications for Energy Efficiency Program Efforts, Sept. 2005, Table 1, p. 6.

7.2.7 Federal Energy Efficiency Tax Credits for Individuals and Average Credit Claimed

	2006		2007		2008		2009	
	Count (10^3)	Avg Credit ($)	Count (10^3)	Avg Credit ($)	Count (10^3)	Avg Credit ($)	Count (10^3)	Avg Credit ($)
Nonbusiness Energy Property Credit								
Envelope Improvements	3352	226	3274	215	N/A	N/A	N/A	N/A
Equipment Improvements	676	291	990	291	N/A	N/A	N/A	N/A
Total	4314	222	4292	219	N/A	N/A	6566	788
Residential Energy Efficient Property Credit								
Solar Electric	26	1239	34	1134	92	841	78	N/A
Solar Water Heating	24	859	26	1055	61	911	42	N/A
Small Wind Energy	N/A	N/A	N/A	N/A	5	1526	7	N/A
Geothermal Heat Pump	N/A	N/A	N/A	N/A	59	1330	77	N/A
Fuel Cell	1	729	1	650	9	584	7	N/A
Total	45	963	61	1132	201	1048	210	3078
Grand Total	4344	230	4326	233	201	1048	6705	868

Note(s): N/A = Credit not available.

Source(s): Dept. of the Treasury, Internal Revenue Service, 2006 Estimated Data Line Counts Individual Income Tax Returns, Aug. 2008; Dept. of the Treasury, Internal Revenue Service, 2007 Estimated Data Line Counts Individual Income Tax Returns, Aug. 2009; Dept. of the Treasury, Internal Revenue Service, 2008 Estimated Data Line Counts Individual Income Tax Returns, Aug. 2010; and Dept. of the Treasury, Internal Revenue Service, 2009 Estimated Data Line Counts Individual Income Tax Returns, Aug. 2011.

7.3.1 Efficiency Standards for Residential Central Air Conditioners and Heat Pumps (1)

Type	SEER (3)	HSPF (4)
Split System Air Conditioners	13.0	--
Split System Heat Pumps	13.0	7.7
Single Package Air Conditioners	13.0	--
Single Package Heat Pumps	13.0	7.7
Through-the-Wall Air Conditioners and Heat Pumps:		
-Split System (2)	10.9	7.1
-Single Package (2)	10.6	7.0
Small Duct, High Velocity Systems	13.0	7.7
Space Constrained Products		
-Air Conditioners	12.0	--
-Heat Pumps	12.0	7.4

Note(s): 1) Effective for products manufactured on or after January 23, 2006. 2) Applies to products manufactured prior to January 23, 2010. 3) Seasonal Energy Efficiency Ratio. 4) Heating Seasonal Performance Factor.

Source(s): Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010.

7.3.2 Efficiency Standards for Residential Furnaces

Effective for products manufactured before November 19, 2015

	AFUE (%) (2)
Furnaces (excluding classes noted below)	78
Mobile Home Furnaces	75
Small Furnaces with input rate < 45,000 Btu/hr (1)	
- Weatherized (outdoor)	78
- Non-Weatherized (indoor)	78

Effective for products manufactured on or after November 19, 2015

	AFUE (%) (2)
Non-Weatherized Gas Furnaces	80
Weatherized Gas Furnaces	81
Mobile Home Oil-Fired Furnaces	75
Mobile home Gas Furnaces	80
Non-Weatherized Oil-Fired Furnaces	82
Weatherized Oil-Fired Furnaces	78

Note(s): 1) Excludes those intended solely for installation in mobile homes. 2) Annual Fuel Utilization Efficiency.

Source(s): Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010.

7.3.3 Efficiency Standards for Residential Boilers

Effective for products manufactured before September 1, 2012

	AFUE(%) (1)
Boilers (excluding gas steam)	80
Gas Steam Boilers	75

Effective for products manufactured on or after September 1, 2012 (2)

	AFUE (%) (1)	Design Requirements
Gas Hot Water	82	No Constant Burning Pilot Automatic Means for Adjusting Water Temperature
Gas Steam	80	No Constant Burning Pilot
Oil Hot Water	84	Automatic Means for Adjusting Water Temperature
Oil Steam	82	None
Electric Hot water	None	Automatic Means for Adjusting Water Temperature
Electric Steam	None	None

Note(s): 1) Annual Fuel Utilization Efficiency. 2) Boilers manufactured to operate without any need for electricity, an electric connection, electric gauges, electric pumps, electric wires, or electric devices are not required to comply with the revised standards that take effect September 1, 2012. These must, however, meet the standards that were effective prior to September 1, 2012.

Source(s): Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010.

7.4.1 Efficiency Standards for Commercial Warm Air Furnaces

Effective for products manufactured on or after January 1, 1994

	Thermal Efficiency (1)
Gas-fired, with capacity ≥ 225,000 Btu/hr	Not less than 80%
Oil-fired, with capacity ≥ 225,000 Btu/hr	Not less than 81%

Note(s): 1) Measured at the maximum rated capacity.

Source(s): Title 10, Code of Federal Regulations, Part 431 - Energy Efficiency Program for Certain Commercial and Industrial Equipment, Subpart D - Commercial Warm Air Furnaces. January 1, 2010.

7.4.2 Efficiency Standards for Commercial Packaged Boilers

Effective for products manufactured between January 1, 1994 and March 1, 2012

	Combustion Efficiency (1)
Gas-fired, with capacity ≥ 300,000 Btu/hr	Not less than 80%
Oil-fired, with capacity ≥ 300,000 Btu/hr	Not less than 83%

Effective for products manufactured on or after March 2, 2012

	Size (Btu/hr)	Efficiency Level (1)
Gas-fired, hot water	≥300,000 and ≤2,500,000	80% thermal efficiency
Gas-fired, hot water	>2,500,000	82% combustion efficiency
Oil-fired, hot water	≥300,000 and ≤2,500,000	82% thermal efficiency
Oil-fired, hot water	>2,500,000	84% combustion efficiency
Gas-fired except natural draft, steam	≥300,000 and ≤2,500,000	79% thermal efficiency
Gas-fired except natural draft, steam	>2,500,000	79% thermal efficiency
Gas-fired-natural draft, steam	≥300,000 and ≤2,500,000	77% thermal efficiency
Gas-fired-natural draft, steam	>2,500,000	77% thermal efficiency
Oil-fired, steam	≥300,000 and ≤2,500,000	81% thermal efficiency
Oil-fired, steam	>2,500,000	81% thermal efficiency

Effective March 2, 2022	Size (Btu/hr)	Thermal Efficiency (1)
Gas-fired natural draft, steam	≥300,000 and ≤2,500,000	79%
Gas-fired natural draft, steam	>2,500,000	79%

Note(s): 1) Measured at the maximum rated capacity.

Source(s): Title 10, Code of Federal Regulations, Part 431 - Energy Efficiency Program for Certain Commercial and Industrial Equipment, Subpart E - Commercial Packaged Boilers. January 1, 2010.

7.4.3 Efficiency Standards for Commercial Air Conditioners and Heat Pumps (1)

Type	Cooling Capacity (Btu/hr)	Category (2)	Efficiency Level
Small commercial package air conditioning and heating equipment (air-cooled, three-phase)	<65,000	AC	SEER = 13.0
		HP	SEER = 13.0
Single package vertical air conditioners and single package vertical heat pumps, single-phase and three phase	<65,000	AC	EER = 9.0
		HP	EER = 9.0, COP = 3.0
Single package vertical air conditioners and single package vertical heat pumps	≥65,000 and <135,000	AC	EER = 8.9
		HP	EER = 8.9, COP = 3.0
Single package vertical air conditioners and single package vertical heat pumps	≥135,000 and <240,000	AC	EER = 8.6
		HP	EER = 8.6, COP = 2.9
Small commercial package air-conditioning and heating equipment (air-cooled)	≥65,000 and <135,000	AC	EER = 11.2 (3)
			EER = 11.0 (4)
		HP	EER = 11.0 (3)
			EER = 10.8 (4)
Large commercial package air-conditioning and heating equipment (air-cooled)	≥135,000 and <240,000	AC	EER = 11.0 (3)
			EER = 10.8 (4)
		HP	EER = 10.6 (3)
			EER = 10.4 (4)
Very large commercial package air-conditioning and heating equipment (air-cooled)	≥240,000 and <760,000	AC	EER = 10.0 (3)
			EER = 9.8 (4)
		HP	EER = 9.5 (3)
			EER = 9.3 (4)
Small commercial package air-conditioning heat pump	≥65,000 and <135,000	HP	COP = 3.3
Large commercial package air-conditioning heat pump	≥135,000 and <240,000	HP	COP = 3.2
Very large commercial package air-conditioning heat pump	≥240,000 and <760,000	HP	COP = 3.2

Note(s): EER = Energy Efficiency Ratio, COP = Coefficient of Performance. 1) Effective for products manufactured on or after January 1, 2010, excpet for air-cooled, three-phase small commercial package air-conditioning and heating equipment <65,000 Btu/hr for which standards are effective for products manufactured on or after June 16, 2008. 2) AC = Air Conditioner, HP = Heat Pump. 3) Applies to equipment with electric resistance heating or no heating. 4) Applies to equipment with all other integrated heating-system types.

Source(s): Title 10, Code of Federal Regulations, Part 431 - Energy Efficiency Program for Certain Commercial and Industrial Equipment, Subpart F - Commercial Air Conditioners and Heat Pumps. January 1, 2010.

7.5.1 Efficiency Standards for Residential Room Air Conditioners (1)

Without Reverse Cycle, With Louvered Sides		Without Reverse Cycle, Without Louvered Sides	
Capacity (Btu/hr):	EER (2)	Capacity (Btu/hr):	EER (2)
<6,000	9.7	<6,000	9.0
6,000-7,999	9.7	6,000-7,999	9.0
8,000-13,999	9.8	8,000-13,999	8.5
14,000-19,999	9.7	14,000-19,999	8.5
20,000+	8.5	20,000+	8.5

Note(s): 1) Effective for products manufactured on or after October 1, 2000. 2) EER = Energy Efficiency Ratio.

Source(s): Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010.

7.5.2 Efficiency Standards for Residential Refrigerators and Freezers (1)

Product Class	Maximum Energy Use (kWh) (2)
1) Refrigerator-freezers, partial automatic defrost	8.82AV + 248.4
2) Refrigerator-freezers, automatic defrost with top-mounted freezer without through-the-door ice service and all refrigerators, automatic defrost	9.80AV + 276.0
3) Refrigerator-freezers, automatic defrost with side-mounted freezer without through-the-door ice service	4.91AV + 507.5
4) Refrigerator-freezers, automatic defrost with bottom-mounted freezer without through-the-door ice service	4.60AV + 459.0
5) Refrigerator freezers, automatic defrost with top-mounted freezer with through-the-door ice service	10.20AV + 356.0
6) Refrigerator-freezers, automatic defrost with side-mounted freezer with through-the-door ice service	10.10AV + 406.0

Note(s): 1) Effective for products manufactured on or after July 1, 2001. Standards do not apply to refrigerators and refrigerator-freezers with total refrigerated volume exceeding 39 cubic feet or freezers with total refrigerated volume exceeding 30 cubic feet. AV = total adjusted volume (ft^3).

Source(s): Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010.

7.5.3 Efficiency Standards for Residential Water Heaters (1)

Effective for products manufactured from January 20, 2004 through April 15, 2015

Gas-Fired Storage Water Heaters
EF = 0.67 - (0.0019 x Rated Storage Volume in gallons)

Oil-Fired Water Heaters
EF = 0.59 - (0.0019 x Rated Storage Volume in gallons)

Instantaneous Gas-Fired Water Heaters
EF = 0.62 - (0.0019 x Rated Storage Volume in gallons)

Instantaneous Electric and Table Top Water Heaters
EF = 0.93 - (0.00132 x Rated Storage Volume in gallons)

Electric Storage Water Heaters
EF = 0.97 - (0.00132 x Rated Storage Volume in gallons)

Effective for products manufactured on or after April 16, 2015

Gas-Fired Storage Water Heaters

Rated Storage Volume ≤ 55 gallons	EF = 0.675 - (0.0015 x Rated Storage Volume in gallons)
Rated Storage Volume > 55 gallons	EF = 0.8012 - (0.00078 x Rated Storage Volume in gallons)

Electric Storage Water Heaters

Rated Storage Volume ≤ 55 gallons	EF = 0.960 - (0.0003 x Rated Storage Volume in gallons)
Rated Storage Volume > 55 gallons	EF = 2.057 - (0.00113 x Rated Storage Volume in gallons)

Instantaneous Water Heaters

Gas-Fired	EF = 0.82 - (0.0019 x Rated Storage Volume in gallons)
Electric	EF = 0.93 - (0.00132 x Rated Storage Volume in gallons)

Oil-Fired Storage Water Heaters
EF = 0.68 - (0.0019 x Rated Storage Volume in gallons)

Table Top Water Heaters
EF = 0.93 - (0.00132 x Rated Storage Volume in gallons)

Note(s): 1) EF stands for "Energy Factor," while the Rated Storage Volume is a measure of capacity specified by the manufacturer.

Source(s): Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010; Energy Conservation standards for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters: Final Rule, Federal Register, 75 FR 20112, April 16, 2010.

7.5.4 Efficiency Standards for Wet Cleaning Equipment

Clothes Washers:

Effective from products manufactured from January 1, 2007 through December 31, 2011

	Modified Energy Factor (ft^3/kWh/cycle)	Water Factor (gallons/ft^3)
Top-Loading, Compact (Capacity < 1.6 ft^3)	0.65	--
Front-Loading, Compact (Capacity < 1.6 ft^3)	1.26 (ft^3/kWh/cycle)	--
Top-Loading, Semi-Automatic (1)	--	--
Suds-Saving (1)	--	--

Effective for products manufactured on or after January 1, 2011

	Modified Energy Factor (ft^3/kWh/cycle)	Water Factor (gallons/ft^3)
Top-Loading, Compact (Capacity ≥ 1.6 ft^3)	1.26 (ft^3/kWh/cycle)	9.50
Front-Loading, Compact (Capacity ≥ 1.6 ft^3)	1.26 (ft^3/kWh/cycle)	9.50

Dishwashers:

Effective for products manufactured on or after January 1, 2010 (2)

	Maximum Energy Consumption (kWh/yr)	Maximum Gallons per Cycle
Standard	355	6.5

Note(s): 1) Must have an unheated rinse water option. 2) Size is to be determined by ANSI/AHAM DW-1.

Source(s): Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010.

