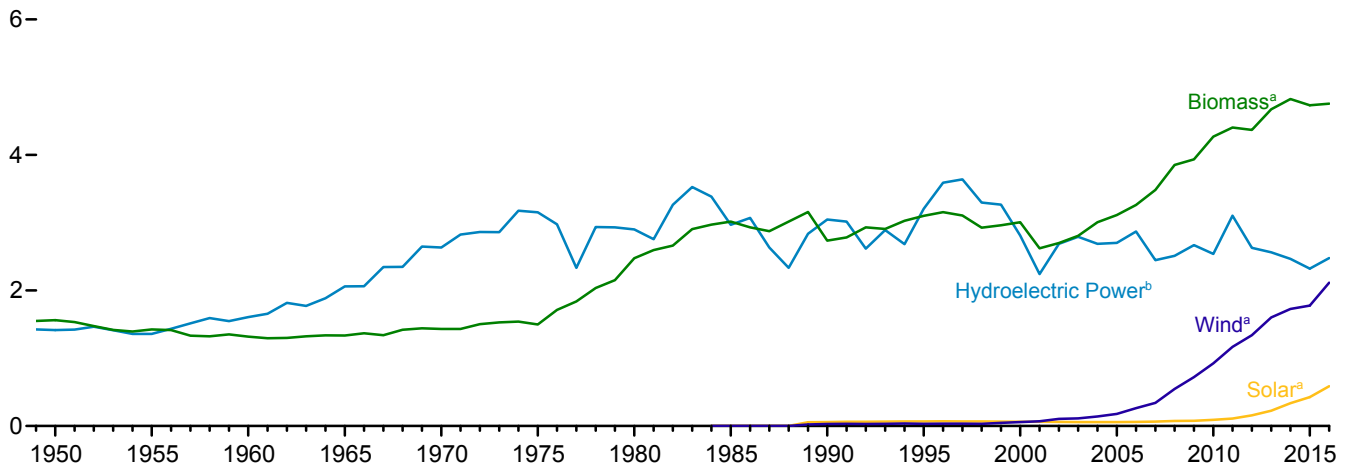


# 10. Renewable Energy

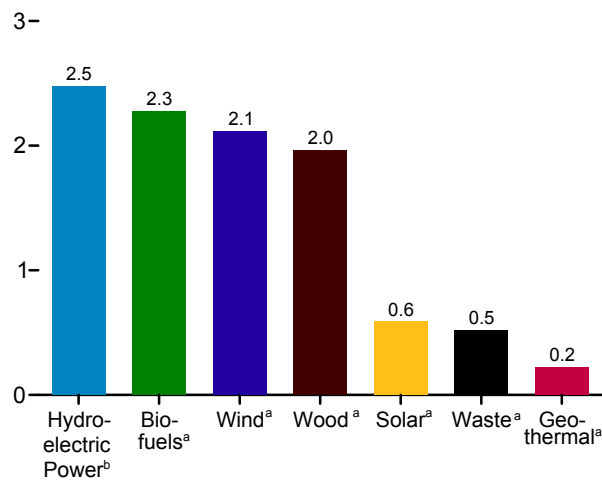
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**Figure 10.1 Renewable Energy Consumption**  
(Quadrillion Btu)

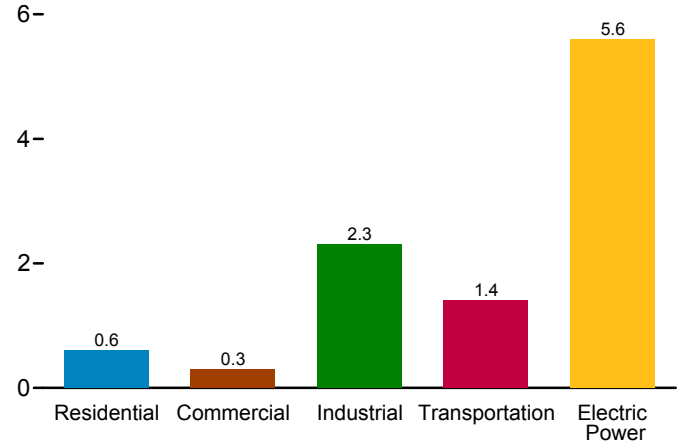
Major Sources, 1949–2016



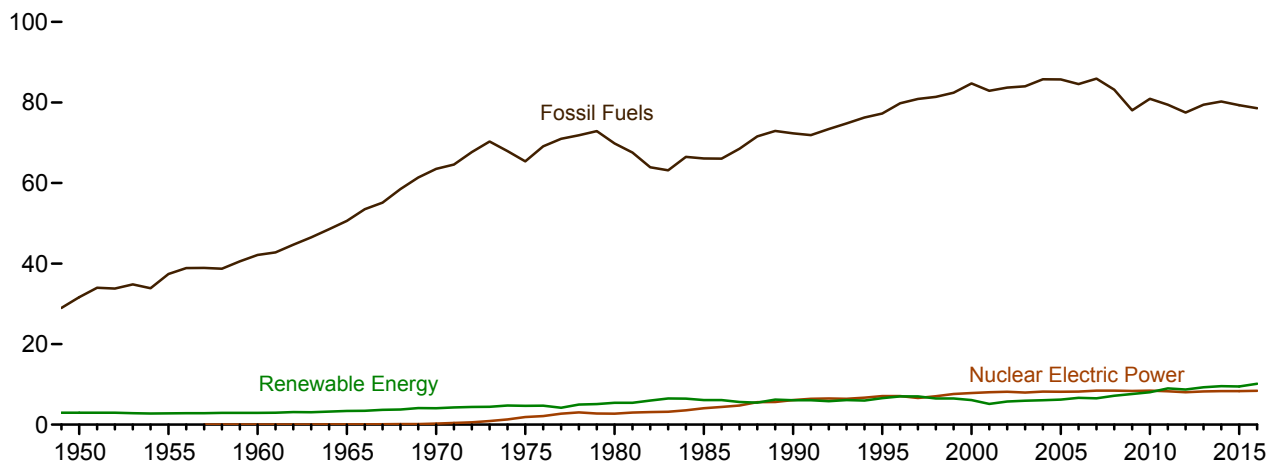
By Source, 2016



By Sector, 2016



Compared With Other Resources, 1949–2016



<sup>a</sup> See Table 10.1 for definition.  
<sup>b</sup> Conventional hydroelectric power.

Web Page: <http://www.eia.gov/totalenergy/data/monthly/#renewable>.  
Sources: Tables 1.3 and 10.1–10.2c.