7.6.1 Efficiency Standards for General Service Fluorescent Lamps

Effective for products manufactured before July 14, 2012

Lamp Type (1)	Nominal Lamp Wattage (W)	Minimum CRI	Minimum Average Lamp Efficacy (lm/W)	Effective Date
4-Foot Medium Bipin	>35	69	75.0	November 1, 1995
4-Foot Medium Bipin	≤35	45	75.0	November 1, 1995
2-Foot U-Shaped	>35	69	68.0	November 1, 1995
2-Foot U-Shaped	≤35	45	64.0	November 1, 1995
8-Foot Slimline	>65	69	80.0	May 1, 1994
8-Foot Slimline	≤65	45	80.0	May 1, 1994
8-Foot High Output	>100	69	80.0	May 1, 1994
8-Foot High Output	≤100	45	80.0	May 1, 1994

Effective for products manufactured on or after July 14, 2012

Lamp Type	Correlated Color Temperature (K)	Minimum Average Lamp Efficacy (lm/W)
4-Foot Medium Bipin	≤4,500	89
4-Foot Medium Bipin	>4,500 and ≤7,000	88
2-Foot U-Shaped	≤4,500	84
2-Foot U-Shaped	>4,500 and ≤7,000	81
8-Foot Slimline	≤4,500	97
8-Foot Slimline	>4,500 and ≤7,000	93
8-Foot High Output	≤4,500	92
8-Foot High Output	>4,500 and ≤7,000	88
4-Foot Miniature Bipin, Standard Output	≤4,500	86
4-Foot Miniature Bipin, Standard Output	>4,500 and ≤7,000	81
4-Foot Miniature Bipin, High Output	≤4,500	76
4-Foot Miniature Bipin, High Output	>4,500 and ≤7,000	72

Note(s): 1) Do not apply to 4-foot medium bipin lamps or 2-foot U-shaped lamps with rated wattages less than 28W; 8-foot high outputt lamps not defined in ANSI C78.81 or related supplements, or not 0.800 nominal amperes; or 8-foot slimline lamps not defined in ANSI 78.3.

Source(s): Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy Conservation Standards and Their Effective Dates. January 1, 2010; and Energy Conservation Standards and Test Procedures for General Service Fluorescent Lamps and Incandescent Reflector Lamps; Final Rule, Federal Register, 74 FR 34080, July 14, 2009.

7.6.2 Efficiency Standards for Incandescent Reflector Lamps (1)

Effective for lamps manufactured after November 1, 1995 and before July 14, 2012

Nominal Lamp Wattage	Minimum Average Lamp Efficacy (lm/W)
40-50	10.5
51-66	11.0
67-85	12.5
86-115	14.0
116-155	14.5
156-205	15.0

Effective for lamps manufactured on or after July 14, 2012

Rated Lamp Wattage	Lamp Spectrum	Lamp Diameter (in)	Rated Voltage (V)	Minimum Average Lamp Efficacy (lm/W) (2)
40-205	Standard Spectrum	>2.5	≥125	6.8*P^0.27
40-205	Standard Spectrum	>2.5	<125	5.9*P^0.27
40-205	Standard Spectrum	≤2.5	≥125	5.7*P^0.27
40-205	Standard Spectrum	≤2.5	<125	5.0*P^0.27
40-205	Modified Spectrum	>2.5	≥125	5.8*P^0.27
40-205	Modified Spectrum	>2.5	<125	5.0*P^0.27
40-205	Modified Spectrum	≤2.5	≥125	4.9*P^0.27
40-205	Modified Spectrum	≤2.5	<125	4.2*P^0.27

Note(s): 1) Subject to exclusions, these specified standards apply to ER, BR, and BPAR incandescent refrlector lamps and similar bulb shapes on and after January 1, 2008. Subject to exclusions, these standards apply to incandescent reflector lamps with diameters between 2.25 and 2.75 inches on and after June 15, 2008. These standards do not apply to ER30, BR30, BR40, or ER40 lamps rated at 50W or less, These standards do not apply to BR30, BR40, or ER40 lamps rate at 65W. These standards do not apply to R20 incandescent reflector lamps rated 45W or less. 2) P = rated lamp wattage, in watts.

Source(s): Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010.

7.6.3 Efficiency Standards for Medium Base Compact Fluorescent Lamps (1)

Factor	**Requirements**
Lamp Power (W) & Configuration	Minimum Efficacy: lumens/watt (based upon initial lumen data)
Bare Lamp:	
Lamp Power < 15	45.0
Lamp Power ≥ 15	60.0
Covered Lamp (no reflector):	
Lamp Power < 15	40.0
15 ≤ Lamp Power < 19	48.0
19 ≤ Lamp Power < 25	50.0
25 ≤ Lamp Power	55.0

Note(s): 1) Effective for products manufactured on or after January 1, 2006.

Source(s): Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010.

7.6.4 Lighting Standards for General Service Incandescent Lamps Prescribed by EISA 2007

General Service Incandescent

Effective Date	Maximum Wattage	Rated Lumen Range	Minimum Life
2012	72	1,490-2,600	1000 hrs.
2013	53	1,050-1,498	1000 hrs.
2014	43	750-1,049	1000 hrs.
2015	29	310-749	1000 hrs.

Modified Spectrum General Service Incandescent

Effective Date	Maximum Wattage	Rated Lumen Range	Minimum Life
2012	72	1,118-1,950	1000 hrs.
2013	53	788-1,117	1000 hrs.
2014	43	563-787	1000 hrs.
2015	29	232-563	1000 hrs.

By 2020, the minimum efficacy for general service incandescent will be 45 lm/W unless the Secretary of Energy has implemented another standard which saves as much or more energy than a 45 lm/W standard.

Source(s): U. S. Government, Energy Independence and Security Act of 2007, January 2007, Section 321.

7.7.1 Water Use Standards for Faucets, Showerheads, and Prerinse Spray Valves (1)

Faucet Type (2)	Maximum Flow Rate
Kitchen Faucets (3)	2.2 gpm
Lavatory Replacement Aerators	2.2 gpm
Kitchen Faucets	2.2 gpm
Kitchen Replacement Aerators	2.2 gpm
Metering Faucets (4)	0.25 gal/cycle
Showerheads (5)	2.5 gpm
Commercial Prerinse Spray Valves (6)	1.6 gpm

Note(s): 1) Effective for products manufactured on or after January 1, 1994. 2) When measured at a flowing water pressure of 60 psi (414 kilopascals). 3) For sprayheads with independently-controlled orifices and manual controls, the maximum flow rate of each manual on/off orifice shall not exceed the maximum flow rate for a lavatory faucet. For those with collectively controlled orifices and manual controls, the maximum flow rate of each manual on/off sprayhead shall be the product of the maximum flow rate for a lavatory faucet and the number of component lavatories. 4) For sprayheads with independently controlled orifices and metered controls, the maximum flow rate of each orifice that delivers a pre-set volume of water before gradually shutting itself off shall not exceed the maximum flow rate for a metering faucet. For sprayheads with collectively-controlled orifices and metered controls, the maximum flow rate of a sprayhead that delivers a pre-set volume of water before gradually shutting itself off shall be the product of the maximum flow rate for a metering faucet and the number of component lavatories. 5) When measured at a flowing water pressure of 80 psi (552 kilopascals). Shall also meet the requirements of ASME/ANSI Standard A112.18.1M-1996, 7.4.4(a). 6) Effective for products manufactured on or after January 1, 2006.

Source(s): Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010; and Title 10, Code of Federal Regulations, Part 431 - Energy Efficiency Program for Certain Commercial and Industrial Equipment, Subpart O - Commercial Prerinse Spray Valves. January 1, 2010.

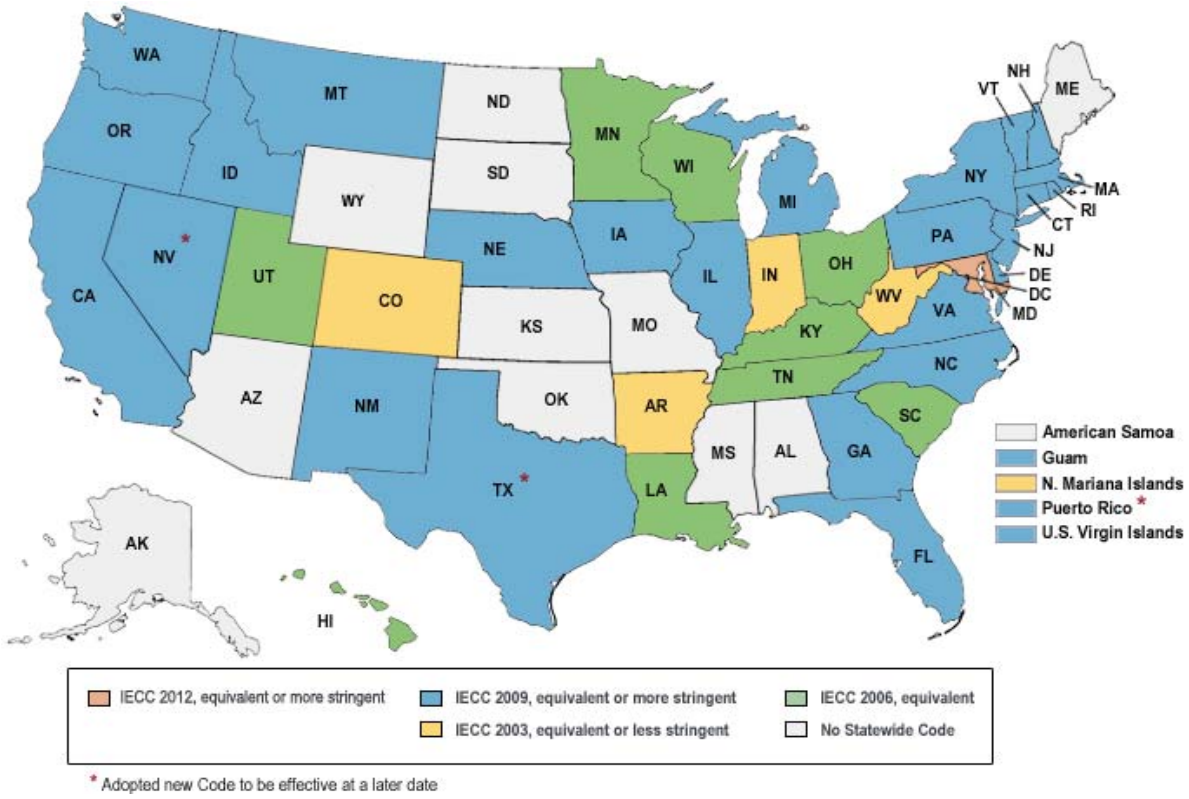
7.7.2 Water Use Standards for Water Closets (1)

Water Closet Type	Maximum Flush Rate (gpf)
Gravity Tank-Type Toilets	1.6
Flushometer Tank Toilets	1.6
Electromechanical Hydraulic Toilets	1.6
Blowout Toilets	3.5
Flushometer Valve Toilets (2)	1.6
Urinals (3)	1.0

Note(s): 1) Effective for products manufactured on or after January 1, 1994, unless otherwise noted. 2) Does not include blowout toilets. Effective for products manufactured on or after January 1, 1997. 3) Except for trough-type urinals. The maximum water use for trough-type urinals should be the product of the maximum flow rate and the length of the urinal in inches divided by 16 inches.

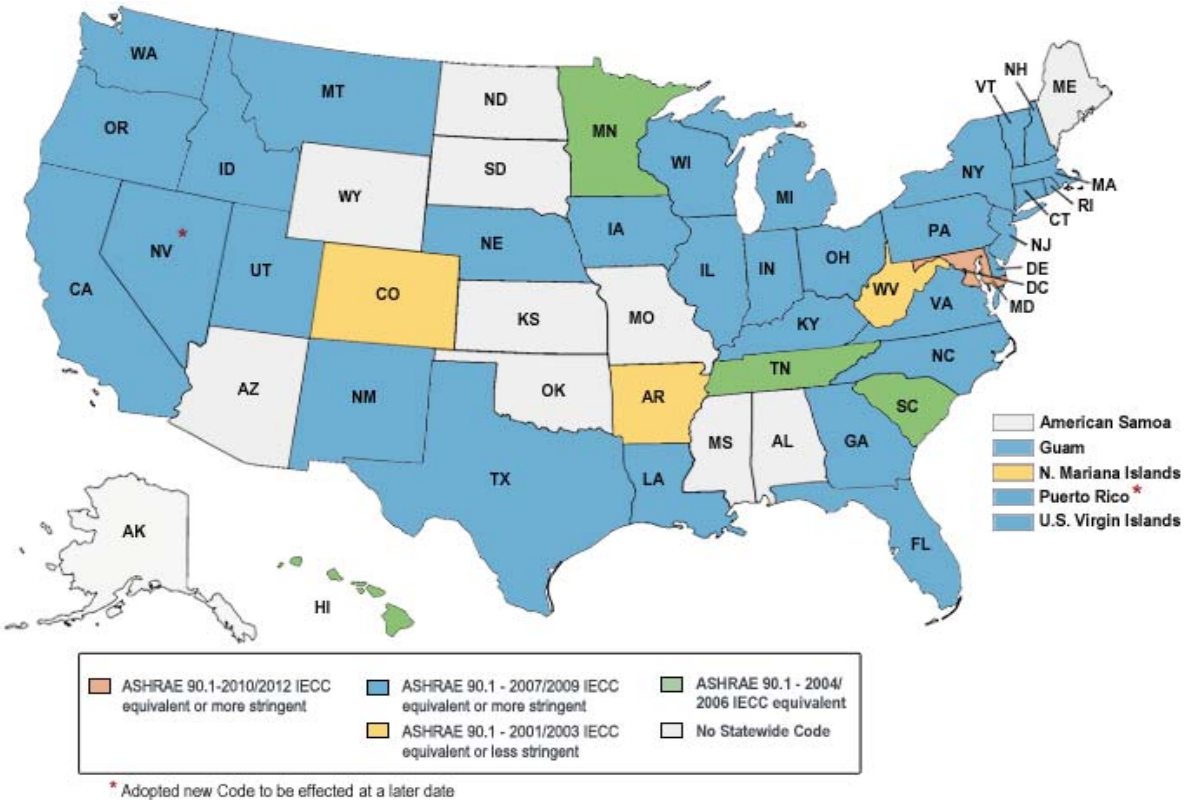
Source(s): Title 10, Code of Federal Regulations, Part 430 - Energy Conservation Program for Consumer Products, Subpart C - Energy and Water Conservation Standards and Their Effective Dates. January 1, 2010.