**Table 10.1 Renewable Energy Production and Consumption by Source**  
(Trillion Btu)

	Production <sup>a</sup>			Consumption								
	Biomass		Total Renewable Energy <sup>d</sup>	Hydroelectric Power <sup>e</sup>	Geothermal <sup>f</sup>	Solar <sup>g</sup>	Wind <sup>h</sup>	Biomass				Total Renewable Energy
	Bio-fuels <sup>b</sup>	Total <sup>c</sup>						Wood <sup>i</sup>	Waste <sup>j</sup>	Bio-fuels <sup>k</sup>	Total	
1950 Total	NA	1,562	2,978	1,415	NA	NA	NA	1,562	NA	NA	1,562	2,978
1955 Total	NA	1,424	2,784	1,360	NA	NA	NA	1,424	NA	NA	1,424	2,784
1960 Total	NA	1,320	2,928	1,608	(s)	NA	NA	1,320	NA	NA	1,320	2,928
1965 Total	NA	1,335	3,396	2,059	2	NA	NA	1,335	NA	NA	1,335	3,396
1970 Total	NA	1,431	4,070	2,634	6	NA	NA	1,429	2	NA	1,431	4,070
1975 Total	NA	1,499	4,687	3,155	34	NA	NA	1,497	2	NA	1,499	4,687
1980 Total	NA	2,475	5,428	2,900	53	NA	NA	2,474	2	NA	2,475	5,428
1985 Total	93	3,016	6,084	2,970	97	(s)	(s)	2,687	236	93	3,016	6,084
1990 Total	111	2,735	6,040	3,046	171	59	29	2,216	408	111	2,735	6,040
1995 Total	198	3,099	6,557	3,205	152	68	33	2,370	531	200	3,101	6,559
2000 Total	233	3,006	6,102	2,811	164	63	57	2,262	511	236	3,008	6,104
2001 Total	254	2,624	5,162	2,242	164	62	70	2,006	364	253	2,622	5,160
2002 Total	308	2,705	5,731	2,689	171	60	105	1,995	402	303	2,701	5,726
2003 Total	401	2,805	5,942	2,793	173	58	113	2,002	401	403	2,806	5,944
2004 Total	486	2,996	6,063	2,688	178	58	142	2,121	389	498	3,008	6,075
2005 Total	561	3,101	6,221	2,703	181	58	178	2,137	403	574	3,114	6,233
2006 Total	716	3,212	6,586	2,869	181	61	264	2,099	397	766	3,262	6,637
2007 Total	970	3,472	6,510	2,446	186	65	341	2,089	413	983	3,485	6,523
2008 Total	1,374	3,868	7,191	2,511	192	74	546	2,059	435	1,357	3,851	7,174
2009 Total	1,570	3,953	7,620	2,669	200	78	721	1,931	452	1,553	3,936	7,604
2010 Total	1,868	4,316	8,077	2,539	208	90	923	1,981	468	1,821	4,270	8,030
2011 Total	2,029	4,501	9,095	3,103	212	111	1,168	2,010	462	1,933	4,405	8,999
2012 Total	1,929	4,406	8,743	2,629	212	157	1,340	2,010	467	1,892	4,369	8,706
2013 Total	1,981	4,647	9,250	2,562	214	225	1,601	2,170	496	2,007	4,673	9,276
2014 Total	2,103	4,861	9,607	2,467	214	337	1,728	2,242	516	2,067	4,825	9,570
2015 January	178	403	808	225	18	21	141	182	43	163	388	793
February	162	364	753	208	17	25	139	164	38	158	360	748
March	180	395	817	226	18	35	143	172	43	176	391	813
April	172	381	814	209	17	40	167	168	42	170	380	812
May	183	398	807	188	18	43	160	173	42	185	400	808
June	184	397	773	190	17	43	125	171	42	186	399	775
July	187	411	798	196	18	45	127	179	46	189	413	799
August	185	408	772	178	18	45	122	179	44	189	413	776
September	175	387	723	150	16	39	130	170	42	182	394	730
October	183	395	755	155	18	34	153	167	45	184	396	755
November	182	396	807	180	18	30	183	170	45	179	393	804
December	190	414	862	216	18	27	187	177	47	185	408	857
Total	2,161	4,751	9,487	2,321	212	426	1,777	2,071	518	2,145	4,734	9,471
2016 January	184	406	861	237	19	27	173	172	44	172	388	844
February	175	383	852	225	18	38	188	160	41	174	375	844
March	189	403	924	252	19	45	205	164	44	188	395	916
April	174	377	875	237	18	50	193	154	44	173	372	870
May	188	398	887	236	19	58	175	160	43	191	395	883
June	188	403	845	213	18	59	152	163	43	191	397	839
July	195	412	856	198	19	64	164	168	45	201	414	858
August	197	416	804	180	19	62	126	168	45	204	417	804
September	186	392	773	152	19	57	153	159	41	192	391	772
October	192	399	819	161	19	50	190	158	43	193	394	813
November	191	401	817	175	19	42	180	162	43	196	400	817
December	202	427	908	210	20	37	214	172	45	201	419	900
Total	2,262	4,816	10,220	2,477	226	587	2,114	1,959	522	2,275	4,756	10,161
2017 January	193	416	920	258	20	36	190	170	47	177	393	897
February	174	376	866	229	18	41	202	155	42	165	362	852
March	196	417	1,023	281	20	66	239	169	45	190	404	1,010
April	182	388	988	272	19	72	237	158	42	183	383	983
4-Month Total	746	1,597	3,797	1,041	76	215	867	652	175	715	1,542	3,741
2016 4-Month Total	723	1,568	3,512	951	74	159	759	649	174	707	1,531	3,474
2015 4-Month Total	692	1,543	3,192	868	70	121	590	686	166	666	1,518	3,167

<sup>a</sup> For hydroelectric power, geothermal, solar, wind, and biomass waste, production equals consumption. For biofuels, production equals total biomass inputs to the production of fuel ethanol and biodiesel. For wood, through 2015, production equals consumption; beginning in 2016, production equals consumption plus densified biomass exports.

<sup>b</sup> Total biomass inputs to the production of fuel ethanol and biodiesel.  
<sup>c</sup> Wood and wood-derived fuels, biomass waste, and total biomass inputs to the production of fuel ethanol and biodiesel.

<sup>d</sup> Hydroelectric power, geothermal, solar, wind, and biomass.  
<sup>e</sup> Conventional hydroelectricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6).

<sup>f</sup> Geothermal electricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6), and geothermal heat pump and direct use energy.

<sup>g</sup> Solar photovoltaic (PV) and solar thermal electricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6), and solar thermal direct use energy.

<sup>h</sup> Wind electricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6).

<sup>i</sup> Wood and wood-derived fuels.

<sup>j</sup> Municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural byproducts, and other biomass. Through 2000, also includes non-renewable waste (municipal solid waste from non-biogenic sources, and tire-derived fuels).

<sup>k</sup> Fuel ethanol (minus denaturant) and biodiesel consumption, plus losses and co-products from the production of fuel ethanol and biodiesel.

NA=Not available. (s)=Less than 0.5 trillion Btu.

Notes: • Most data for the residential, commercial, industrial, and transportation sectors are estimates. See notes and sources for Tables 10.2a and 10.2b. • See Note, "Renewable Energy Production and Consumption," at end of section.

• Totals may not equal sum of components due to independent rounding.

• Geographic coverage is the 50 states and the District of Columbia.  
Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#renewable> (Excel and CSV files) for all available annual data beginning in 1949 and monthly data beginning in 1973.

Sources: • **Production:** Tables 10.2a–10.4 and U.S. Energy Information Administration, Form EIA-63C, "Densified Biomass Fuel Report."  
• **Consumption:** Tables 10.2a–10.2c.

**Table 10.2a Renewable Energy Consumption: Residential and Commercial Sectors**  
(Trillion Btu)

	Residential Sector				Commercial Sector <sup>a</sup>								
	Geo-thermal <sup>b</sup>	Solar <sup>c</sup>	Biomass		Hydro-electric Power <sup>e</sup>	Geo-thermal <sup>b</sup>	Solar <sup>f</sup>	Wind <sup>g</sup>	Biomass			Total	Total
			Wood <sup>d</sup>	Total					Wood <sup>d</sup>	Waste <sup>h</sup>	Fuel Ethanol <sup>i,j</sup>		
1950 Total	NA	NA	1,006	1,006	NA	NA	NA	NA	19	NA	NA	19	19
1955 Total	NA	NA	775	775	NA	NA	NA	NA	15	NA	NA	15	15
1960 Total	NA	NA	627	627	NA	NA	NA	NA	12	NA	NA	12	12
1965 Total	NA	NA	468	468	NA	NA	NA	NA	9	NA	NA	9	9
1970 Total	NA	NA	401	401	NA	NA	NA	NA	8	NA	NA	8	8
1975 Total	NA	NA	425	425	NA	NA	NA	NA	8	NA	NA	8	8
1980 Total	NA	NA	850	850	NA	NA	NA	NA	21	NA	NA	21	21
1985 Total	NA	NA	1,010	1,010	NA	NA	NA	NA	24	NA	(s)	24	24
1990 Total	6	55	580	640	1	3	(s)	-	66	28	(s)	94	98
1995 Total	7	63	520	589	1	5	(s)	-	72	40	(s)	113	119
2000 Total	9	58	420	486	1	8	1	-	71	47	(s)	119	128
2001 Total	9	55	370	435	1	8	1	-	67	25	(s)	92	101
2002 Total	10	53	380	444	(s)	9	1	-	69	26	(s)	95	105
2003 Total	13	52	400	465	1	11	1	-	71	29	1	101	114
2004 Total	14	51	410	475	1	12	1	-	70	34	1	105	120
2005 Total	16	50	430	496	1	14	2	-	70	34	1	105	121
2006 Total	18	53	380	451	1	14	2	-	65	36	1	103	120
2007 Total	22	55	420	497	1	14	4	-	70	31	2	103	121
2008 Total	26	58	470	555	1	15	6	-	73	34	2	109	130
2009 Total	33	60	500	593	1	17	7	(s)	73	36	3	112	137
2010 Total	37	65	440	541	1	19	11	(s)	72	36	3	111	142
2011 Total	40	71	450	560	(s)	20	19	(s)	69	43	3	115	154
2012 Total	40	79	420	539	(s)	20	32	1	61	45	3	108	161
2013 Total	40	92	580	711	(s)	20	41	1	70	47	3	120	182
2014 Total	40	109	590	739	(s)	20	52	1	75	47	4	126	199
2015 January	3	6	37	47	(s)	2	3	(s)	7	4	2	13	18
February	3	7	34	44	(s)	2	4	(s)	6	3	2	12	17
March	3	10	37	51	(s)	2	5	(s)	7	4	2	13	20
April	3	11	36	51	(s)	2	5	(s)	7	4	2	13	20
May	3	12	37	53	(s)	2	6	(s)	7	4	2	13	21
June	3	13	36	52	(s)	2	6	(s)	7	4	2	13	20
July	3	13	37	54	(s)	2	6	(s)	7	4	2	14	21
August	3	13	37	54	(s)	2	6	(s)	7	4	2	13	21
September	3	12	36	52	(s)	2	5	(s)	7	4	2	13	20
October	3	11	37	52	(s)	2	5	(s)	7	4	2	13	19
November	3	9	36	49	(s)	2	4	(s)	7	4	2	13	18
December	3	8	37	49	(s)	2	3	(s)	7	4	2	13	18
Total	40	128	440	607	(s)	20	57	1	81	47	26	154	232
2016 January	3	8	32	43	(s)	2	4	(s)	7	4	2	13	19
February	3	10	30	42	(s)	2	5	(s)	7	4	2	12	19
March	3	13	32	48	(s)	2	6	(s)	7	5	2	14	22
April	3	14	31	48	(s)	2	7	(s)	7	4	2	13	21
May	3	16	32	51	(s)	2	7	(s)	7	4	2	13	22
June	3	17	31	50	(s)	2	7	(s)	7	4	2	13	22
July	3	17	32	52	(s)	2	8	(s)	7	4	2	13	23
August	3	17	32	52	(s)	2	7	(s)	7	4	2	13	22
September	3	15	31	49	(s)	2	7	(s)	7	4	2	13	21
October	3	13	32	48	(s)	2	6	(s)	7	4	2	13	21
November	3	11	31	45	(s)	2	5	(s)	7	4	2	13	19
December	3	10	32	45	(s)	2	4	(s)	7	4	2	14	20
Total	40	161	373	573	1	20	72	1	82	49	27	157	251
2017 January	3	10	32	46	(s)	2	5	(s)	7	4	2	14	20
February	3	11	29	43	(s)	2	5	(s)	6	4	2	12	19
March	3	16	32	51	(s)	2	7	(s)	7	4	2	13	22
April	3	18	31	52	(s)	2	8	(s)	7	4	2	13	22
4-Month Total	13	54	125	192	(s)	6	24	(s)	27	16	8	51	83
2016 4-Month Total	13	45	123	181	(s)	7	21	(s)	27	17	9	53	81
2015 4-Month Total	13	35	145	193	(s)	6	17	(s)	27	15	8	50	74

<sup>a</sup> Commercial sector, including commercial combined-heat-and-power (CHP) and commercial electricity-only plants. See Note 2, "Classification of Power Plants Into Energy-Use Sectors," at end of Section 7.

<sup>b</sup> Geothermal heat pump and direct use energy.  
<sup>c</sup> Distributed (small-scale) solar photovoltaic (PV) electricity generation in the residential sector (converted to Btu by multiplying by the fossil fuels heat rate factors in Table A6) and distributed solar thermal energy in the residential, commercial, and industrial sectors. See Table 10.5.

<sup>d</sup> Wood and wood-derived fuels.  
<sup>e</sup> Conventional hydroelectricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6).

<sup>f</sup> Solar photovoltaic (PV) electricity net generation in the commercial sector (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6), both utility-scale and distributed (small-scale). See Table 10.5.

<sup>g</sup> Wind electricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6).

<sup>h</sup> Municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural byproducts, and other biomass. Through 2000, also includes

non-renewable waste (municipal solid waste from non-biogenic sources, and tire-derived fuels).

<sup>i</sup> The fuel ethanol (minus denaturant) portion of motor fuels, such as E10, consumed by the commercial sector.

<sup>j</sup> There is a discontinuity in this time series between 2014 and 2015 due to a change in the method for allocating motor gasoline consumption to the end-use sectors. Beginning in 2015, the commercial and industrial sector shares of fuel ethanol consumption are larger than in 2014, while the transportation sector share is smaller.

NA=Not available. - =No data reported. (s)=Less than 0.5 trillion Btu.

Notes: • Data are estimates, except for commercial sector hydroelectric power, wind, and waste. • Totals may not equal sum of components due to independent rounding. • Geographic coverage is the 50 states and the District of Columbia.

Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#renewable> (Excel and CSV files) for all available annual data beginning in 1949 and monthly data beginning in 1973.

Sources: See end of section.

**Table 10.2b Renewable Energy Consumption: Industrial and Transportation Sectors**  
(Trillion Btu)

	Industrial Sector <sup>a</sup>									Transportation Sector			
	Hydro-electric Power <sup>b</sup>	Geo-thermal <sup>c</sup>	Solar <sup>d</sup>	Wind <sup>e</sup>	Biomass				Total	Biomass			
					Wood <sup>f</sup>	Waste <sup>g</sup>	Fuel Ethanol <sup>h,i</sup>	Losses and Co-products <sup>j</sup>		Total	Fuel Ethanol <sup>l,k</sup>	Bio-diesel <sup>l</sup>	Total <sup>m</sup>
1950 Total	69	NA	NA	NA	532	NA	NA	NA	532	602	NA	NA	NA
1955 Total	38	NA	NA	NA	631	NA	NA	NA	631	669	NA	NA	NA
1960 Total	39	NA	NA	NA	680	NA	NA	NA	680	719	NA	NA	NA
1965 Total	33	NA	NA	NA	855	NA	NA	NA	855	888	NA	NA	NA
1970 Total	34	NA	NA	NA	1,019	NA	NA	NA	1,019	1,053	NA	NA	NA
1975 Total	32	NA	NA	NA	1,063	NA	NA	NA	1,063	1,096	NA	NA	NA
1980 Total	33	NA	NA	NA	1,600	NA	NA	NA	1,600	1,633	NA	NA	NA
1985 Total	33	NA	NA	NA	1,645	230	1	42	1,918	1,951	50	NA	50
1990 Total	31	2	(s)	—	1,442	192	1	49	1,684	1,717	60	NA	60
1995 Total	55	3	(s)	—	1,652	195	2	86	1,934	1,992	112	NA	112
2000 Total	42	4	(s)	—	1,636	145	1	99	1,881	1,928	135	NA	135
2001 Total	33	5	(s)	—	1,443	129	3	108	1,681	1,719	141	1	142
2002 Total	39	5	(s)	—	1,396	146	3	130	1,676	1,720	168	2	170
2003 Total	43	3	(s)	—	1,363	142	4	168	1,678	1,725	228	2	230
2004 Total	33	4	(s)	—	1,476	132	6	201	1,815	1,852	286	3	290
2005 Total	32	4	(s)	—	1,452	148	7	227	1,834	1,871	327	12	339
2006 Total	29	4	1	—	1,472	130	10	280	1,892	1,926	442	33	475
2007 Total	16	5	1	—	1,413	145	10	369	1,937	1,958	557	45	602
2008 Total	17	5	1	—	1,339	143	12	519	2,012	2,035	786	39	825
2009 Total	18	4	2	—	1,178	154	13	603	1,948	1,972	894	41	935
2010 Total	16	4	3	—	1,273	168	17	727	2,185	2,208	1,041	33	1,075
2011 Total	17	4	4	(s)	1,309	165	17	756	2,246	2,272	1,045	113	1,158
2012 Total	22	4	7	(s)	1,339	159	17	711	2,226	2,259	1,045	115	1,162
2013 Total	33	4	9	(s)	1,312	187	18	709	2,226	2,272	1,072	182	1,278
2014 Total	12	4	11	1	1,325	190	14	757	2,286	2,314	1,093	181	1,292
2015 January	1	(s)	1	(s)	115	17	1	65	199	201	88	6	94
February	1	(s)	1	(s)	103	15	1	59	178	180	83	11	95
March	1	(s)	1	(s)	107	17	1	65	190	193	92	13	107
April	1	(s)	1	(s)	107	16	1	61	186	189	88	15	105
May	1	(s)	1	(s)	110	15	2	65	192	195	97	18	116
June	1	(s)	1	(s)	107	15	1	65	189	192	94	21	117
July	1	(s)	1	(s)	112	16	2	67	196	199	97	18	118
August	1	(s)	1	(s)	112	15	2	66	195	197	98	20	120
September	1	(s)	1	(s)	107	15	1	63	186	189	94	20	116
October	1	(s)	1	(s)	106	17	1	66	190	193	94	17	114
November	1	(s)	1	(s)	108	16	1	65	191	193	92	14	110
December	1	(s)	1	(s)	111	17	1	68	198	201	93	17	113
Total	13	4	14	(s)	1,306	190	18	776	2,290	2,321	1,109	191	1,325
2016 January	1	(s)	1	(s)	113	16	1	66	196	198	88	13	102
February	1	(s)	1	(s)	103	15	1	62	182	184	91	15	108
March	1	(s)	1	(s)	106	16	2	67	190	194	98	16	117
April	1	(s)	2	(s)	102	16	1	61	180	183	90	17	109
May	1	(s)	2	(s)	106	16	2	66	189	193	97	22	121
June	1	(s)	2	(s)	107	16	2	66	190	193	97	27	121
July	1	(s)	2	(s)	109	17	2	68	195	199	100	27	129
August	1	(s)	2	(s)	109	16	2	69	195	198	101	28	131
September	1	(s)	2	(s)	103	15	1	65	184	187	94	26	123
October	1	(s)	1	(s)	104	14	1	67	187	190	94	26	122
November	1	(s)	1	(s)	108	15	2	67	192	194	95	26	125
December	1	(s)	1	(s)	113	16	2	71	202	205	99	26	126
Total	12	4	17	1	1,283	186	18	796	2,283	2,318	1,145	263	1,434
2017 January	1	(s)	1	(s)	111	17	1	70	200	203	89	13	104
February	1	(s)	1	(s)	101	16	1	62	180	183	85	13	100
March	1	(s)	2	(s)	110	17	2	70	198	202	95	19	117
April	1	(s)	2	(s)	103	16	1	64	184	188	93	21	115
4-Month Total	5	1	7	(s)	424	67	6	265	762	775	361	66	436
2016 4-Month Total	5	1	5	(s)	423	62	6	257	748	759	367	62	436
2015 4-Month Total	5	1	4	(s)	433	64	6	251	753	763	351	46	402