7.8.1 Status of State Energy Codes: Residential Sector (1)



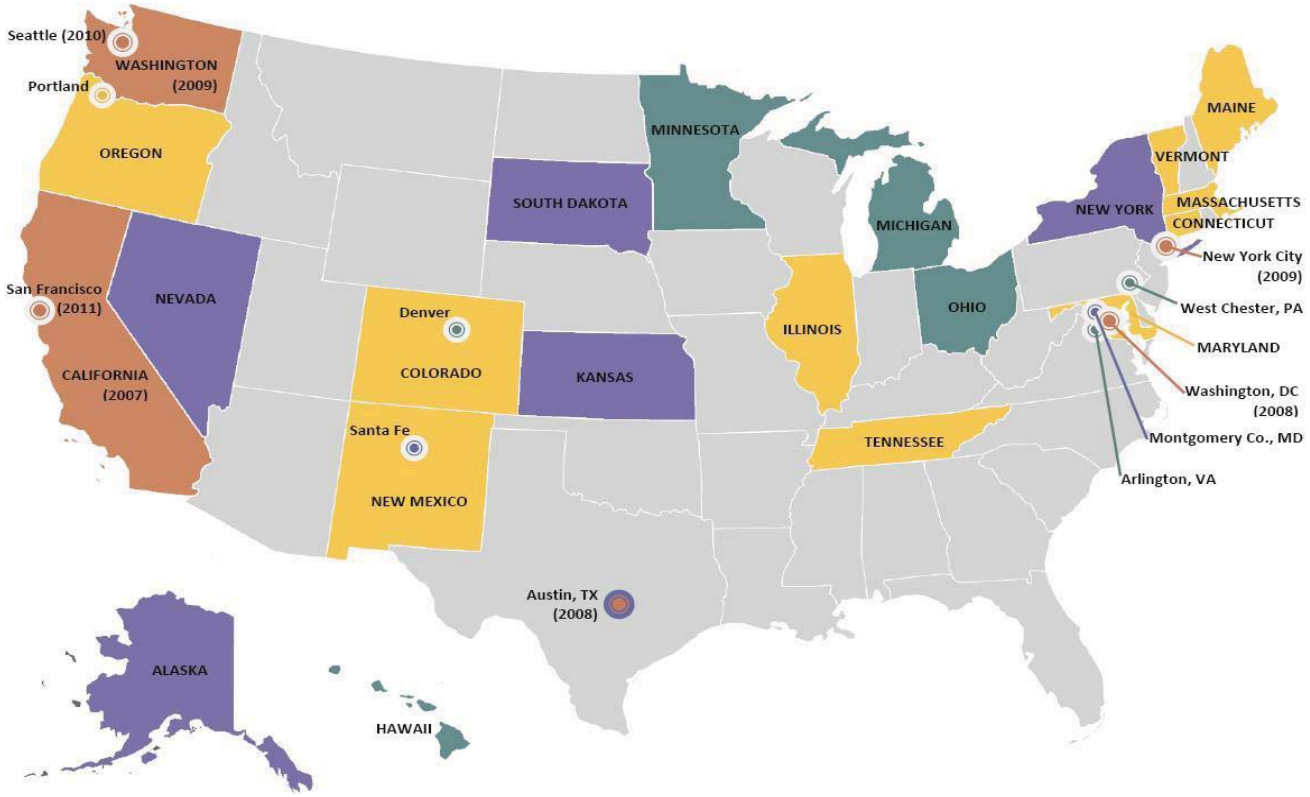
Note(s): 1) These are the current residential codes as of March 2012.
Source(s): DOE/EERE, The Status of State Energy Codes, www.energycodes.gov/states/.

7.8.2 Status of State Energy Codes: Commercial Sector(1)



Note(s): 1) These are the current Commercial codes as of March 2012.
Source(s): DOE/EERE, The Status of State Energy Codes, http://www.energycodes.gov/states/.

7.8.3 Building Energy Rating and Disclosure Policies in the United States



Commercial Buildings Existing Policy	Commercial Buildings Policy Being Considered	Public Buildings Rating Requirement	Homes Disclosure Requirement
Austin, TX	Connecticut	Arlington County, VA	Alaska
California	Colorado	Denver, CO	Austin, TX
District of Columbia	Illinois	Hawaii	Kansas
New York, NY	Maine	Michigan	Montgomery County, MD
San Francisco, CA	Maryland	Minnesota	Nevada
Seattle, WA	Massachusetts	Ohio	New York
Washington	New Mexico	West Chester, PA	Santa Fe, NM
	Oregon		South Dakota
	Portland, OR		
	Tennessee		
	Vermont		

Note(s): Map depicts the policy landscape as of March 17, 2011. More information available at www.BuildingRating.org.
Source(s): Institute for Market Transformation, "Rating Policy Map and Timeline."

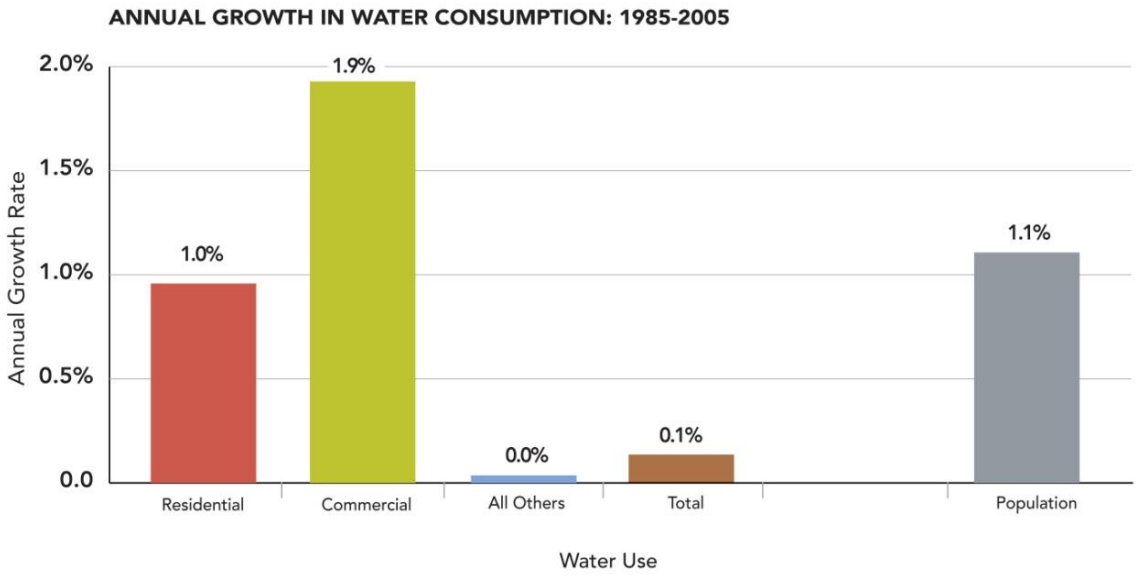
Chapter 8: Water

This chapter includes data on water use in commercial and residential buildings and the energy needed to supply that water. The main points from this chapter are summarized below.

- In 2005, water use in the buildings sector was estimated at 39.6 billion gallons per day, which is nearly 10% of total water use in the United States.
- From 1985 to 2005, water use in the residential sector closely tracked population growth, while water use in the commercial sector grew almost twice as fast.
- In 2005, between 27 billion and 39 billion kWh were consumed to pump, treat, distribute, and clean the water used in the buildings sector, accounting for 0.7% to 1% of net electricity generation.

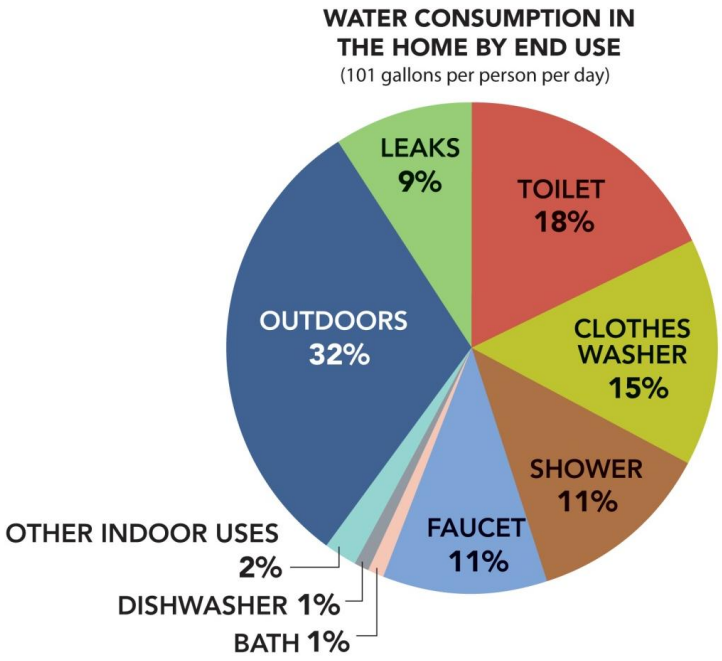
In 2005, an estimated 410 billion gallons per day (bgd) of water were withdrawn for all uses in the United States. This total includes fresh and saline water from ground and surface sources. Domestic (residential) water use was the third largest water use category after thermoelectric power generation and irrigation, with an estimated 29.4 bgd. Another 10.2 bgd were used in commercial buildings, for a total of 39.6 bgd in the buildings sector as a whole. (8.1.1)

From 1985 to 2005, water use in the residential sector closely tracked population growth, while water use in the commercial sector grew almost twice as fast, as shown in the figure. All other water uses taken together were unchanged. As a result, total water use over those two decades increased less than 3%, while water use in the buildings sector increased 27%. The buildings sector's share of total water use increased from 7.8% to 9.7%. (2.2.1, 8.1.1)



In 2005, public and private water suppliers provided 32.7 bgd of water to the buildings sector, representing 87% and 70% of residential and commercial sector water use, respectively. The remainder was supplied by users themselves from wells and surface water sources. (8.2.1, 8.3.1)

Most water used in the buildings sector is pumped, treated, distributed, and cleaned—processes that consume energy in the form of electricity. Two sources estimate the national average energy intensity of public water supplies at 2.3 and 3.3 kWh per thousand gallons. (8.1.2) These two estimates of energy intensity combined with the water use estimates above yield estimates of aggregate energy consumption across all water suppliers in the United States of 27 billion and 39 billion kWh to supply water to the buildings sector in 2005. These values correspond to 0.7% and 1% of the electricity generated by all power plants in that year. (6.1.4)



Water use in the residential sector averages about 100 gallons per person per day. Of this amount, approximately 58 gallons are used indoors, 32 gallons are used outdoors, and 10 gallons are lost to leaks. Based on metering in 1,188 single-family homes in 1999, the leading end uses within the home are toilets (19 gallons), clothes washers (15 gallons), showers (12 gallons), and faucets (11 gallons). (8.2.2) Of the 68 gallons not used outdoors, 25 gallons (37%) are heated. Leading end uses for hot water are faucets (9 gallons), showers (6 gallons), baths (4 gallons), and clothes washers (4 gallons). (8.2.4)

A survey of water suppliers conducted in 2000 found that uniform rates (a set price for each unit of water) are the most common billing rate structure offered to residential consumers. About 56% of suppliers offered this type of rate. Between 18% and 28% of the suppliers surveyed offered increasing block rates, which are designed to encourage conservation. Rate structures that do not encourage conservation were also common. About one-quarter of the suppliers charged a flat fee for some or all of the water they supplied, and between 25% and 35% of suppliers offered declining block rates. (8.2.6)

Water use in the commercial sector varies greatly among establishments based on their size and purpose. One study of water utility billing data for a range of institutions in Southern California and Arizona found that hotels and motels, laundries/laundromats, and car washes were the biggest water users, consuming more than 3,000 gallons per establishment per day, on average. Restaurants, food stores, auto shops, and membership organizations used the least—fewer than 1,000 gallons per establishment per day, on average. (8.3.2)

The study also examined water end uses in several types of establishments and normalized the results to allow for comparison of similar establishments. For example, the normalized total amount of water used varied greatly among the five restaurants in the study, from 2,910 to 15,350 gallons per seat per year and 2.7 to 16.2 gallons per meal per day. Much less variation was observed among supermarkets and hotels. (8.3.3, 8.3.4, 8.3.5)

The WaterSense program, sponsored by the U.S. Environmental Protection Agency (EPA), has set criteria to help consumers identify water-saving products and homes. As of 2010, there were criteria for bathroom sink faucets, toilets, flushing urinals, showerheads, and homes. Products built to these criteria are designed to use between 20% and 50% less water than products that just meet the Federal standards. As of this writing, criteria are under development for pre-rinse spray valves and irrigation control equipment. (8.4.1)

8.1.1 Total Use of Water by Buildings (Million Gallons per Day) (1)

Year	All Buildings	% of Total Water Use	Residential	% of Total Water Use	Commercial	% of Total Water Use
1985	31,260	7.8%	24,320	6.1%	6,940	1.7%
1990	33,580	8.2%	25,290	6.2%	8,290	2.0%
1995	35,670	8.9%	26,090	6.5%	9,580	2.4%
2000 (2)	38,342	9.4%	28,028	6.9%	10,314	2.5%
2005 (3)	39,601	9.7%	29,430	7.2%	10,171	2.5%

Note(s): 1) Includes water from the public supply and self-supplied sources (e.g., wells) for residential and commercial sectors. 2) USGS did not estimate water use in the commercial and residential sectors for 2000. Estimates are based on available data and 1995 splits between domestic and commercial use. 3) USGS did not estimate commercial sector use for 2005. Estimated based on available data and commercial

Source(s): U.S. Geological Survey, Estimated Use of Water in the U.S. in 1985, U.S. Geological Survey Circular 1004, 1988; U.S. Geological Survey, Estimated Use of Water in the U.S. in 1990, U.S. Geological Survey Circular 1081, 1993; U.S. Geological Survey, Estimated Use of Water in the U.S. in 1995, U.S. Geological Survey Circular 1200, 1998; U.S. Geological Survey, Estimated Use of Water in the U.S. in 2000, U.S. Geological Survey Circular 1268, 2004; and U.S. Geological Survey, Estimated Use of Water in the U.S. in 2005, U.S. Geological Survey Circular 1344, 2009.

8.1.2 Average Energy Intensity of Public Water Supplies by Location (kWh per Million Gallons)

Location	Sourcing		Treatment (1)	Distribution	Wastewater	Total
United States (2)	836		627	437	1,363	3,263
United States (3)	2,230		65	(6)	1,649	2,295
Northern California Indoor	2,117		111	1,272	1,911	5,411
Northern California Outdoor	2,117		111	1,272	0	3,500
Southern California Indoor	9,727	(5)	111	1,272	1,911	13,021
Southern California Outdoor	9,727		111	1,272	0	11,110
Iowa	2390		(6)	380	1,570	4,340
Massachusetts	1,500		(6)	(6)	1,750	3,250
Wisconsin Class AB (4)	–		–	–	not included	1,510
Wisconsin Class C (4)	–		–	–	not included	1,850
Wisconsin Class D (4)	–		–	–	not included	1,890
Wisconsin Total (4)	–		–	–	not included	1,601

Note(s): 1) Treatment before delivery to customer. 2) Source: Electric Policy Research Institute (EPRI) 2009. Wastewater estimated based on EPRI 2002. 3) Source: TIAX 2006. 4) Based on water treatment facility size: Class AB >4000 customers, Class C: 1000 to 4000, Class D <1000. Median energy use value reported. 5) Southern California sourcing energy is high because of energy used to pump water from Northern California. 6) Included with Sourcing.

Source(s): Electric Power Research Institute, Program on Technology Innovation: Electric Efficiency Through Water Supply Technologies A Roadmap, Publication 1019360, 2009; EPRI, Water & Sustainability (Volume 4): U.S. Electricity Consumption for Water Supply & Treatment – The Next Half Century, 2002; DOE/TIAX LLC, Commercial and Residential Sector Miscellaneous Electricity Consumption: Y2005 and Projections to 2030, 2006; California Energy Commission/Navigant Consulting, Refining Estimates of Water Related Energy Use in California, Public Interest Energy Research Program, CEC-500-2006-118; Iowa Association of Municipal Utilities/Iowa Energy Center, Energy Consumption and Costs to Treat Water and Wastewater in Iowa Part II: Survey Results Tables and Charts, 2002; EPA, Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities, 2008; and Energy Center of Wisconsin, Energy Use at Wisconsin's Drinking Water Utilities, 2003.