<sup>a</sup> Industrial sector, including industrial combined-heat-and-power (CHP) and industrial electricity-only plants. See Note 2, "Classification of Power Plants Into Energy-Use Sectors," at end of Section 7.

<sup>b</sup> Conventional hydroelectricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6).

<sup>c</sup> Geothermal heat pump and direct use energy.

<sup>d</sup> Solar photovoltaic (PV) electricity net generation in the industrial sector (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6), both utility-scale and distributed (small-scale). See Table 10.5.

<sup>e</sup> Wind electricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6).

<sup>f</sup> Wood and wood-derived fuels.

<sup>g</sup> Municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural byproducts, and other biomass. Through 2000, also includes non-renewable waste (municipal solid waste from non-biogenic sources, and tire-derived fuels).

<sup>h</sup> The fuel ethanol (minus denaturant) portion of motor fuels, such as E10, consumed by the industrial sector.

<sup>i</sup> There is a discontinuity in this time series between 2014 and 2015 due to a change in the method for allocating motor gasoline consumption to the end-use sectors. Beginning in 2015, the commercial and industrial sector shares of fuel ethanol consumption are larger than in 2014, while the transportation sector share

is smaller.

<sup>j</sup> Losses and co-products from the production of fuel ethanol and biodiesel. Does not include natural gas, electricity, and other non-biomass energy used in the production of fuel ethanol and biodiesel—these are included in the industrial sector consumption statistics for the appropriate energy source.

<sup>k</sup> The fuel ethanol (minus denaturant) portion of motor fuels, such as E10 and E85, consumed by the transportation sector.

<sup>l</sup> Although there is biodiesel use in other sectors, all biodiesel consumption is assigned to the transportation sector.

<sup>m</sup> Beginning in 2009, includes imports minus stock change of other renewable diesel fuel and other renewable fuels. See "Renewable Diesel Fuel (Other)" and "Renewable Fuels (Other)" in Glossary.

NA=Not available. —=No data reported. (s)=Less than 0.5 trillion Btu.

Notes: • Data are estimates, except for industrial sector hydroelectric power in 1949–1978 and 1989 forward, and wind. • Totals may not equal sum of components due to independent rounding. • Geographic coverage is the 50 states and the District of Columbia.

Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#renewable> (Excel and CSV files) for all available annual data beginning in 1949 and monthly data beginning in 1973.

Sources: See end of section.

**Table 10.2c Renewable Energy Consumption: Electric Power Sector**  
(Trillion Btu)

	Hydro-electric Power <sup>a</sup>	Geo-thermal <sup>b</sup>	Solar <sup>c</sup>	Wind <sup>d</sup>	Biomass			Total
					Wood <sup>e</sup>	Waste <sup>f</sup>	Total	
<b>1950 Total</b> .....	1,346	NA	NA	NA	5	NA	5	1,351
<b>1955 Total</b> .....	1,322	NA	NA	NA	3	NA	3	1,325
<b>1960 Total</b> .....	1,569	(s)	NA	NA	2	NA	2	1,571
<b>1965 Total</b> .....	2,026	2	NA	NA	3	NA	3	2,031
<b>1970 Total</b> .....	2,600	6	NA	NA	1	2	4	2,609
<b>1975 Total</b> .....	3,122	34	NA	NA	(s)	2	2	3,158
<b>1980 Total</b> .....	2,867	53	NA	NA	3	2	4	2,925
<b>1985 Total</b> .....	2,937	97	(s)	(s)	8	7	14	3,049
<b>1990 Total</b> <sup>g</sup> .....	3,014	161	4	29	129	188	317	3,524
<b>1995 Total</b> .....	3,149	138	5	33	125	296	422	3,747
<b>2000 Total</b> .....	2,768	144	5	57	134	318	453	3,427
<b>2001 Total</b> .....	2,209	142	6	70	126	211	337	2,763
<b>2002 Total</b> .....	2,650	147	6	105	150	230	380	3,288
<b>2003 Total</b> .....	2,749	146	5	113	167	230	397	3,411
<b>2004 Total</b> .....	2,655	148	6	142	165	223	388	3,339
<b>2005 Total</b> .....	2,670	147	6	178	185	221	406	3,406
<b>2006 Total</b> .....	2,839	145	5	264	182	231	412	3,665
<b>2007 Total</b> .....	2,430	145	6	341	186	237	423	3,345
<b>2008 Total</b> .....	2,494	146	9	546	177	258	435	3,630
<b>2009 Total</b> .....	2,650	146	9	721	180	261	441	3,967
<b>2010 Total</b> .....	2,521	148	12	923	196	264	459	4,064
<b>2011 Total</b> .....	3,085	149	17	1,167	182	255	437	4,855
<b>2012 Total</b> .....	2,606	148	40	1,339	190	262	453	4,586
<b>2013 Total</b> .....	2,529	151	83	1,600	207	262	470	4,833
<b>2014 Total</b> .....	2,454	151	165	1,726	251	279	530	5,026
<b>2015</b> January .....	224	13	11	141	22	23	45	433
February .....	207	12	14	139	21	20	41	412
March .....	225	13	19	143	21	22	43	443
April .....	208	12	22	166	18	22	40	448
May .....	186	13	23	160	18	23	41	423
June .....	189	12	23	125	21	23	44	393
July .....	195	13	24	127	22	26	48	407
August .....	177	13	25	122	23	25	48	384
September .....	149	11	20	130	20	23	43	354
October .....	154	12	17	152	17	24	41	378
November .....	179	12	16	183	19	25	44	434
December .....	214	13	14	187	21	25	47	476
<b>Total</b> .....	<b>2,308</b>	<b>148</b>	<b>228</b>	<b>1,776</b>	<b>244</b>	<b>281</b>	<b>525</b>	<b>4,985</b>
<b>2016</b> January .....	236	14	14	173	21	25	45	481
February .....	224	13	22	188	21	23	43	490
March .....	250	14	25	205	20	23	43	536
April .....	236	12	27	193	15	25	40	508
May .....	235	14	33	175	16	24	40	496
June .....	212	13	33	152	19	24	42	452
July .....	197	13	38	164	20	24	45	456
August .....	180	13	36	126	21	25	46	401
September .....	151	14	34	153	18	23	41	393
October .....	160	14	29	190	15	24	39	432
November .....	175	14	25	180	17	23	40	433
December .....	209	15	21	214	20	25	46	505
<b>Total</b> .....	<b>2,465</b>	<b>162</b>	<b>337</b>	<b>2,112</b>	<b>222</b>	<b>287</b>	<b>509</b>	<b>5,585</b>
<b>2017</b> January .....	257	14	20	189	19	25	44	525
February .....	228	13	24	202	18	22	41	507
March .....	280	14	41	238	20	24	44	618
April .....	271	14	44	237	18	22	39	605
<b>4-Month Total</b> .....	<b>1,036</b>	<b>55</b>	<b>130</b>	<b>866</b>	<b>75</b>	<b>93</b>	<b>168</b>	<b>2,255</b>
<b>2016 4-Month Total</b> .....	<b>946</b>	<b>53</b>	<b>88</b>	<b>758</b>	<b>76</b>	<b>95</b>	<b>171</b>	<b>2,016</b>
<b>2015 4-Month Total</b> .....	<b>864</b>	<b>49</b>	<b>65</b>	<b>589</b>	<b>81</b>	<b>87</b>	<b>169</b>	<b>1,736</b>

<sup>a</sup> Conventional hydroelectricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6).

<sup>b</sup> Geothermal electricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6).

<sup>c</sup> Solar photovoltaic (PV) and solar thermal electricity net generation in the electric power sector (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6). See Table 10.5.

<sup>d</sup> Wind electricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6).

<sup>e</sup> Wood and wood-derived fuels.

<sup>f</sup> Municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural byproducts, and other biomass. Through 2000, also includes non-renewable waste (municipal solid waste from non-biogenic sources, and

tire-derived fuels).

<sup>g</sup> Through 1988, data are for electric utilities only. Beginning in 1989, data are for electric utilities and independent power producers.

NA=Not available. (s)=Less than 0.5 trillion Btu.

Notes: • The electric power sector comprises electricity-only and combined-heat-and-power (CHP) plants within the NAICS 22 category whose primary business is to sell electricity, or electricity and heat, to the public. • Totals may not equal sum of components due to independent rounding. • Geographic coverage is the 50 states and the District of Columbia.

Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#renewable> (Excel and CSV files) for all available annual data beginning in 1949 and monthly data beginning in 1973.

Sources: Tables 7.2b, 7.4b, and A6.

**Table 10.3 Fuel Ethanol Overview**

	Feed-stock <sup>a</sup>	Losses and Co-products <sup>b</sup>	Denaturant <sup>c</sup>	Production <sup>d</sup>			Trade <sup>d</sup>	Stocks <sup>d,f</sup>	Stock Change <sup>d,g</sup>	Consumption <sup>d</sup>			Consumption Minus Denaturant <sup>h</sup>
							Net Imports <sup>e</sup>						
							TBtu						
1981 Total	13	6	40	1,978	83	7	NA	NA	NA	1,978	83	7	7
1985 Total	93	42	294	14,693	617	52	NA	NA	NA	14,693	617	52	51
1990 Total	111	49	356	17,802	748	63	NA	NA	NA	17,802	748	63	62
1995 Total	198	86	647	32,325	1,358	115	387	2,186	-207	32,919	1,383	117	114
2000 Total	233	99	773	38,627	1,622	138	116	3,400	-624	39,367	1,653	140	137
2001 Total	253	108	841	42,028	1,765	150	315	4,298	898	41,445	1,741	148	144
2002 Total	307	130	1,019	50,956	2,140	182	306	6,200	1,902	49,360	2,073	176	171
2003 Total	400	168	1,335	66,772	2,804	238	292	5,978	-222	67,286	2,826	240	233
2004 Total	482	201	1,621	81,058	3,404	289	3,542	6,002	24	84,576	3,552	301	293
2005 Total	550	227	1,859	92,961	3,904	331	3,234	5,563	-439	96,634	4,059	344	335
2006 Total	683	280	2,326	116,294	4,884	414	17,408	8,760	3,197	130,505	5,481	465	453
2007 Total	907	368	3,105	155,263	6,521	553	10,457	10,535	1,775	163,945	6,886	584	569
2008 Total	1,286	518	4,433	221,637	9,309	790	12,610	14,226	3,691	230,556	9,683	821	800
2009 Total	1,503	602	5,688	260,424	10,938	928	4,720	16,594	2,368	262,776	11,037	936	910
2010 Total	1,823	726	6,506	316,617	13,298	1,127	-9,115	17,941	1,347	306,155	12,858	1,090	1,061
2011 Total	1,904	754	6,649	331,646	13,929	1,181	-24,365	18,238	297	306,984	12,893	1,093	1,065
2012 Total	1,801	709	6,264	314,714	13,218	1,120	-5,891	20,350	2,112	306,711	12,882	1,092	1,064
2013 Total	1,805	707	6,181	316,493	13,293	1,126	-5,761	16,424	-3,926	314,658	13,216	1,120	1,092
2014 Total	1,938	755	6,476	340,781	14,313	1,212	-18,371	18,739	2,315	320,995	13,444	1,139	1,111
2015 January	169	65	589	29,770	1,250	106	-1,633	20,647	1,908	26,229	1,102	93	91
February	152	59	534	26,814	1,126	95	-1,623	21,057	410	24,781	1,041	88	86
March	167	65	567	29,485	1,238	105	-2,050	20,878	-179	27,614	1,160	98	96
April	158	61	527	27,910	1,172	99	-1,504	20,854	-24	26,430	1,110	94	92
May	168	65	545	29,666	1,246	106	-1,489	20,154	-700	28,877	1,213	103	100
June	168	65	528	29,684	1,247	106	-1,490	20,128	-26	28,220	1,185	100	98
July	172	66	539	30,249	1,270	108	-1,675	19,701	-427	29,001	1,218	103	101
August	169	65	524	29,762	1,250	106	-905	19,390	-311	29,168	1,225	104	101
September	162	63	519	28,571	1,200	102	-987	18,944	-446	28,030	1,177	100	97
October	169	66	560	29,886	1,255	106	-1,579	18,984	40	28,267	1,187	101	98
November	168	65	580	29,675	1,246	106	-929	20,099	1,115	27,631	1,161	98	96
December	176	68	624	31,081	1,305	111	-1,767	21,596	1,497	27,817	1,168	99	96
<b>Total</b>	<b>1,998</b>	<b>774</b>	<b>6,636</b>	<b>352,553</b>	<b>14,807</b>	<b>1,254</b>	<b>-17,632</b>	<b>21,596</b>	<b>2,857</b>	<b>332,064</b>	<b>13,947</b>	<b>1,181</b>	<b>1,153</b>
2016 January	171	66	615	30,319	1,273	108	-2,073	23,168	<sup>i</sup> 1,730	26,516	1,114	94	92
February	162	62	583	28,678	1,204	102	-1,595	23,004	-164	27,247	1,144	97	94
March	174	67	600	30,812	1,294	110	-2,268	22,301	-703	29,247	1,228	104	101
April	158	61	554	28,059	1,178	100	-2,273	20,992	-1,309	27,095	1,138	96	94
May	171	66	584	30,228	1,270	108	-1,327	20,792	-200	29,101	1,222	104	101
June	171	66	564	30,258	1,271	108	-858	21,199	407	28,993	1,218	103	101
July	177	68	565	31,251	1,313	111	-1,338	21,167	-32	29,945	1,258	107	104
August	179	69	560	31,669	1,330	113	-1,601	21,042	-125	30,193	1,268	107	105
September	169	65	542	29,876	1,255	106	-2,342	20,605	-437	27,971	1,175	100	97
October	174	67	560	30,797	1,293	110	-3,135	20,005	-600	28,262	1,187	101	98
November	173	66	556	30,565	1,284	109	-2,904	19,136	-869	28,530	1,198	102	99
December	183	71	602	32,467	1,364	116	-2,334	19,531	395	29,738	1,249	106	103
<b>Total</b>	<b>2,061</b>	<b>794</b>	<b>6,885</b>	<b>364,979</b>	<b>15,329</b>	<b>1,299</b>	<b>-24,049</b>	<b>19,531</b>	<sup>i</sup> <b>-1,907</b>	<b>342,837</b>	<b>14,399</b>	<b>1,220</b>	<b>1,190</b>
2017 January	182	69	593	32,241	1,354	115	-2,507	22,633	3,102	26,632	1,119	95	93
February	162	62	541	28,747	1,207	102	-2,972	23,028	395	25,380	1,066	90	88
March	181	69	597	32,161	1,351	114	-3,044	23,759	731	28,386	1,192	101	99
April	166	64	540	29,500	1,239	105	-1,981	23,593	-166	27,685	1,163	99	96
<b>4-Month Total ...</b>	<b>690</b>	<b>264</b>	<b>2,271</b>	<b>122,649</b>	<b>5,151</b>	<b>436</b>	<b>-10,505</b>	<b>23,593</b>	<b>4,062</b>	<b>108,082</b>	<b>4,539</b>	<b>385</b>	<b>375</b>
2016 4-Month Total ...	665	256	2,352	117,868	4,950	419	-8,209	20,992	-446	110,105	4,624	392	382
2015 4-Month Total ...	646	250	2,217	113,979	4,787	406	-6,811	20,854	2,115	105,053	4,412	374	365

<sup>a</sup> Total corn and other biomass inputs to the production of undenatured ethanol used for fuel ethanol.