8.1.3 Energy Use of Wastewater Treatment Plants by Capacity and Treatment Level (kWh per Million Gallons)

	Level Of Treatment				
		Secondary		Tertiary	
Treatment Capacity (Million Gallons per Day)	Less than Secondary	Trickling Filter	Activated Sludge	Advanced	Advanced with Nitrification
1	-	1,811	2,236	2,596	2,951
5	-	978	1,369	1,573	1,926
10	-	852	1,203	1,408	1,791
20	-	750	1,114	1,303	1,676
50	-	687	1,051	1,216	1,588
100	-	673	1,028	1,188	1,558

Note(s): The level of treatment indicates the amount of processing involved before water is released from the treatment facility. Primary treatment removes solids and oils from wastewater. Secondary treatment uses biological processes to remove organic material from the water. Tertiary treatment includes additional processes to further refine the water. Nitrification is a process to remove nitrogen from water.

Source(s): Electric Power Research Institute, Water & Sustainability (Volume 4): U.S. Electricity Consumption for Water Supply & Treatment – The Next Half Century, 2002.

8.1.4 Municipal Wastewater Treatment Facilities by Treatment Level and Population Served (Millions) (1)

	Less than Secondary		Secondary		Tertiary		No Discharge		Partial Treatment	
	Facilities	Pop.	Facilities	Pop.	Facilities	Pop.	Facilities	Pop.	Facilities	Pop.
1996	176	17.2	9388	81.9	4428	82.9	2032	7.7	0	-
2000	47	6.4	9156	88.2	4892	100.9	1938	12.3	222	-
2004	40	3.3	9221	96.5	4916	108.5	2188	14.6	218	-
2008	30	3.8	7302	92.7	5071	112.9	2251	16.9	115	-

Note(s): 1) The level of treatment indicates the amount of processing involved before water is released from the treatment facility. Primary treatment removes solids and oils from wastewater. Secondary treatment uses biological processes to remove organic material from the water. Tertiary treatment includes additional processes to further refine the water. No Discharge refers to facilities that do not discharge effluent to surface waters (e.g. groundwater discharge). Partial Treatment facilities perform some treatment before transferring water to another facility for further treatment.

Source(s): EPA, Clean Watersheds Needs Survey 2008 Report to Congress, 2010; EPA, Clean Watersheds Needs Survey 2004 Report to Congress, 2008.

8.2.1 Residential Water Use by Source (Million Gallons per Day)

Year	Total Residential Water Use	Public Supply (1)	Self-Supply (2)
1980	25,400	22,000	3,400
1985	24,320	21,000	3,320
1990	25,290	21,900	3,390
1995	26,090	22,700	3,390
2000	28,028 (3)	24,438 (3)	3,590
2005	29,430	25,600	3,830

Note(s): 1) Public supply water use: water withdrawn by public and private water suppliers that furnish water to at least 25 people or have a minimum of 15 connections. 2) Self-supply water use: Water withdrawn from a groundwater or surface-water source by a user rather than being obtained from a public supply. 3) USGS did not provide estimates of residential use from public supplies in 2000. This value was estimated based on the residential portion of public supply in 1995 and applied to the total public supply water use in 2000.

Source(s): U.S. Geological Survey, Estimated Use of Water in the U.S. in 1985, U.S. Geological Survey Circular 1004, 1988; U.S. Geological Survey, Estimated Use of Water in the U.S. in 1990, U.S. Geological Survey Circular 1081, 1993; U.S. Geological Survey, Estimated Use of Water in the U.S. in 1995, U.S. Geological Survey Circular 1200, 1998; U.S. Geological Survey, Estimated Use of Water in the U.S. in 2000, U.S. Geological Survey Circular 1268, 2004; and U.S. Geological Survey, Estimated Use of Water in the U.S. in 2005, U.S. Geological Survey Circular 1344, 2009.

8.2.2 1999 Single-Family Home Daily Water Consumption by End Use (Gallons per Capita) (1)

Fixture/End Use	Average gallons per capita per day	Total Use Percent
Toilet	18.5	18.3%
Clothes Washer	15	14.9%
Shower	11.6	11.5%
Faucet	10.9	10.8%
Other Domestic	1.6	1.6%
Bath	1.2	1.2%
Dishwasher	1	1.0%
Leaks	9.5	9.4%
Outdoor Use (2)	31.7	31.4%
Total (2)	**101**	**100%**

Note(s): 1) Based analysis of 1,188 single-family homes at 12 study locations. 2) Total Water use derived from USGS. Outdoor use is the difference between total and indoor uses.

Source(s): American Water Works Association Research Foundation, Residential End Uses of Water, 1999; U.S. Geological Survey, Estimated Use of Water in the U.S. in 2000, U.S. Geological Survey Circular 1268, 2004, Table 6, p. 17; and Vickers, Amy, Handbook of Water Use and Conservation, June 2002, p. 15.

8.2.3 2004 Water Use in Multi-Family Housing Units, In-Rent and Submetered Billing (Gallons per Unit per Day)

	In-Rent	Submetering	Estimated Savings from Submetering	Estimated Potential Range of Savings from Submetering
Indoor Water Use	143	121	-15.3%	6% - 24.6%

Note(s): Based on a regression analysis on a sample of 7,942 properties at 13 sample locations. Results are significant at the 95th percentile.
Source(s): Aquacraft, Inc./East Bay Municipal Utility District W, National Multiple Family Submetering and Allocation Billing Program Study, 2004.

8.2.4 Per Capita Use of Hot Water in Single Family Homes by End Use (Gallons per Capita per Day) (1)

Fixture/End Use	Average gallons per capita per day	Household Use gallons per day	Percent of Total Hot Water Use	Percent of End Use that is Hot Water
Toilet	0.0	0.0	0.0%	0.0%
Clothes Washer	3.9	10.1	15.5%	27.8%
Shower	6.3	16.4	25.1%	73.1%
Faucet	8.6	22.4	34.2%	72.7%
Other	0.0	0.0	0.0%	35.1%
Bath	4.2	10.9	16.7%	78.2%
Dishwasher	0.9	2.3	3.6%	100%
Leaks	1.2	3.1	4.8%	26.8%
Total	**25.1**	**65.2**	**100%**	**39.6%**

Note(s): 1) Based analysis of 10 single-family homes in Seattle, WA. Average number of residents per home: 2.6.
Source(s): Aquacraft, Inc. Residential End Uses of Hot Water in Single-Family Homes from Flow-Trace Analysis, 2000.

8.2.5 2010 Community Water Systems by Size and Type

System Size (1)	Facilities	Population Served (Millions)
Less than 500	29,711	4.9
501 - 3,300	14,031	20.1
3,301 - 10,000	4,914	28.6
10,001 - 100,000	3,801	108.5
More than 100,000	416	138.1
Total	**52,873**	**300.2**

Note(s): 1) Population served by each system. 2) Community water systems provide water to the same population year-round.
Source(s): EPA, Fiscal Year 2010 Drinking Water and Ground Water Statistics, EPA 816-K-09-004, June 2011.

8.2.6 Residential Water Billing Rate Structures for Community Water Systems

	Population Served by System (1)	
Rate Structure	10,001 - 100,000	More than 100,000
Uniform Rates	39.0%	30.0%
Declining Block Rate	15.0%	23.0%
Increasing Block Rate	25.0%	27.0%
Peak Period or Seasonal Rate	0.0%	5.0%
Separate Flat Fee	18.0%	20.0%
Annual Connection Fee	6.0%	3.0%
Combined Flat Fee	4.0%	2.0%
Other Rate Structures	3.0%	9.0%

Note(s): 1) Systems serving more than 10,000 users provide service to 82% of the population served by community water systems. Columns do not sum to 100% because some systems use more than one rate structure. 2) Uniform rates charge a set price for each unit of water. Block rates charge a different price for each additional increment of usage. The prices for each increment is higher for increasing block rates and lower for decreasing block rates. Peak rates and seasonal rates charge higher prices when demand is highest. Flat fees charge a set price for water delivery, with no restrictions on use. Combined flat fees charge one fee for water and other charges, such as rental fees. Separate flat fees bill water and other charges separately.

Source(s): EPA, Community Water System Survey 2006 Volume 1: Overview, p. 24, February 2009.

8.3.1 Commercial Water Use by Source (Million Gallons per Day)

Year	Total Commercial Water Use	Public Supply (1)	Self-Supply (2)
1980	-	-	-
1985	6,940	5,710	1,230
1990	8,290	5,900	2,390
1995	9,580	6,690	2,890
2000 (3)	10,314	7,202	3,111
2005 (3)	10,171	7,102	3,068

Note(s): 1) Public supply water use: water withdrawn by public and private water suppliers that furnish water to at least 25 people or have a minimum of 15 connections. 2) Self-supply water use: Water withdrawn from a groundwater or surface-water source by a user rather than being obtained from a public supply. 3) USGS did not estimate commercial water use in this year. Estimates are based on available data and percentage breakdown of commercial use in the 1995 survey.

Source(s): U.S. Geological Survey, Estimated Use of Water in the U.S. in 1985, U.S. Geological Survey Circular 1004, 1988; U.S. Geological Survey, Estimated Use of Water in the U.S. in 1990, U.S. Geological Survey Circular 1081, 1993; U.S. Geological Survey, Estimated Use of Water in the U.S. in 1995, U.S. Geological Survey Circular 1200, 1998; U.S. Geological Survey, Estimated Use of Water in the U.S. in 2000, U.S. Geological Survey Circular 1268, 2004; and U.S. Geological Survey, Estimated Use of Water in the U.S. in 2005, U.S. Geological Survey Circular 1344, 2009.

8.3.2 Average Water Use of Commercial and Institutional Establishments (Gallons per Establishment per Day)

	Average Daily Use	Variation In Use (1)	% Total CI Use	% of CI Customers	% Seasonal Use (2)
Hotels and Motels	7,113	5.41	5.8%	1.9%	23.1%
Laundries/Laundromats	3,290	8.85	4.0%	1.4%	13.4%
Car Washes	3,031	3.12	0.8%	0.4%	14.2%
Urban Irrigation	2,596	8.73	28.5%	30.2%	86.9%
Schools and Colleges	2,117	12.13	8.8%	4.8%	58.0%
Hospitals/Medical Offices	1,236	78.5	3.9%	4.2%	23.2%
Office Buildings	1,204	6.29	10.2%	11.7%	29.0%
Restaurants	906	7.69	8.8%	11.2%	16.1%
Food Stores	729	16.29	2.9%	5.2%	19.4%
Auto Shops (3)	687	7.96	2.0%	6.7%	27.2%
Membership Organizations (4)	629	6.42	2.0%	5.6%	46.2%
Total	**23,538**		**77.6%**	**83.3%**	

Note(s): Estimated from 24 months of water utility billing data in five Western locations: four locations in Southern California and one in Arizona. 1) Ratio of standard deviation of daily use to average of daily use. 2) Percent seasonal use is the difference between the average monthly use and the lowest monthly use over the average monthly use. 3) Includes auto repair shops, dealers, and service stations. 4) Includes religious organizations and other membership-based organizations.

Source(s): American Water Works Association Research Foundation, Commercial and Institutional End Uses of Water, 2000.

8.3.3 Normalized Annual End Uses of Water in Select Restaurants in Western United States (1)

Fixture/End Use (2)	Range of Water Use (gal/SF)	Range of Water Use (gal/seat)	Range of Water Use (gal/meal/day)
Faucets	68.9 - 250	1225 - 4630	1.1 - 2.6
Dishwashing	54.4 - 183.3	970 - 3000	0.9 - 1.4
Toilets/Urinals	25.6 - 75	455 - 1230	0.4 - 0.5
Ice Making	7.8 - 44.6	140 - 1440	0.1 - 0.9
Total Indoor Use	163.3 - 563.3 (3)	2910 - 15350 (4)	2.7 - 16.2 (4)

Building Size (SF) 1200 - 9800 **Seats:** 73 - 253 **Meals:** 190 - 800

Logged average daily use (thousand gal)	Indoor peak instantaneous demand, gpm (5)
1.5 - 9.7	21.1 - 59.6

Benchmarking Values for Restaurants (6)	N	25th Percentile of Users
Gal./SF/year	90	130 - 331
Gal./meal	90	6 - 9
Gal./seat/day	90	20 - 31
Gal./employee/day	90	86 - 122

Note(s): Familiy-style dine-in establishments. Four restaurants in southern California, one in Phoenix, AZ. 1) Water use data for the buildings was collected over a few days. Estimates of annual use were created by accounting for seasonal use and other variables, billing data, and interviews with building managers. 2) Based on three restaurants. 3) Based on four restaurants. 4) Based on five restaurants. 5) gpm = gallons per minute. 6) The study derived efficiency benchmarks by analyzing measured data and audit data. The benchmark was set at the lower 25th percentile of users.

Source(s): American Water Works Association Research Foundation, Commercial and Institutional End Uses of Water, 2000.

8.3.4 Normalized Annual End Uses of Water in Select Supermarkets in Western United States (1)

Fixture/End Use	Range of Water Use (gal/SF)
Toilets/Urinals	190 - 320
Other/Misc. Indoor (2)	895 - 1,405
Cooling	2,190 - 3,390
Total	3,560 - 5,075

Building Size (SF) 3,8000 - 66,000

Logged average daily use (thousand gal)	Indoor peak instantaneous demand (gpm)
9.71 - 14.33	29.7 - 58.8

Benchmarking Values for Supermarkets (3)	N	25th Percentile of Users
Indoor Use with Cooling, gal./SF/year	38	52 - 64
Indoor Use with Cooling, gal./SF/daily transaction	38	9 - 16

Note(s): 1) Water use data for the buildings was collected over a few days. Estimates of annual use were created by accounting for seasonal use and other variables, billing data, and interviews with building managers. 2) Includes water for sinks, spraying vegetables, cleaning, etc. 3) The study derived efficiency benchmarks by analyzing measured data and audit data. The benchmark was set at the lower 25th percentile of users.

Source(s): American Water Works Association Research Foundation, Commercial and Institutional End Uses of Water, 2000.