<sup>b</sup> Losses and co-products from the production of fuel ethanol. Does not include natural gas, electricity, and other non-biomass energy used in the production of fuel ethanol—these are included in the industrial sector consumption statistics for the appropriate energy source.

<sup>c</sup> The amount of denaturant in fuel ethanol produced.

<sup>d</sup> Includes denaturant.

<sup>e</sup> Through 2009, data are for fuel ethanol imports only; data for fuel ethanol exports are not available. Beginning in 2010, data are for fuel ethanol imports minus fuel ethanol (including industrial alcohol) exports.

<sup>f</sup> Stocks are at end of period.

<sup>g</sup> A negative value indicates a decrease in stocks and a positive value indicates an increase.

<sup>h</sup> Consumption of fuel ethanol minus denaturant. Data for fuel ethanol minus denaturant are used to develop data for "Renewable Energy/Biomass" in Tables 10.1–10.2b, as well as in Sections 1 and 2.

<sup>i</sup> Derived from the preliminary 2015 stocks value (21,438 thousand barrels), not the final 2015 value (21,596 thousand barrels) that is shown under "Stocks."

NA=Not available.

Notes: • Mbbl = thousand barrels. MMgal = million U.S. gallons. TBtu = trillion Btu. • Fuel ethanol data in thousand barrels are converted to million gallons by multiplying by 0.042, and are converted to Btu by multiplying by the approximate heat content of fuel ethanol—see Table A3. • Through 1980, data are not available. For 1981–1992, data are estimates. For 1993–2008, only data for feedstock, losses and co-products, and denaturant are estimates. Beginning in 2009, only data for feedstock, and losses and co-products, are estimates. • See "Denaturant," "Ethanol," "Fuel Ethanol," and "Fuel Ethanol Minus Denaturant" in Glossary. • Totals may not equal sum of components due to independent rounding. • Geographic coverage is the 50 states and the District of Columbia.

Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#renewable> (Excel and CSV files) for all available annual and monthly data beginning in 1981. Sources: See end of section.

**Table 10.4 Biodiesel and Other Renewable Fuels Overview**

	Biodiesel													Other Renewable Fuels <sup>f</sup>	
	Feed-stock <sup>a</sup>	Losses and Co-products <sup>b</sup>	Production			Trade			Stocks <sup>d</sup>	Stock Change <sup>e</sup>	Consumption				
						Imports	Exports	Net Imports <sup>c</sup>							
			TBtu	TBtu	Mbbl	MMgal	TBtu	Mbbl			Mbbl	Mbbl	Mbbl		Mbbl
<b>2001 Total</b> .....	1	(s)	204	9	1	81	41	40	NA	NA	244	10	1	NA	
<b>2002 Total</b> .....	1	(s)	250	10	1	197	57	140	NA	NA	390	16	2	NA	
<b>2003 Total</b> .....	2	(s)	338	14	2	97	113	-17	NA	NA	322	14	2	NA	
<b>2004 Total</b> .....	4	(s)	666	28	4	101	128	-27	NA	NA	639	27	3	NA	
<b>2005 Total</b> .....	12	(s)	2,162	91	12	214	213	1	NA	NA	2,163	91	12	NA	
<b>2006 Total</b> .....	32	(s)	5,963	250	32	1,105	856	250	NA	NA	6,213	261	33	NA	
<b>2007 Total</b> .....	63	1	11,662	490	62	3,455	6,696	-3,241	NA	NA	8,422	354	45	NA	
<b>2008 Total</b> .....	88	1	16,145	678	87	7,755	16,673	-8,918	NA	NA	7,228	304	39	NA	
<b>2009 Total</b> .....	67	1	12,281	516	66	1,906	6,546	-4,640	711	711	<sup>g</sup> 7,663	322	41	(s)	
<b>2010 Total</b> .....	44	1	8,177	343	44	564	2,588	-2,024	672	-39	6,192	260	33	(s)	
<b>2011 Total</b> .....	125	2	23,035	967	123	890	1,799	-908	2,005	<sup>h</sup> 1,028	21,099	886	113	(s)	
<b>2012 Total</b> .....	128	2	23,588	991	126	853	3,056	-2,203	1,984	-20	21,406	899	115	3	
<b>2013 Total</b> .....	176	2	32,368	1,359	173	8,152	4,675	3,477	3,810	1,825	34,020	1,429	182	24	
<b>2014 Total</b> .....	165	2	30,452	1,279	163	4,578	1,974	2,604	3,131	-679	33,735	1,417	181	18	
<b>2015</b>															
January .....	9	(s)	1,727	73	9	372	22	350	4,032	902	1,176	49	6	(s)	
February .....	10	(s)	1,851	78	10	526	23	503	4,245	212	2,141	90	11	1	
March .....	13	(s)	2,326	98	12	340	191	149	4,244	(s)	2,475	104	13	2	
April .....	14	(s)	2,568	108	14	330	240	90	4,071	-173	2,831	119	15	2	
May .....	15	(s)	2,784	117	15	336	255	81	3,599	-471	3,337	140	18	2	
June .....	16	(s)	2,901	122	16	673	260	413	3,063	-536	3,850	162	21	2	
July .....	16	(s)	2,883	121	15	1,157	255	902	3,404	341	3,444	145	18	3	
August .....	16	(s)	2,933	123	16	961	275	686	3,333	-71	3,690	155	20	2	
September .....	13	(s)	2,479	104	13	1,062	200	862	3,021	-312	3,652	153	20	3	
October .....	14	(s)	2,535	106	14	863	161	702	3,070	48	3,189	134	17	3	
November .....	14	(s)	2,521	106	14	701	76	625	3,600	530	2,616	110	14	3	
December .....	14	(s)	2,573	108	14	1,078	133	945	3,943	343	3,174	133	17	3	
<b>Total</b> .....	163	2	30,080	1,263	161	8,399	2,091	6,308	3,943	813	35,575	1,494	191	25	
<b>2016</b>															
January .....	14	(s)	2,490	105	13	211	42	169	4,036	<sup>i</sup> 221	2,437	102	13	1	
February .....	14	(s)	2,503	105	13	287	55	232	3,937	-99	2,834	119	15	2	
March .....	15	(s)	2,829	119	15	437	234	203	3,923	-14	3,046	128	16	3	
April .....	15	(s)	2,827	119	15	891	246	645	4,175	253	3,219	135	17	1	
May .....	17	(s)	3,169	133	17	1,117	334	783	4,062	-113	4,065	171	22	2	
June .....	17	(s)	3,205	135	17	1,575	220	1,355	4,735	672	3,888	163	21	3	
July .....	18	(s)	3,330	140	18	1,681	250	1,431	4,444	-291	5,053	212	27	1	
August .....	18	(s)	3,385	142	18	1,829	234	1,595	4,267	-177	5,157	217	28	2	
September .....	17	(s)	3,131	132	17	1,793	150	1,643	4,212	-54	4,829	203	26	3	
October .....	18	(s)	3,380	142	18	1,824	95	1,729	4,560	347	4,762	200	26	2	
November .....	18	(s)	3,388	142	18	2,184	152	2,032	5,078	518	4,902	206	26	4	
December .....	18	(s)	3,400	143	18	2,668	80	2,588	6,217	1,140	4,847	204	26	1	
<b>Total</b> .....	201	3	37,037	1,556	198	16,497	2,093	14,404	6,217	<sup>j</sup> 2,403	49,038	2,060	263	26	
<b>2017</b>															
January .....	12	(s)	2,204	93	12	241	43	198	6,259	41	2,361	99	13	2	
February .....	12	(s)	2,232	94	12	549	57	492	6,466	207	2,516	106	13	1	
March .....	15	(s)	2,757	116	15	650	136	514	6,194	-272	3,542	149	19	3	
April .....	16	(s)	3,014	127	16	681	283	398	5,713	-481	3,893	163	21	2	
<b>4-Month Total</b> .....	55	1	10,207	429	55	2,121	520	1,601	5,713	-504	12,313	517	66	9	
<b>2016 4-Month Total</b> .....	58	1	10,648	447	57	1,826	577	1,249	4,175	360	11,537	485	62	7	
<b>2015 4-Month Total</b> .....	46	1	8,472	356	45	1,568	476	1,092	4,071	940	8,623	362	46	5	

<sup>a</sup> Total vegetable oil and other biomass inputs to the production of biodiesel—calculated by multiplying biodiesel production by 5.433 million Btu per barrel. See "Biodiesel Feedstock" entry in the "Thermal Conversion Factor Source Documentation" at the end of Appendix A.

<sup>b</sup> Losses and co-products from the production of biodiesel. Does not include natural gas, electricity, and other non-biomass energy used in the production of biodiesel—these are included in the industrial sector consumption statistics for the appropriate energy source.

<sup>c</sup> Net imports equal imports minus exports.

<sup>d</sup> Stocks are at end of period. Includes biodiesel stocks at (or in) refineries, pipelines, and bulk terminals. Beginning in 2011, also includes stocks at biodiesel production plants.

<sup>e</sup> A negative value indicates a decrease in stocks and a positive value indicates an increase.

<sup>f</sup> Imports minus stock change of other renewable diesel fuel and other renewable fuels. See "Renewable Diesel Fuel (Other)" and "Renewable Fuels (Other)" in Glossary.

<sup>g</sup> In 2009, because of incomplete data coverage and differing data sources, a "Balancing Item" amount of 733 thousand barrels (653 thousand barrels in January

2009; 80 thousand barrels in February 2009) is used to balance biodiesel supply and disposition.

<sup>h</sup> Derived from the final 2010 stocks value for bulk terminals and biodiesel production plants (977 thousand barrels), not the final 2010 value for bulk terminals only (672 thousand barrels) that is shown under "Stocks."

<sup>i</sup> Derived from the preliminary 2015 stocks value (3,815 thousand barrels), not the final 2015 value (3,943 thousand barrels) that is shown under "Stocks."

NA=Not available. (s)=Less than 0.5 trillion Btu and greater than -0.5 trillion Btu.

Notes: • Mbbl = thousand barrels. MMgal = million U.S. gallons. TBtu = trillion Btu. • Biodiesel data in thousand barrels are converted to million gallons by multiplying by 0.042, and are converted to Btu by multiplying by 5.359 million Btu per barrel (the approximate heat content of biodiesel—see Table A1). • Through 2000, data are not available. Beginning in 2001, data not from U.S. Energy Information Administration (EIA) surveys are estimates. • Totals may not equal sum of components due to independent rounding. • Geographic coverage is the 50 states and the District of Columbia.

Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#renewable> (Excel and CSV files) for all available annual and monthly data beginning in 2001.

Sources: See end of section.



**Table 10.5 Solar Energy Consumption**  
(Trillion Btu)

	Distributed <sup>a</sup> Solar Energy <sup>b</sup>					Utility-Scale <sup>c</sup> Solar Energy <sup>d</sup>				Total <sup>k</sup>
	Heat <sup>f</sup>	Electricity <sup>d</sup>			Total <sup>g</sup>	Electricity <sup>e</sup>				
		Residential Sector	Commercial Sector	Industrial Sector		Total	Commercial Sector <sup>h</sup>	Industrial Sector <sup>i</sup>	Electric Power Sector <sup>j</sup>	
<b>1985 Total</b> .....	NA	NA	NA	NA	NA	NA	NA	(s)	(s)	(s)
<b>1990 Total</b> .....	55	(s)	(s)	(s)	55	—	—	4	4	59
<b>1995 Total</b> .....	63	(s)	(s)	(s)	63	—	—	5	5	68
<b>2000 Total</b> .....	57	(s)	1	(s)	58	—	—	5	5	63
<b>2001 Total</b> .....	55	(s)	1	(s)	56	—	—	6	6	62
<b>2002 Total</b> .....	53	1	1	(s)	54	—	—	6	6	60
<b>2003 Total</b> .....	51	1	1	(s)	53	—	—	5	5	58
<b>2004 Total</b> .....	50	1	1	(s)	53	—	—	6	6	58
<b>2005 Total</b> .....	49	1	2	(s)	52	—	—	6	6	58
<b>2006 Total</b> .....	51	2	2	1	56	—	—	5	5	61
<b>2007 Total</b> .....	53	2	4	1	59	—	—	6	6	65
<b>2008 Total</b> .....	54	4	6	1	65	(s)	—	9	9	74
<b>2009 Total</b> .....	55	5	7	2	69	(s)	—	9	9	78
<b>2010 Total</b> .....	56	9	11	3	79	(s)	(s)	12	12	90
<b>2011 Total</b> .....	58	13	19	4	93	1	(s)	17	18	111
<b>2012 Total</b> .....	59	20	30	7	116	1	(s)	40	41	157
<b>2013 Total</b> .....	61	31	38	9	139	3	(s)	83	86	225
<b>2014 Total</b> .....	62	47	49	11	169	4	(s)	165	168	337
<b>2015</b> January .....	3	3	3	1	7	10	(s)	(s)	11	21
February .....	4	3	3	1	8	11	(s)	(s)	14	25
March .....	5	5	4	1	11	16	(s)	(s)	19	35
April .....	6	6	5	1	12	17	(s)	(s)	22	40
May .....	6	6	5	1	13	19	(s)	(s)	23	43
June .....	6	6	5	1	13	19	(s)	(s)	23	43
July .....	7	7	6	1	14	20	(s)	(s)	24	45
August .....	7	7	5	1	14	20	(s)	(s)	25	45
September .....	6	6	5	1	12	18	(s)	(s)	20	39
October .....	5	6	4	1	11	16	(s)	(s)	17	34
November .....	4	5	3	1	9	14	(s)	(s)	16	30
December .....	4	4	3	1	9	13	(s)	(s)	14	27
<b>Total</b> .....	<b>63</b>	<b>65</b>	<b>53</b>	<b>14</b>	<b>132</b>	<b>194</b>	<b>4</b>	<b>(s)</b>	<b>228</b>	<b>426</b>
<b>2016</b> January .....	3	5	4	1	10	13	(s)	(s)	14	27
February .....	4	6	4	1	11	15	(s)	(s)	22	38
March .....	5	8	6	1	15	20	(s)	(s)	25	45
April .....	6	9	6	2	16	22	(s)	(s)	27	50
May .....	6	10	7	2	18	24	1	(s)	33	58
June .....	6	10	7	2	19	25	1	(s)	33	59
July .....	7	11	7	2	19	26	1	(s)	38	64
August .....	7	10	7	2	19	25	1	(s)	36	62
September .....	6	9	6	2	17	22	1	(s)	34	57
October .....	5	8	5	1	15	20	(s)	(s)	29	50
November .....	4	7	4	1	12	16	(s)	(s)	25	42
December .....	4	6	4	1	11	15	(s)	(s)	21	37
<b>Total</b> .....	<b>63</b>	<b>98</b>	<b>67</b>	<b>17</b>	<b>181</b>	<b>245</b>	<b>5</b>	<b>(s)</b>	<b>337</b>	<b>587</b>
<b>2017</b> January .....	3	6	4	1	12	15	(s)	(s)	20	36
February .....	4	7	5	1	14	17	(s)	(s)	24	41
March .....	5	11	7	2	19	24	(s)	(s)	41	66
April .....	6	12	7	2	21	27	(s)	(s)	44	72
<b>4-Month Total</b> .....	<b>18</b>	<b>36</b>	<b>23</b>	<b>6</b>	<b>66</b>	<b>84</b>	<b>1</b>	<b>(s)</b>	<b>130</b>	<b>215</b>
<b>2016 4-Month Total</b> .....	<b>18</b>	<b>27</b>	<b>20</b>	<b>5</b>	<b>52</b>	<b>70</b>	<b>1</b>	<b>(s)</b>	<b>88</b>	<b>159</b>
<b>2015 4-Month Total</b> .....	<b>18</b>	<b>17</b>	<b>16</b>	<b>4</b>	<b>37</b>	<b>54</b>	<b>1</b>	<b>(s)</b>	<b>65</b>	<b>121</b>