8.3.5 Normalized Annual End Uses of Water in Select Hotels in Western United States (Gallons per Room per Year) (1)

Fixture/End Use	Budget Hotels Range of Water Use (gal/room)	Luxury Hotel Range of Water Use (gal/room)
Bathtub	986 (2)	2,331
Faucets	2,196 - 2,683	6,297
Showers	10,203 - 13,724	32,453
Toilets	9,493 - 11,986	28,047
Leaks	439 - 8,007	5,351
Laundry	6047 - 12,027	74,480
Ice making	811 - 1,568 (3)	0
Other/misc. indoor	946 - 9,953	0
Total Indoor Use	37,703 - 50,696	82,770
Number of Rooms	140 - 209	297
Logged average daily use, kgal:	18.6 - 29.3	59.3
Peak instantaneous demand, gpm:	40.5 - 106.9	130.7

Benchmarking Values for Hotels	N	25th Percentile of Users
Indoor Use, gal./day/occupied room	98	60 - 115
Cooling Use, gal./year/occupied room	97	7,400 - 41,600

Note(s): Based on four budget hotels and one luxury hotel. Three budget hotels in Southern California, one in Phoenix, AZ. Luxury hotel in Los Angeles, CA. 1) Water use data for the buildings was collected over a few days. Estimates of annual use were created by accounting for seasonal use and other variables, billing data, and interviews with building managers. 2) Based on one hotel. 3) Based on three hotels. 5) The study derived efficiency benchmarks by analyzing measured data and audit data. The benchmark was set at the lower 25th percentile of

Source(s): American Water Works Association Research Foundation, Commercial and Institutional End Uses of Water, 2000.

8.3.6 Normalized Annual End Uses of Water in Two California High Schools

Fixture/End Use	Range of Water Use (gal/room)	Range of Water Use (gal/person)
Toilet	2.9 - 3.2	206 - 271
Urinal	1.2 - 2.6	106 - 186
Faucet	1.0 - 2.3	87 - 165
Shower	0.5 - 0.7	44 - 47
Kitchen	0.7 - 1.0	58 - 58
Misc. uses (2)	0.9	68
Cooling	-	-
Leaks	1.6 - 3.6	112
Swimming Pool	0.4 - 0.9	31
Total Use	**11.1 - 12.3**	**883**

Average Building Size (SF)	Logged average daily use (thousand gal)	Indoor peak instantaneous demand (gpm)
222326	9.1 - 16.4	41 - 60

Benchmarking Values for Schools (3)	N	25th Percentile of Users
Indoor Use, Gal./sq. ft./year	142	8 - 16
Indoor Use, Gal./school day/student	141	3 - 15
Cooling Use, Gal./sq. ft./year	35	8 - 20

Note(s): 1) Water use data for the buildings was collected over a few days. Estimates of annual use were created by accounting for seasonal use and other variables, billing data, and interviews with building managers. 2) One high school. 3) The study derived efficiency benchmarks by analyzing measured data and audit data. The benchmark was set at the lower 25th percentile of users.

Source(s): American Water Works Association Research Foundation, Commercial and Institutional End Uses of Water, 2000.

8.4.1 WaterSense List of Covered Products and Efficiency Specifications

Covered Product	Specification Effective Date	WaterSense Criteria		Federal Standard Level
Lavatory Faucets	October 2007	1.5 gpm	(1)	2.2 gpm
Toilets	January 2007	1.28 gpf	(2)	1.6 gpf
Urinals	October 2009	0.5 gpf		1.0 gpf
Shower Heads	March 2010	2.0 gpm		2.5 gpm
Irrigation Control Equipment	November 2011	Qualitative	(3)	–
Pre-Rinse Spray Valves	In Progress	1.25 gpm	(4)	1.6 gpm
Water Softeners	In Progress	–	(4)	–

WaterSense Landscape Irrigation Partners as of February 2012: 2001 (5)

Note(s): 1) GPM = gallons per minute. 2) GPF = gallons per flush. 3) Mulitiple criteria for irrigation includes requirements for percentage reduction in irrigation adequacy and irrigation excess, as well as conformance to supplemental capability requirements 4) Final criteria for these categories have not been set. These are criteria levels that WaterSense is considering. 5) WaterSense qualifies individuals as partners via private programs certified by WaterSense.

Source(s): EPA, High-Efficiency Lavatory Faucet Specification, October 2007; EPA, Tank-Type High-Efficiency Toilet Specification, January 2007; EPA, Showerheads Specification, March 2010; EPA, High-Efficiency Urinals Specification, October 2009; EPA, Irrigation Controllers Specification, January 2011; and EPA, Meet Our Partners List as of 2/8/2012, http://www.epa.gov/watersense/meet_our_partners.html.

8.4.2 Federal Water Consumption Intensity and Costs (Millions of Gallons)

Agency	Annual Consumption (million gallons)	Annual Cost (thousand $))	Facility Gross SF (thousands)	Gallons per Gross SF
DOD	116,752.0	358,806.6	1,952,056.2	59.8
VA	9,337.3	26,511.4	144,836.1	64.5
Justice	8,990.3	27,928.4	72,917.6	123.3
DOE	6,455.2	13,838.8	111,942.5	57.7
USPS	5,455.9	29,265.8	312,962.7	17.4
Interior	3,624.3	10,905.9	61,724.9	58.7
GSA	2,651.2	18,104.9	176,414.5	15.0
USDA	2,150.9	4,876.0	57,480.9	37.4
NASA	2,036.5	5,085.8	38,896.2	52.4
HHS	1,799.7	11,814.7	31,338.4	57.4
DHS	1,522.8	12,442.9	45,556.7	33.4
Labor	1,029.0	4,816.3	20,335.8	50.6
TVA	733.0	2,248.2	27,969.8	26.2
DOT	464.1	3,002.8	25,722.1	18.0
Treasury	431.1	1,795.5	12,049.6	35.8
Commerce	352.1	1,571.2	13,627.9	25.8
State	169.0	762.2	4,476.7	37.8
EPA	168.1	1,196.0	3,723.3	45.2
SSA	125.0	617.1	9,262.0	13.5
Archives	107.9	552.9	4,062.0	26.6
HUD	21.8	139.1	1,432.0	15.2
RRB	5.5	19.5	346.9	15.9
Total	**164,382.9**	**536,301.9**	**3,129,134.9**	**52.5**

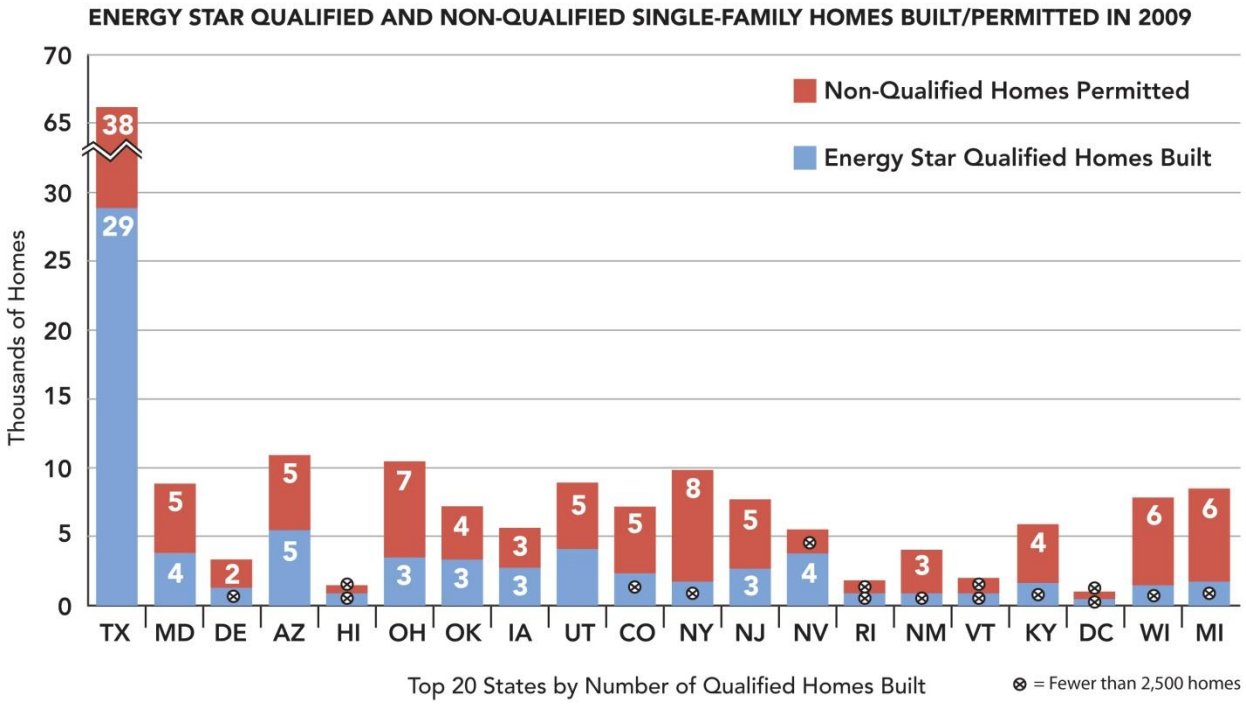
Source(s): FEMP, Annual Report to Congress on Federal Government Energy Management and Conservation Programs FY 2007, Table 9, p. 26, Jan. 2010.

Chapter 9: Market Transformation

This chapter contains data on two market transformation programs that reach across the United States and to other countries: the ENERGY STAR program, jointly administered by the U.S. Environmental Protection Agency and the U.S. Department of Energy, and the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system. It also includes data on three professional certifications and five case studies of high performance buildings. The main points from this chapter are summarized below:

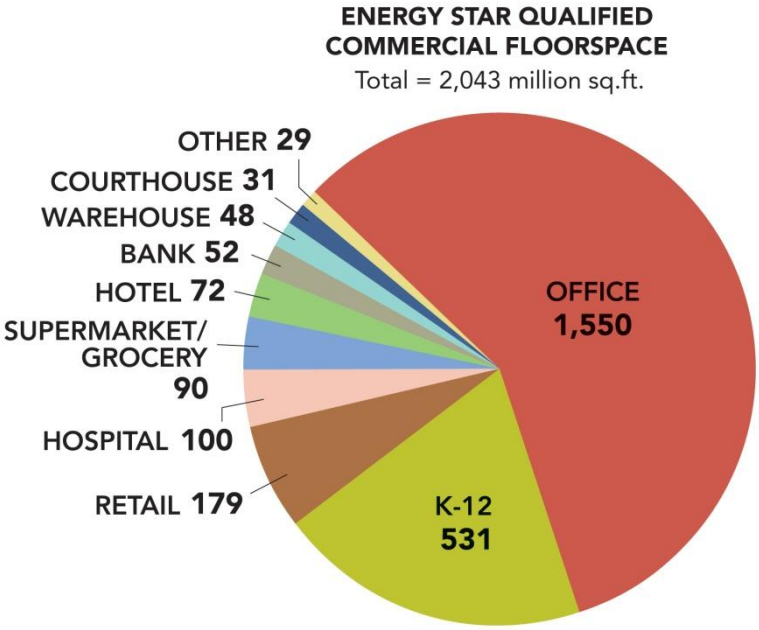
- More than 100,000 new homes qualified for the ENERGY STAR label in 2010, almost a quarter of all the single-family homes permitted in the United States that year. (9.1.1)
- Approximately 35,000 homes were retrofitted in 2010 under Home Performance with ENERGY STAR, a 41% increase from 2009 and a 158% increase from 2008. (9.1.2)
- In the commercial sector, the ENERGY STAR label has been awarded to more than 22,000 buildings containing a total of 2.6 billion square feet of floorspace, which represents 3.7% of all commercial floorspace in the United States. (9.1.3), (3.2.2)
- As of February 2012, there were 10,207 LEED-certified projects in the United States, a 58% jump from the number of certified projects in December 2010. (9.2.6)

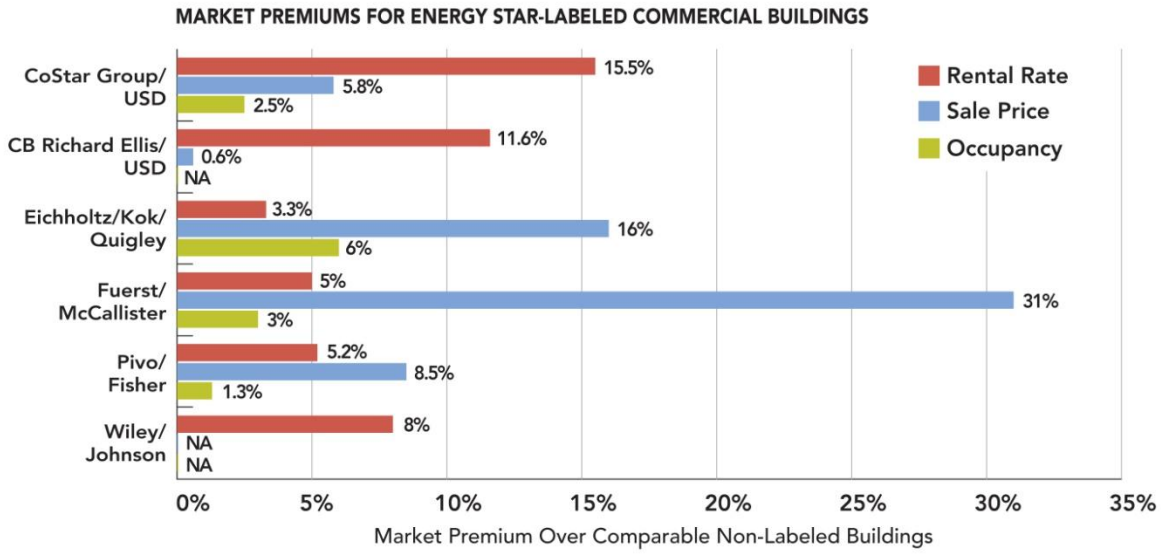
The number of ENERGY STAR qualified homes continued to increase in 2010, reaching 24% of the single-family home market. ENERGY STAR qualified homes represented more than half of new homes in Hawaii, Nevada, Iowa, and Arizona. (9.1.1)



The ENERGY STAR program also helped improve the efficiency of existing homes through Home Performance with ENERGY STAR. Approximately 35,000 homes were retrofitted in 2010, bringing the total number of retrofits completed since program inception to more than 110,000. NYSERDA in New York and National Grid in Massachusetts sponsor the most successful programs in terms of number of homes retrofitted, each with more than 26,000 retrofits completed to date. (9.1.2)

In the commercial sector, the number of ENERGY STAR buildings reached more than 22,000. Office buildings and K-12 schools account for the largest shares of qualified floorspace, with 58% and 20% of the total, respectively. (9.1.3), (3.2.2) Six studies conducted in 2008 and 2009 assessed the value of the ENERGY STAR label for commercial buildings in the United States. They found that labeled buildings fetched quantifiable rental rate, sale price, and occupancy premiums relative to comparable non-labeled buildings. (9.1.4)





As of February 2012, 10,207 projects in the United States were LEED-certified, 56% of which had been certified under LEED for New Construction (LEED-NC). (9.2.1), (9.2.6) The LEED-NC rating has five levels: Certified, Bronze, Silver, Gold, and Platinum. About 34% of the LEED-NC projects are Silver, 40% are Gold, and 5% are Platinum. (9.2.2) Initially, LEED-NC was the only certification available, but the LEED system has expanded to encompass a greater variety of project types, including core and shell improvements, renovations to commercial interiors, renovation or rehabilitation of existing buildings, and

improvements to operations and maintenance practices. (9.2.3), (9.2.4), (9.2.5) Half of certified projects in the United States are owned by for-profit organizations, 19% by state and local governments, 14% by nonprofits, and 16% by other types of organizations, including the Federal Government. (9.2.6) Professional certifications in building science and energy efficiency also rose dramatically in 2011. From December 2010 to February 2012, the number of Building Performance Institute (BPI) certifications in the U.S. increased 79%, reaching a total of 30,541 certifications. Energy Auditor Certifications offered by the Association of Energy Engineers rose by 20%.

9.1.1 2010 ENERGY STAR Qualified New Single-Family Homes, by Selected State

	ENERGY STAR Qualified New Homes	New Single-Family Housing Permits	Market Penetration
Hawaii	1,459	1,919	76%
Nevada	3,514	5,361	66%
Iowa	3,355	5,952	56%
Arizona	5,475	10,755	51%
Ohio	5,275	10,603	50%
Colorado	3,937	8,790	45%
Texas	29,074	66,973	43%
Maryland	3,544	8,489	42%
Oklahoma	2,824	6,866	41%
New Jersey	2,851	7,378	39%
Delaware	940	2,673	35%
Utah	2,308	6,883	34%
Kentucky	1,977	5,983	33%
Rhode Island	229	727	31%
New Mexico	1,152	4,006	29%
Vermont	279	980	28%
District of Columbia	42	177	24%
Wisconsin	1,792	7,687	23%
New York	2,320	9,959	23%
Michigan	1,790	7,755	23%
United States	**108,974**	**447,311**	**24%**

Note(s): The States listed are the top 20 by ENERGY STAR market penetration.

Source(s): Personal communication, Zachary Shadid, U.S. EPA, February 9, 2012; DOC/Census Bureau, Building Permits Survey, 2010, "New Privately Owned Housing Units Authorized".

9.1.2 Home Performance with ENERGY STAR, Completed Jobs

Rank	Program Sponsor	State	2007	2008	2009	2010	Total (2)
1	NY State Energy R&D Authority	NY	4,301	5,206	6,343	6122	26209
2	National Grid	MA	2,536	2,351	6,259	10019	26017
3	Austin Energy	TX	1,950	2,223	2,773	2633	12579
4	Wisconsin Energy Conservation Corp.	WI	840	1,012	1,944	2176	8717
5	New Jersey Board of Public Utilities	NJ	17	163	1,138	4365	5686
6	Energy Trust of Oregon	OR	560	1,040	767	777	3156
7	Sacramento Municipal Utility District (1)	CA	338	417	1,194	155	2104
8	Long Island Power Authority	NY	43	138	703	930	1885
9	Metropolitan Energy Center	MO	-	28	760	843	1631
10	Efficiency Vermont	VT	122	295	494	632	1594
	Total		**11,647**	**13,549**	**24,818**	**35,012**	**110,922**

Note(s): 1) Part of the California Building Performance Contractors Association. 2) Totals include homes completed since program's inception in 2001.

Source(s): Personal communication, Chandler Von Schrader, U.S. EPA, February 10, 2012.

9.1.3 ENERGY STAR Commercial and Institutional Buildings and Industrial Plants (1)

	Qualified Buildings	Floorspace Million SF	Building Type	Floorspace Million SF	% of Total	Buildings
1999	87	33	Office	1,550.2	57.8%	5,981
2000	452	73	K-12 School	531.3	19.8%	5,453
2001	298	73	Retail	179.1	6.7%	2,048
2002	486	127	Hospital (General and Surgica	100.5	3.4%	144
2003	592	150	Supermarket/Grocery	90.2	3.7%	1,878
2004	892	172	Hotel	71.9	2.7%	448
2005	1,026	216	Bank/Financial Institution	51.9	1.9%	257
2006	1,156	239	Warehouse (Unrefrigerated)	47.9	1.2%	179
2007	1,797	458	Courthouse	31.3	1.8%	121
2008	3,697	847	Medical Office	12.0	0.4%	138
2009	4,722	1,035	Residence Hall/Dormitory	7.9	0.3%	99
2010	6,851	1,348	Senior Care Facility	3.3	0.1%	45
2011	6,049	1,215	Data Center	2.5	0.1%	20
Total (2)	**22,056**	**2,682**	Warehouse (Refrigerated)	2.3	0.0%	6
			House of Worship	0.7	0.0%	23
			Industrial Plants	N/A	N/A	110
			Total	**2,683**	**100%**	**16,949**

Note(s): 1) Data as of February 13, 2012. Additional buildings may qualify after applications are reviewed. 2) Totals are less than sum of individual years since some buildings have multiple years listed. Totals include buildings qualified in 2012.

Source(s): EPA, Database of ENERGY STAR Labeled Buildings and Plants, accessed February 13, 2012 (http://www.energystar.gov/index.cfm?fuseaction=labeled_buildings.locator).

9.1.4 Market Premiums for ENERGY STAR-Labeled Commercial Buildings in Six Studies (1)

	Rental Rate Premium	Sale Price Premium	Occupancy Premium (2)
CoStar Group/USD	16%	6%	3%
CB Richard Ellis/USD	12%	1%	N/A (3)
Eichholtz/Kok/Quigley	3%	16%	6%
Fuerst/McCallister	5%	31%	3%
Pivo/Fisher	5%	9%	1%
Wiley/Johnson	8%	N/A (3)	N/A (3)

Note(s): 1) All studies were conducted in 2008 and 2009 and compared ENERGY STAR-labeled buildings in the United States with similar non-labeled buildings. More information at http://www.imt.org/rating-value. 2) Lower vacancy rates. 3) Not reported.

Source(s): Institute for Market Tranformation, "Rating and Disclosing the Energy Performance of Buildings: A Market-Based Solution to Unlock Commercial Energy Efficiency Opportunities" (undated).

9.1.5 Specification Dates for ENERGY STAR-Labeled Consumer Electronics and Office Equipment

Labeled (Covered) Product	Inception - End Date	Dates of updated specification
Computers	1992	1995, 1999, 2000, 2007, 2009
Displays	1992	1995, 1998, 1999, 2005, 2006, 2009
Printers (1)	1993	1995, 2000, 2001, 2007, 2009
Fax Machines (1)	1995	1995, 2000, 2001, 2007, 2009
Copiers (1)	1995	1997, 1999, 2007, 2009
Scanners (1)	1997	2007, 2009
Multi-Function Devices (1)	1997	1999, 2007, 2009
Televisions	1998	2002, 2004, 2005, 2008, 2010, 2011
VCRs	1998-2008	2002, 2004, 2005
Consumer A/V Equipment	1999	2003, 2009, 2010, 2012
Bottled Water Coolers	2000	2004, 2010
Set-Top Boxes	2001-2005, 2009 (2)	2009, 2011
Cordless Phones	2002	2004, 2006, 2008
External Power Adapters	2005-2010	2008
Battery Charging Systems	2006	2011, 2012
Digital-to-Analog Converter Boxes	2007-2010	-

Note(s): 1) Treated together with other products as "Imaging Equipment." 2) Program relaunched in 2009.

Source(s): LBNL, Calendar Year 2007 Program Benefits for ENERGY STAR Labeled Products, October 2008; EPA, Revisions to Existing Standards, energystar.gov, October 2009; EPA, ENERGY STAR Program Specifications for each product listed, energystar.gov, February 2012.

9.1.6 Specification Dates for ENERGY STAR-Labeled HVAC and Residential Appliances

Heating and Cooling Equipment	Inception - End Date	Dates of updated specification
Central AC	1995	2002, 2006, 2009
Air-Source Heat Pumps	1995	2002, 2006, 2009
Oil Furnaces	1995	2006, 2008, 2012, 2013
Gas Furnaces	1995	2006, 2008, 2012, 2013
Programable Thermostats	1995-2009	-
Gas Boilers	1996	2002
Oil Boilers	1996	2002
Gas-Fired Heat Pumps	1995-2000	-
Geothermal Heat Pumps	2001	2009, 2011, 2012
Ventilating Fans	2001	2003, 2009, 2012
Ceiling Fans	2001	2003, 2006, 2009, 2012
Light Commercial HVAC	2002	2004, 2010, 2011
Residential Appliances		
Dishwashers	1996	2001, 2007, 2009, 2011, 2012, 2014
Room AC	1996	2000, 2003, 2005
Refrigerators	1996	2001, 2003, 2004, 2008
Clothes Washers	1997	2001, 2004, 2007, 2009, 2011
Dehumidifiers	2001	2006, 2008
Freezers	2004	2008
Air Cleaners	2004	-
Water Heaters	2009	2010
Other Products		
Insulation	1996-2002	-
Residential Light Fixtures	1997	2001, 2002, 2003, 2005, 2007, 2008, 2011
Windows, Doors, Skylights	1997	2003, 2005, 2010
Roof Products	1999	2005, 2007, 2009
Screw base CFLs	1999	2001, 2004, 2008
Decorative Light Strings	2008	-
Residential LED Lighting	2008	2009, 2011
LED Light Bulbs	2010	-

Source(s): LBNL, Calendar Year 2007 Program Benefits for ENERGY STAR Labeled Products, October 2008; EPA, Revisions to Existing Standards, energystar.gov,

October 2009; EPA, ENERGY STAR Program Specifications for each product listed, energystar.gov, February 2012.

9.1.7 Specification Dates for ENERGY STAR-Labeled Commercial and Miscellaneous Products

Commercial Products	Inception - End Date	Dates of updated specification
Commercial Refrigerators and Freezers	2001	2009/2010
Hot Food Holding Cabinets	2003	2011
Commercial Steam Cookers	2003	-
Commercial Fryers	2003	2011
Cold Beverage Vending Machines	2004	2006, 2007
Solid State Lighting	2008	2009
Commercial Dishwashers	2007	-
Commercial Icemakers	2008	-
Commercial Griddles	2009	2011
Commercial Ovens	2009	-
Enterprise Servers	2009	-
Other Products		
Transformers	1995-2007	-
Exit Signs	1996-2008	1999, 2004
Traffic Signals	2000-2007	2003

Source(s): LBNL, Calendar Year 2007 Program Benefits for ENERGY STAR Labeled Products, October 2008; EPA, Revisions to Existing Standards, energystar.gov, October 2009; EPA, ENERGY STAR Program Specifications for each product listed, energystar.gov, February 2012.

9.1.8 Total Appliance Shipments (Millions) and ENERGY STAR Market Share

	Dishwashers		Room AC		Refrigerators		Clothes Washers		Dehumidifiers		Air Cleaners	
1997	5.1	6%	4.1	12%	9.0	25%	7.4	4%	-	N/A	-	N/A
1998	5.1	19%	4.4	13%	8.8	19%	7.0	6%	-	N/A	-	N/A
1999	5.7	12%	6.1	13%	9.1	24%	7.5	9%	-	N/A	-	N/A
2000	5.8	11%	6.5	19%	9.2	27%	7.5	9%	1.0	N/A	-	N/A
2001	5.6	20%	5.6	12%	9.3	17%	7.4	10%	0.8	19%	-	N/A
2002	6.2	36%	6.2	36%	9.7	20%	7.7	16%	0.8	39%	-	N/A
2003	6.4	57%	8.2	29%	10.0	26%	8.1	23%	1.3	74%	-	N/A
2004	7.1	78%	8.8	35%	10.9	33%	8.8	27%	1.7	76%	1.6	5%
2005	7.4	82%	8.0	39%	11.1	33%	9.2	36%	2.0	92%	1.6	13%
2006	7.3	92%	10.1	36%	11.1	31%	9.5	38%	1.5	82%	2.0	17%
2007	7.0	77%	9.5	50%	10.4	30%	8.8	42%	2.0	57%	2.5	14%
2008	6.0	67%	9.1	43%	9.3	31%	8.3	24%	1.6	75%	2.6	15%
2009	5.4	68%	5.8	36%	8.4	35%	7.9	48%	1.6	82%	2.6	19%
2010	5.6	100%	6.4	33%	9.4	50%	8.2	64%	1.6	99%	2.7	21%

Note(s): N/A = Not Applicable. ENERGY STAR specification did not exist.

Source(s): Appliance Magazine, "U.S. Appliance Industry Statistical Review: 2000 to YTD 2010" (July 2010) and "ENERGY STAR Qualified Appliance Retail Sales Data" (2007, 2008, and 2009) for dishwashers, room AC, refrigerators, and clothes washers; LBNL, Climate Change Action Plan spreadsheet (2009); EPA, ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2009 Summary (2010) for air cleaners and dehumidifiers; EPA, ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2010 Summary (2011); EPA, ENERGY STAR Unit Shipment Data Annual Summary Reports, 2003-2009.

9.1.9 Total Lighting Shipments (Millions) and ENERGY STAR Market Share

	Light Fixtures		Medium Screw-Base Lamps	
1998	221.5	1%	-	N/A
1999	213.2	1%	1,328	0%
2000	210.8	2%	1,026	1%
2001	196.7	2%	1,088	5%
2002	220.5	1%	1,076	4%
2003	225.0	3%	1,161	5%
2004	237.8	2%	1,389	6%
2005	247.4	3%	1,343	7%
2006	248.6	4%	1,302	11%
2007	217.9	6%	1,518	21%
2008	194.6	10%	1,230	22%
2009	174.7	6%	1,681	15%
2010	182.4	15%	1,658	20%

Note(s): N/A = Not Applicable. ENERGY STAR specification did not exist.
Source(s): LBNL, Climate Change Action Plan spreadsheet, 2009; EPA, ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2010 Summary;

9.1.10 Total Cooling Equipment Shipments (Thousands) and ENERGY STAR Market Share

	Central AC		Air-Source Heat Pumps		Geothermal Heat Pumps		Exhaust Fans		Ceiling Fans	
1995	3,300	15%	850	27%	32	N/A	-	N/A	-	N/A
1996	4,251	16%	1,125	30%	31	N/A	-	N/A	-	N/A
1997	4,024	18%	1,110	29%	37	N/A	-	N/A	-	N/A
1998	4,681	18%	1,236	31%	38	N/A	-	N/A	-	N/A
1999	5,011	20%	1,267	30%	42	N/A	-	N/A	-	N/A
2000	5,003	19%	1,310	29%	36	N/A	5,835	N/A	19,500	N/A
2001	4,839	22%	1,442	29%	36	40%	5,909	2%	17,680	18%
2002	5,263	14%	1,484	14%	37	29%	5,975	3%	19,500	8%
2003	5,181	17%	1,626	19%	36	37%	6,036	6%	18,500	17%
2004	5,515	19%	1,886	22%	44	58%	6,102	11%	19,700	14%
2005	6,471	19%	2,137	27%	48	68%	6,199	13%	19,800	18%
2006	4,951	21%	2,118	23%	64	79%	6,285	12%	20,800	15%
2007	4,500	23%	1,900	20%	86	100%	6,354	13%	19,830	14%
2008	3,968	19%	1,865	22%	130	58%	6,432	11%	19,972	13%
2009	3,612	17%	1,622	32%	125	59%	6,511	17%	20,896	7%
2010	3,519	27%	1,652	46%	128	47%	6,823	13%	12,348	15%

Note(s): N/A = Not Applicable. ENERGY STAR specification did not exist.
Source(s): LBNL, Climate Change Action Plan spreadsheet, 2009; EPA, ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2010 Summary;

9.1.11 Total Heating Equipment Shipments (Thousands) and ENERGY STAR Market Share

	Gas Furnaces		Gas Boilers		Oil Boilers		Oil Furnaces	
1995	2,592	22%	109	N/A	156	N/A	146	1%
1996	2,871	24%	198	4%	161	48%	152	1%
1997	2,779	27%	206	6%	160	55%	124	1%
1998	2,977	29%	185	8%	148	67%	128	1%
1999	3,126	31%	201	10%	149	74%	125	1%
2000	3,104	35%	224	15%	144	85%	121	3%
2001	3,063	39%	221	17%	149	89%	122	4%
2002	3,202	40%	214	21%	148	98%	117	6%
2003	3,266	42%	235	21%	167	54%	127	7%
2004	3,519	47%	237	41%	162	71%	130	7%
2005	3,512	37%	224	25%	146	57%	111	7%
2006	3,197	37%	196	38%	121	90%	100	6%
2007	2,782	37%	201	38%	123	80%	84	13%
2008	2,300	43%	192	57%	122	62%	59	12%
2009	2,190	50%	192	46%	123	62%	54	24%
2010	2,197	61%	192	52%	123	61%	56	36%

Note(s): N/A = Not Applicable. ENERGY STAR specification did not exist.
Source(s): LBNL, Climate Change Action Plan spreadsheet, 2009; EPA, ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2010 Summary;

9.1.12 Total Commercial Product Shipments (Thousands) and ENERGY STAR Market Share

	Exit Signs		Commercial Refrigeration		Hot Food Holding Cabinets		Comm. Steam Cookers		Cold Beverage Vending Machines		Bottled Water Coolers	
1996	1,847	10%	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A
1997	2,170	13%	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A
1998	2,493	20%	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A
1999	2,816	27%	-	N/A	-	N/A	-	N/A	-	N/A	-	N/A
2000	3,140	34%	200	N/A	-	N/A	-	N/A	251	N/A	822	1%
2001	3,463	41%	220	14%	-	N/A	-	N/A	249	N/A	822	1%
2002	3,786	44%	226	12%	-	N/A	-	N/A	246	N/A	885	1%
2003	3,831	91%	232	17%	13	8%	35	10%	246	N/A	948	38%
2004	3,877	63%	238	30%	20	62%	35	11%	255	26%	1,012	56%
2005	3,924	50%	244	43%	31	34%	35	12%	246	28%	1,075	68%
2006	3,971	89%	248	49%	31	59%	24	14%	246	31%	1,138	44%
2007	4,019	0%	251	59%	31	64%	23	22%	246	26%	1,201	52%
2008	4,067	0%	292	66%	30	79%	23	23%	246	32%	1,264	41%
2009	-	N/A	292	53%	29	75%	21	28%	246	18%	1,328	43%
2010	-	N/A	317	72%	37	63%	14	35%	243	28%	1,454	43%

	Commercial Dishwashers		Ice Machines		Commercial Fryers	
2003	-	N/A	-	N/A	72	2%
2004	-	N/A	-	N/A	74	10%
2005	-	N/A	-	N/A	77	7%
2006	-	N/A	-	N/A	82	11%
2007	25	0%	-	N/A	85	7%
2008	28	83%	138	40%	90	7%
2009	37	78%	142	42%	91	12%
2010	38	74%	111	63%	84	19%

Note(s): N/A = Not Applicable. ENERGY STAR specification did not exist.
Source(s): LBNL, Climate Change Action Plan spreadsheet, 2009; EPA, ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2010 Summary;

9.1.13 Total Consumer Electronics Shipments (Thousands) and ENERGY STAR Market Share

	TV		Telephony		TV-DVD/VCR		Audio/Video	
1998	28,170	N/A	-	N/A	3,147	17%	13,314	N/A
1999	25,137	39%	-	N/A	4,148	71%	18,279	17%
2000	25,391	46%	40,942	N/A	4,964	76%	23,894	24%
2001	22,773	45%	48,793	N/A	4,630	77%	27,628	38%
2002	23,150	45%	49,686	52%	5,687	82%	29,493	53%
2003	25,574	47%	52,000	59%	4,373	78%	25,438	59%
2004	23,053	83%	54,333	34%	7,169	85%	24,799	29%
2005	26,350	39%	55,967	26%	6,698	55%	24,239	29%
2006	32,310	54%	50,317	29%	3,166	4%	29,732	12%
2007	31,680	53%	42,090	23%	6,683	12%	26,428	36%
2008	32,670	79%	35,127	50%	1,684	67%	32,919	35%
2009	42,562	95%	28,624	74%	-	N/A	-	N/A
2010	42,743	80%	28,656	68%	-	N/A	-	N/A

	External Power Supplies		Battery Charging System	
1998	-	N/A	-	N/A
1999	-	N/A	-	N/A
2000	-	N/A	-	N/A
2001	-	N/A	-	N/A
2002	77,783	N/A	39,357	N/A
2003	79,709	N/A	39,646	N/A
2004	268,717	N/A	40,042	N/A
2005	457,725	3%	40,443	N/A
2006	505,665	30%	40,847	N/A
2007	554,710	56%	41,255	16%
2008	565,704	47%	41,668	15%
2009	668,524	59%	42,085	27%
2010	(1)	N/A	42,674	34%

Note(s): N/A = Not Applicable. ENERGY STAR specification did not exist or information not available. 1) The ENERGY STAR specification for external power supplies was sunset in 2010.

Source(s): LBNL, Climate Change Action Plan spreadsheet, 2009; EPA, ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2010 Summary;

9.1.14 Total Office Equipment Shipments (Millions) and ENERGY STAR Market Share

	Computers		Monitors		Printers		Fascimile		Copiers		Scanners		Multi-Function Devices	
1992	-	N.A.	-	N.A.	-	N.A.	-	N.A.	-	N.A.	-	N.A.	-	N.A.
1993	12.1	41%	12.0	19%	6.9	80%	-	N.A.	-	N.A.	-	N.A.	-	N.A.
1994	14.8	50%	14.6	50%	9.4	98%	-	N.A.	-	N.A.	-	N.A.	-	N.A.
1995	18.4	73%	18.2	93%	11.3	98%	1.3	14%	1.6	24%	-	N.A.	-	N.A.
1996	20.5	79%	20.3	95%	13.2	100%	2.1	57%	1.6	35%	-	N.A.	-	N.A.
1997	25.9	86%	24.6	95%	15.1	100%	3.4	74%	1.7	45%	4.2	30%	0.1	30%
1998	32.4	92%	30.2	95%	18.3	100%	5.6	91%	1.6	65%	5.4	30%	0.4	30%
1999	44.5	47%	33.9	48%	23.0	100%	6.5	99%	1.1	87%	4.9	40%	1.3	91%
2000	49.7	86%	33.4	95%	22.6	100%	7.0	99%	0.9	94%	4.4	50%	1.7	92%
2001	52.9	85%	35.9	95%	28.8	85%	7.2	99%	0.6	90%	3.9	50%	2.2	92%
2002	52.9	83%	36.7	95%	19.7	95%	6.0	99%	0.3	90%	3.4	60%	7.6	98%
2003	58.2	83%	35.1	95%	16.4	98%	4.5	99%	1.4	90%	2.9	70%	13.2	98%
2004	64.1	83%	36.6	95%	16.4	100%	4.2	99%	1.4	90%	2.4	75%	14.9	98%
2005	70.2	83%	38.2	65%	17.5	100%	3.8	99%	1.4	90%	1.9	80%	17.1	98%
2006	71.6	81%	42.0	78%	13.9	100%	3.1	99%	1.4	90%	1.6	85%	18.7	98%
2007	93.0	67%	42.8	92%	10.9	21%	3.9	2%	0.3	27%	1.0	43%	21.2	28%
2008	95.0	21%	32.8	84%	8.8	43%	3.8	4%	0.2	91%	0.6	87%	19.9	49%
2009	66.5	55%	29.4	90%	6.7	67%	3.7	7%	0.2	78%	0.4	97%	19.0	47%
2010	69.5	71%	28.2	43%	7.8	99%	3.7	7%	0.2	79%	0.7	99%	20.2	99%

Note(s): N/A = Not Applicable. ENERGY STAR specification did not exist.
Source(s): LBNL, Climate Change Action Plan spreadsheet, 2009; EPA, ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2010 Summary;

9.2.1 LEED for New Construction, by Selected States

	Certified	Bronze	Silver	Gold	Platinum	Total
California	118	0	216	329	49	712
Texas	65	0	131	112	14	322
Pennsylvania	67	0	110	94	6	278
Washington	40	0	101	121	8	270
Florida	67	0	112	120	10	309
Ilinois	53	0	92	94	15	254
Michigan	92	0	63	53	2	210
Virginia	51	0	99	79	9	238
Oregon	22	1	44	97	23	187
New York	50	0	80	85	23	238
All Other States	560	2	928	1,086	151	2,730
National Totals	**1,185**	**3**	**1,976**	**2,270**	**310**	**5,748**

Note(s): Totals include two buildings (one each in Pennsylvania and Massachusetts) whose certification level was not given, and two buildings whose
Source(s): United States Green Building Council, http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx, February 2012

9.2.2 LEED for New Construction, by Version

	v1.0	v2.0	v2.1	v2.2	v2009	Retail v2009	Total
Platinum	3	13	70	207	17	0	310
Gold	2	81	416	1,695	76	1	2,271
Silver	1	82	494	1,321	78	1	1,977
Bronze	3	0	0	0	0	0	3
Certified	1	105	429	588	62	0	1,185
Total	**10**	**283**	**1,409**	**3,811**	**233**	**2**	**5,748**

Note(s): Includes only buildings in the United States. Totals include two buildings whose certification level was not given (two at NC 2.0). Pilots are not
Source(s): United States Green Building Council, http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx, February 2012.

9.2.3 LEED for Core and Shell, by Version

	v2.0	v2009	Total
Platinum	34	1	35
Gold	326	5	331
Silver	224	10	234
Certified	61	6	67
Total	**645**	**22**	**667**

Note(s): Includes only buildings in the United States. Pilots are not included.
Source(s): United States Green Building Council, http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx, February 2012.

9.2.4 LEED for Commercial Interiors, by Version

	v2.0	v2009	Retail v2009	Total
Platinum	88	46	0	134
Gold	617	207	1	825
Silver	524	186	3	713
Certified	308	78	2	388
Total	**1,537**	**517**	**6**	**2,060**

Note(s): Includes only buildings in the United States. Pilots are not included.
Source(s): United States Green Building Council, http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx, February 2012.

9.2.5 LEED for Existing Buildings, by Version

	EB v2.0	EB O&M	EB O&M v2009
Platinum	20	22	22
Gold	78	316	195
Silver	92	241	156
Certified	109	103	132
Total	**299**	**683**	**505**

Note(s): Includes only buildings in the United States. Total for EB O&M includes one building whose certification level was not given. Pilots are not
Source(s): United States Green Building Council, http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx, February 2012.

9.2.6 LEED for Schools, by Version

	v2.0	v2009	Total
Platinum	14	1	15
Gold	103	8	111
Silver	78	5	83
Certified	39	3	42
Total	**234**	**17**	**251**

Note(s): Includes only buildings in the United States. Pilots are not included.
Source(s): United States Green Building Council, http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx, February 2012.

9.2.7 LEED Certified Projects, by Ownership Category and Certification Level

	Platinum	Gold	Silver	Bronze	Certified	Unknown	Total
For-Profit Organization	249	2,022	1,809	0	1,082	0	5,164
State or Local Government	88	819	679	2	366	1	1,955
Not-for-Profit Organization	134	586	431	0	286	0	1,437
Federal Government	18	210	237	1	83	0	549
Educational	5	29	22	0	15	0	71
Individual	22	130	94	0	56	0	302
Other	32	259	190	0	109	2	592
Multiple Owner Types	10	66	34	0	27	0	137
Total	**558**	**4,121**	**3,496**	**3**	**2,024**	**3**	**10,207**

Note(s): Includes only buildings in the United States. Pilots and homes are not included.
Source(s): United States Green Building Council, http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx, February 2012.

9.3.1 North American Technician Excellence Program (1)

Individuals Certified:	29,874
Number of Certificates:	36,090

Certifications	**Installation**	**Service (2)**
Air Conditioning	962	5,008
Air Distribution	243	1,481
Heat Pump (3)	864	14,516
Gas Furnace	1,655	9,127
Oil Furnace	43	736
Hydronics Gas	86	550
Hydronics Oil	14	216
Light Commercial Refrigeration	81	283
Commercial Refrigeration	32	129
Senior Technician		64

Census Region	**Percent of**
South	40%
Midwest	26%
West	19%
Northeast	14%
Canada	1%

Note(s): 1)Third party certification program for heating and cooling professionals to ensure knowledge of proper installation and servicing of HVAC/R equipment. 2) All service specialties include their installation counterparts for free. 3) Heat Pump specialties include their Air Conditioning counterparts for free.

Source(s): Personal Communication, Kathy Corr, North American Technical Excellence, February 16, 2012.

9.3.2 Building Performance Institute (BPI) Certifications, by State

State	Certifications (1)	Thousand Residents per Cert. (2)	State	Certifications (1)	Thousand Residents per Cert. (2)
Alabama	84	57	Nebraska	84	22
Alaska	153	5	Nevada	296	9
Arizona	1,035	6	New Hampshire	294	4
Arkansas	115	26	New Jersey	1,982	4
California	2,782	14	New Mexico	116	18
Colorado	914	6	New York	5,408	4
Connecticut	1,041	3	North Carolina	1,379	7
Delaware	152	6	North Dakota	1	684
D.C.	84	7	Ohio	756	15
Florida	234	81	Oklahoma	127	30
Georgia	650	15	Oregon	863	4
Hawaii	2	687	Pennsylvania	1,548	8
Idaho	71	22	Rhode Island	164	6
Illinois	1,130	11	South Carolina	409	11
Indiana	576	11	South Dakota	18	46
Iowa	129	24	Tennessee	218	29
Kansas	125	23	Texas	881	29
Kentucky	369	12	Utah	113	25
Louisiana	136	34	Vermont	317	2
Maine	321	4	Virginia	636	13
Maryland	798	7	Washington	685	10
Massachusetts	893	7	West Virginia	283	7
Michigan	891	11	Wisconsin	208	27
Minnesota	333	16	Wyoming	67	8
Mississippi	20	149			
Missouri	618	10	United States	30,541	10
Montana	32	31	Outside U.S.	28	N/A
			Total	30,569	N/A

Note(s): 1) Counts total active certifications in each state as of February 1, 2012. An individual may hold multiple certifications. 2) Based on 2011 Census population estimates as of July 1, 2011.

Source(s): Personal Communication, Leslie McDowell, Building Performance Institute, February 2, 2012; U.S. Census Bureau Population Estimates: State Totals: Vintage 2011, Table 1.

9.3.3 Association of Energy Engineers Energy Auditor Certifications, by State

State	Certified Energy Auditors (1)	Thousand Residents per Auditor (2)	State	Certified Energy Auditors (1)	Thousand Residents per Auditor (2)
Alabama	78	62	Nebraska	5	369
Alaska	50	14	Nevada	8	340
Arizona	31	209	New Hampshire	14	94
Arkansas	3	979	New Jersey	73	121
California	110	343	New Mexico	13	160
Colorado	35	146	New York	117	166
Connecticut	33	109	North Carolina	37	261
Delaware	3	302	North Dakota	4	171
D.C.	12	51	Ohio	65	178
Florida	100	191	Oklahoma	14	271
Georgia	56	175	Oregon	13	298
Hawaii	7	196	Pennsylvania	82	155
Idaho	2	792	Rhode Island	7	150
Illinois	41	314	South Carolina	16	292
Indiana	37	176	South Dakota	1	824
Iowa	10	306	Tennessee	20	320
Kansas	11	261	Texas	122	210
Kentucky	15	291	Utah	8	352
Louisiana	11	416	Vermont	4	157
Maine	17	78	Virginia	61	133
Maryland	38	153	Washington	15	455
Massachusetts	75	88	West Virginia	2	928
Michigan	47	210	Wisconsin	19	301
Minnesota	37	144	Wyoming	0	N/A
Mississippi	8	372			
Missouri	49	123	Total U.S.	1,637	189
Montana	1	998	Outside U.S.	116	N/A
			Grand Total	1,753	N/A

Note(s): 1) Counts total active certifications in each state as of February 3, 2012. 2) Based on 2011 Census population estimates as of July 1, 2011.

Source(s): Personal Communication, Jennifer Vendola, Association of Energy Engineers, February 3, 2012; U.S. Census Bureau Population Estimates: State Totals: Vintage 2011, Table 1.

9.4.1 Case Study, The Adam Joseph Lewis Center for Environmental Studies, Oberlin College, Oberlin, Ohio (Education)

Building Design

Floor Area: 13,600 SF Floors: 2 Footprint: 140 ft. x 45 ft. with attached 100-seat auditorium

3 Classrooms (1) 1 Conference Room 1 Adminstration Office
Auditorium, 100 seats 6 Small Offices Atrium
Wastewater Treatment Facility

Shell

Windows Material: Green Tint Triple Pane Argon Fill Insulating Glass
Grey Tint Double Pane Argon Fill Insulating Glass

	Fenestration(square feet) Window	Wall (2)	window/wall		Atrium, Triple Pane (3)		Building, Double Pane	
North	1,675	4,372	38%		U-Factor	0.34	U-Factor	0.46
South	2,553	4,498	58%		SHGC	0.26	SHGC	0.46
East	1,084	2,371	46%					
West	350	2,512	14%					
Overall	6,063	14,153	43%					

Wall/Roof

	Main Material	R-Value
Wall :	Face Brink	19
Roof:	Steel/Stone Ballast	30

HVAC

		COP(4)
Offices/Classrooms:	Individual GSHPs (5)	3.9-4.6
	1 Large GSHP for ventilation	3.8
Atrium:	Radiant Flooring Hydronic Heating System	
Auditorium:	1 Standard Range Water Heat Pump	4.2

Lighting Power Densities (W/SF)

Offices:	0.88	Corridors/Others:	0.45	Total Building:	0.79
Classroom/Lecture Halls:	1.18	Atrium:	0.93		

Energy/Power

PV System: 60 kW grid-tie roof system
Net Annual Energy Usage (thousand Btu/SF*year): 16.4

Note(s): 1) Two classrooms seat 36 and one seats 18. 2) Wall total area includes window area. 3) Atrium has only south, north, and east facing windows. 4) Coefficient of performance ranges due to various sizes; GSHPs have the greatest COP 5) GSHP is Ground water Source Heat

Source(s): NREL, Energy Performance Evaluation of an Educational Facility: The Adam Joseph Lewis Center for Environmental Studies, Oberlin College, Oberlin, Ohio, November 2004, Table 4.1 p. 10 Table 4.2 p.12 and Table 6.5 p. 94; NREL, Lessons Learned from Case Studies of Six High-Performance Buildings, June 2006, p. 5 Table A-2 p. 130

9.4.2 Case Study, The Cambria Department of Environmental Protection Office Building, Ebensburg, Pennsylvania (Office)

Building Design

Floor Area: 34,500 SF Floors: 2

Open office space (1)	File storage area	Two small labratories	Conference rooms
Break room	Storage areas	Two mechanical rooms	Telecom room

Shell

Windows

Material: Triple Pane, low-e with Aluminum Frames and Wood Frames

Triple Pane Aluminum Frames		Triple Pane Wood Frames	
U-Factor	0.24	U-Factor	0.26

Wall/Roof

	Primary Material	R-Value
Wall :	Insulating Concrete Forms	27.0
Roof:	Decking and Insulation	33.0

HVAC

	Total Capacities(thousand Btu/hr)
12 Ground Source Heat Pumps	644 (2)
12 Auxiliary Electric Resistance Heaters	382 (3)

Lighting Power Densities(W/SF)

Open Office Area:	0.75
Office Area Task Lighting(4):	0.5

Energy/Power

PV System:	18.2 kW grid-tie system (5)
Net Annual Energy Usage (thousand Btu/SF*year):	36.0

Note(s): 1) Office space is for 100 people. This accounts for approximately 20,000 SF of the total building floorspace. 2) Cooling capacity 3) Auxiliary heating capacity. 4) Task lighting is in addition to the open office area LPD and is only in select cubicals and offices. 5) Includes 17.2 kW of roof PV array and two 0.5 KW ground level single axis tracking PV arrays.

Source(s): NREL, Analysis of the Design and Energy Performance of the Pennsylvania Department of Enverionmental Proctection Cambria Office Building, March 2005, p. ; NREL, Lessons Learned from Case Studies of Six High-Performance Buildings, June 2006, p. 5 Table A-2 p. 130.

9.4.3 Case Study, The Visitor Center at Zion National Park, Utah (Service/Retail/Office)

Building Design

Vistors Center (1): 8,800 SF Comfort Station (2): 2,756 SF Fee Station: 170 SF

Shell

Windows

	Type	U-Factor	SHGC (3)
South/East Glass	Double Pane Insulating Glass, Low-e, Aluminum Frames, Thermally Broken	0.44	0.44
North/West Glass	Double Pane Insulating Glass, Heat Mirror, Aluminum Frames, Thermally Broken	0.37	0.37

Window/Wall Ratio: 28%

Wall/Roof

	Materials	Effective R-Value
Trombe Walls:	Low-iron Patterned Trombe Wall, CMU (4)	2.3
Vistor Center Walls:	Wood Siding, Rigid Insulation Board, Gypsum	16.5
Comfort Station Walls:	Wood Siding, Rigid Insulation Board, CMU (4)	6.6
Roof:	Wood Shingles; Sheathing; Insulated Roof Panels	30.9

HVAC

Heating	Cooling
Trombe Walls	Operable Windows
Electric Radiant Ceiling Panels	3 Cooling Towers

Lighting Power Densities(W/SF)

Main Area:	(5)
Offices:	1.0
Bookstore:	0.9

Energy/Power:

PV System:	7.2 kW grid-tie system
Net Annual Energy Usage (thousand Btu/SF*year):	27.0

Note(s): 1) Includes office, bookstore, and service areas. 2) Restroom complex. 3) Solar heat gain coefficient. 4) Concrete masonry unit. 5) The main vistors center area is handled almost entirely with daylighting. Auxiliary fluorescent lighting is used only occasionally to supplement.

Source(s): NREL, Evaluation of the Low-Energy Design and Energy Performance of the Zion National Park Visitors Center, Feb. 2005, p. 23-37; NREL, Lessons Learned from Case Studies of Six High-Performance Buildings, June 2006, p. 5 Table A-2 p. 130.

9.4.4 Case Study, The Philip Merrill Environmental Center, Annapolis, Maryland (Office)

Building Design

Floor Area: 31,000 SF Floors: 2 Footprint: 220 ft. x (1)

2 Floors of open office space
Attached pavilion containing: Meeting space Kitchen Staff dining Conference room

Shell

Windows

		U-Factor	SHGC (2)
Type:	Double Pane, Low-e, Argon Filled Insulating Glass	0.244	0.41

Wall/Roof

	Material	Effective R-Value
Interior Wall	plywood, gypsum, SIP foam, and sheathing	28.0
Exterior Wall	gypsum and insulated metal framing	9.3
Roof	plywood, gypsum, SIP foam, and sheathing	38.0

HVAC

18 ground source heat pumps
fin and tube radiators connected to a propane boiler
1 air condtioning unit

Lighting Power Densities (W/SF)

First Floor:	1.2
Second Floor:	1.6
Conference Room:	1.4

Energy/Power

PV System:	4.2 kW thin-film system
Net Annual Energy Usage (thousand Btu/SF*year):	39.9

Note(s): 1) Width varies from about 74 ft. to 59 ft. along different sections of the length. 2) Solar heat gain coefficient.

Source(s): NREL, Analysis of the Energy Performance of the Chesapeake Bay Foundation's Philip Merrill Environmental Center, April 2005, p. 6-24; NREL, Lessons Learned from Case Studies of Six High-Performance Buildings, June 2006, p. 5 Table A-2 p. 130.

9.4.5 Case Study, The Thermal Test Facility, National Renewable Energy Laboratory, Golden, Colorado (Office/Laboratory)

Building Design

Floor Area:	10,000 SF	Floors(1): 2	Aspect Ratio: 1.75
Offices	Laboratories	Conference Room	Mechanical Level

Shell

Windows

	Material	U-factor	SHGC(2)
Viewing Windows:	Double Pane, Grey Tint, Low-e	0.42	0.44
Clerestory Windows:	Double Pane, Clear, Low-e	0.45	0.65

	Window Area(SF)
North	38
South(3)	1,134
East	56
West	56

Wall/Roof

	Material	Effective R-Value
North Wall	Concrete Slab/Rigid Polystyrene	5.0
South/East/West	Steel Studs/Batt Insulation/Concrete	23.0
Roof:	Built-up/Polyisocianurate Covering/Steel Supports	23.0

HVAC

VAV air handling unit
Hot water supply paralell VAV boxes
Direct and Indirect evaporative cooling system
Single zone roof top unit(4)
Hot Water Coil(4)

Lighting Power Densities(W/SF)

Interior Overhead:	0.73	Exterior:	0.05
Emergency:	0.02	Building:	0.80

Energy/Power

Net Annual Energy Usage (kBtu/SF*year): 23.02

Note(s): 1) That second floor is actually and mechanical mezzaine level. 2) Solar heat gain coefficient 3) Includes 492 SF of viewing windows and 642 SF of clerestory windows. 4) Only used to handle the conference room.

Source(s): NREL, Evaluation of the Energy Performance and Design Process of the Thermal Test Facility at the National Renewable Energy Laboratory, February 2005, p. 29-54; NREL, Lessons Learned from Case Studies of Six High-Performance Buildings, June 2006, p. 5 Table A-2 p. 130.

9.4.6 Case Study, The Solaire, New York, New York (Apartments/Multi-Family)

Building Design

Floor Area:	357,000 SF	Units:	293	Maximum Occupancy:	700
Floors:	27	Site Size:	0.38 Acres	Typical Occupancy(1):	578

Black-Water Treatment Facility (2)

Shell

Windows

Material: Double Glazed, Low-e, Thermal Breaks with Insulated Spacers

	Operable Windows	Fixed Windows
Visual Transminttance	0.68	0.68
Solar Heat Gain Coefficient	0.35	0.35
U-Factor	0.47	0.41

Wall/Roof

	Material	R-Value
Exterior Walls:	Insulated brick and concrete block	8.4
Roof:	Roof top garden(green roof)	22.7

HVAC

Two direct-fired natural gas absorption chillers
4-Pipe fan-coil units in individual aparments

Power/Energy(3)

PV System(4): 1,300 SF (76 custom panels) of west facing PV rated for 11 kW . These panels are integrated into the building facade.
151 SF PV located in the entrance canopy. Rated for 662 W.
286 standard PV modules mounted on the south and west walls. Rated for 21 kW.

Unit Average Electricity Consumption(5): 15,681 kBtu/year
Building Natural Gas Consumption(6): 104.1 kBtu/SF*year

Predicted End-Use Consumption(kBtu/SF*year)

Heating	60.8	Plug Loads and Equipment	6.7
Cooling	20.7	Domestic Hot Water	7.9
Lighting	7.4	Cooking, Vertical Transportation, and Other	6.8
Fans/Pumps	11.4	**Total**	**121.7**

Note(s): 1) 84 hours per person weekly, 89 visitors weekly, 8 hours per visitor weekly. 2)30,000 gallon storage tank. Water is used for toilets and cooling tower. 3) Appliances in units are ENERGY STAR qualified. (4) PV system designed to handle 5% of building peak non-residential electrical load (i.e. corridor lighting). 5) Includes only electric that was submetered to each apartment. 6) 2007 building consumption.

Source(s): ASHRAE, High Peformance Buildings, NYC's Living Lesson, p. 56-65, Summer 2008; USGBC, LEED Case Studies, The Solaire, http://leedcasestudies.usgbc.org/overview.cfm?ProjectID=273.

Thermal Conversion Factors

Fuel	Units	Approximate Heat Content
Coal		
Production	million Btu per short ton	20.213
Consumption	million Btu per short ton	19.989
Coke Plants	million Btu per short ton	26.280
Industrial	million Btu per short ton	22.360
Residential and Commercial	million Btu per short ton	21.359
Electric Power Sector	million Btu per short ton	19.726
Imports	million Btu per short ton	25.116
Exports	million Btu per short ton	25.393
Coal Coke	million Btu per short ton	24.800
Crude Oil		
Production	million Btu per barrel	5.800
Imports	million Btu per barrel	5.990
Petroleum Products		
Consumption	million Btu per barrel	5.301
Motor Gasoline	million Btu per barrel	5.128
Jet Fuel	million Btu per barrel	5.670
Distillate Fuel Oil	million Btu per barrel	5.775
Diesel Fuel	million Btu per barrel	5.766
Residual Fuel Oil	million Btu per barrel	6.287
Liquefied Petroleum Gases	million Btu per barrel	3.600
Kerosene	million Btu per barrel	5.670
Petrochemical Feedstocks	million Btu per barrel	5.565
Unfinished Oils	million Btu per barrel	6.118
Imports	million Btu per barrel	5.542
Exports	million Btu per barrel	5.840
Ethanol	million Btu per barrel	3.539
Biodiesel	million Btu per barrel	5.376
Natural Gas Plant Liquids		
Production	million Btu per barrel	3,948
Natural Gas		
Production, Dry	Btu per cubic foot	1,028
Consumption	Btu per cubic foot	1,028
End-Use Sectors	Btu per cubic foot	1,029
Electric Power Sector	Btu per cubic foot	1,027
Imports	Btu per cubic foot	1,025
Exports	Btu per cubic foot	1,009
Electricity Consumption	Btu per kilowatt hour	3,412

Note(s): Conversion factors vary from year to year.

Source(s): DOE, EIA, Annual Energy Outlook 2010, Apr. 2008, Table G1, p. 221.

BUILDINGSDATABOOK.EERE.ENERGY.GOV