<sup>a</sup> Data are estimates for distributed (small-scale) facilities (combined generator nameplate capacity less than 1 megawatt).  
<sup>b</sup> See "Photovoltaic Energy" and "Solar Thermal Energy" in Glossary.  
<sup>c</sup> Data are for utility-scale facilities (combined generator nameplate capacity of 1 megawatt or more).  
<sup>d</sup> Solar photovoltaic (PV) electricity generation at distributed (small-scale) facilities connected to the electric power grid (converted to Btu by multiplying by the fossil fuels heat rate factors in Table A6).  
<sup>e</sup> Solar photovoltaic (PV) and solar thermal electricity net generation at utility-scale facilities (converted to Btu by multiplying by the fossil fuels heat rate factors in Table A6).  
<sup>f</sup> Solar thermal direct use energy in the residential, commercial, and industrial sectors for all end uses, such as pool heating, hot water heating, and space heating.  
<sup>g</sup> Data are the sum of "Distributed Solar Energy Heat" and "Distributed Solar Energy Electricity."  
<sup>h</sup> Commercial combined-heat-and-power (CHP) and commercial electricity-only plants. See Note 2, "Classification of Power Plants Into Energy-Use Sectors," at

end of Section 7.  
<sup>i</sup> Industrial combined-heat-and-power (CHP) and industrial electricity-only plants. See Note 2, "Classification of Power Plants Into Energy-Use Sectors," at end of Section 7.  
<sup>j</sup> Electricity-only and combined-heat-and-power (CHP) plants within the NAICS 22 category whose primary business is to sell electricity, or electricity and heat, to the public. Through 1988, data are for electric utilities only; beginning in 1989, data are for electric utilities and independent power producers.  
<sup>k</sup> Data are the sum of "Distributed Solar Energy Total" and "Utility-Scale Solar Energy Total."  
 NA=Not available. —=No data reported. (s)=Less than 0.5 trillion Btu.  
 Notes: • Distributed (small-scale) solar energy data for all years, and utility-scale solar energy data for the current two years, are estimates. • Totals may not equal sum of components due to independent rounding. • Geographic coverage is the 50 states and the District of Columbia.  
 Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#renewable> (Excel and CSV files) for all available annual and monthly data beginning in 1984.  
 Sources: See end of section.

**Table 10.6 Solar Electricity Net Generation**  
(Million Kilowatthours)

	Distributed <sup>a</sup> Solar Generation <sup>b</sup>				Utility-Scale <sup>c</sup> Solar Generation <sup>b</sup>				Total
	Residential Sector	Commercial Sector	Industrial Sector	Total	Commercial Sector <sup>d</sup>	Industrial Sector <sup>e</sup>	Electric Power Sector <sup>f</sup>	Total	
<b>1985 Total</b> .....	NA	NA	NA	NA	NA	NA	11	11	11
<b>1990 Total</b> .....	12	17	4	32	—	—	367	367	399
<b>1995 Total</b> .....	20	29	6	56	—	—	497	497	553
<b>2000 Total</b> .....	39	55	12	107	—	—	493	493	600
<b>2001 Total</b> .....	47	67	15	129	—	—	543	543	672
<b>2002 Total</b> .....	56	79	18	153	—	—	555	555	708
<b>2003 Total</b> .....	66	93	21	179	—	—	534	534	713
<b>2004 Total</b> .....	81	115	25	222	—	—	575	575	797
<b>2005 Total</b> .....	122	172	38	333	—	—	550	550	883
<b>2006 Total</b> .....	178	252	56	485	—	—	508	508	993
<b>2007 Total</b> .....	251	355	79	685	—	—	612	612	1,297
<b>2008 Total</b> .....	404	571	126	1,101	(s)	—	864	864	1,965
<b>2009 Total</b> .....	543	767	170	1,480	(s)	—	891	891	2,371
<b>2010 Total</b> .....	897	1,172	259	2,328	5	2	1,206	1,212	3,540
<b>2011 Total</b> .....	1,330	1,913	424	3,667	84	7	1,727	1,818	5,485
<b>2012 Total</b> .....	2,071	3,173	703	5,947	148	14	4,164	4,327	10,274
<b>2013 Total</b> .....	3,264	4,029	892	8,185	294	17	8,724	9,036	17,221
<b>2014 Total</b> .....	4,947	5,146	1,139	11,233	371	16	17,304	17,691	28,924
<b>2015</b> .....									
January .....	340	327	80	746	20	1	1,134	1,155	1,902
February .....	375	356	85	816	23	1	1,459	1,484	2,299
March .....	536	479	119	1,134	33	2	2,037	2,072	3,206
April .....	609	525	129	1,264	39	2	2,338	2,379	3,643
May .....	676	574	144	1,394	46	2	2,456	2,504	3,898
June .....	693	571	144	1,408	43	2	2,512	2,558	3,966
July .....	741	596	150	1,487	45	2	2,579	2,627	4,114
August .....	746	575	147	1,468	46	2	2,639	2,688	4,156
September .....	679	515	135	1,330	37	2	2,178	2,217	3,547
October .....	618	455	125	1,198	32	2	1,875	1,910	3,107
November .....	515	367	100	982	27	1	1,702	1,730	2,712
December .....	471	349	93	914	24	1	1,545	1,570	2,484
<b>Total</b> .....	<b>6,999</b>	<b>5,689</b>	<b>1,451</b>	<b>14,139</b>	<b>416</b>	<b>21</b>	<b>24,456</b>	<b>24,893</b>	<b>39,032</b>
<b>2016</b> .....									
January .....	513	409	98	1,021	23	NM	1,491	1,516	2,536
February .....	614	468	108	1,189	45	3	2,395	2,443	3,632
March .....	824	608	150	1,582	47	NM	2,664	2,713	4,295
April .....	939	661	164	1,763	44	NM	2,903	2,949	4,712
May .....	1,044	719	181	1,945	54	NM	3,547	3,603	5,548
June .....	1,086	723	183	1,991	62	NM	3,545	3,610	5,601
July .....	1,133	743	190	2,066	69	NM	4,024	4,097	6,163
August .....	1,100	718	186	2,004	59	NM	3,886	3,948	5,952
September .....	977	643	170	1,790	56	3	3,624	3,683	5,473
October .....	874	578	156	1,607	45	3	3,145	3,193	4,801
November .....	717	467	123	1,307	38	2	2,660	2,700	4,007
December .....	644	443	114	1,202	24	NM	2,273	2,299	3,500
<b>Total</b> .....	<b>10,465</b>	<b>7,180</b>	<b>1,823</b>	<b>19,467</b>	<b>565</b>	<b>32</b>	<b>36,157</b>	<b>36,754</b>	<b>56,221</b>
<b>2017</b> .....									
January .....	682	481	120	1,282	23	NM	2,182	2,206	3,488
February .....	784	526	139	1,449	27	NM	2,533	2,562	4,011
March .....	1,142	703	210	2,054	47	2	4,425	4,474	6,529
April .....	1,282	760	226	2,268	50	NM	4,764	4,816	7,084
<b>4-Month Total</b> .....	<b>3,889</b>	<b>2,469</b>	<b>695</b>	<b>7,054</b>	<b>147</b>	<b>NM</b>	<b>13,904</b>	<b>14,058</b>	<b>21,112</b>
<b>2016 4-Month Total</b> .....	<b>2,889</b>	<b>2,146</b>	<b>520</b>	<b>5,556</b>	<b>158</b>	<b>9</b>	<b>9,453</b>	<b>9,620</b>	<b>15,176</b>
<b>2015 4-Month Total</b> .....	<b>1,859</b>	<b>1,687</b>	<b>413</b>	<b>3,959</b>	<b>116</b>	<b>6</b>	<b>6,969</b>	<b>7,090</b>	<b>11,050</b>

<sup>a</sup> Data are estimates for solar photovoltaic (PV) electricity generation at small-scale facilities (combined generator nameplate capacity less than 1 megawatt) connected to the electric power grid.

<sup>b</sup> See "Photovoltaic Energy" and "Solar Thermal Energy" in Glossary.

<sup>c</sup> Solar photovoltaic (PV) and solar thermal electricity net generation at utility-scale facilities (combined generator nameplate capacity of 1 megawatt or more).

<sup>d</sup> Commercial combined-heat-and-power (CHP) and commercial electricity-only plants. See Note 2, "Classification of Power Plants Into Energy-Use Sectors," at end of Section 7.

<sup>e</sup> Industrial combined-heat-and-power (CHP) and industrial electricity-only plants. See Note 2, "Classification of Power Plants Into Energy-Use Sectors," at end of Section 7.

<sup>f</sup> Electricity-only and combined-heat-and-power (CHP) plants within the NAICS 22 category whose primary business is to sell electricity, or electricity and heat, to the public. Through 1988, data are for electric utilities only; beginning in 1989, data are for electric utilities and independent power producers.

NA=Not available. NM=Not meaningful due to large standard error. --=No data reported. (s)=Less than 0.5 million kilowatthours.

Notes: • Distributed (small-scale) solar generation data for all years, and utility-scale solar energy data for the current two years, are estimates. • Totals may not equal sum of components due to independent rounding. • Geographic coverage is the 50 states and the District of Columbia.

Web Page: See <http://www.eia.gov/totalenergy/data/monthly/#renewable> (Excel and CSV files) for all available annual and monthly data beginning in 1984.

Sources: • **Distributed Solar Generation: 1989–2013**—Calculated as distributed solar energy consumption (see Table 10.5) divided by the total fossil fuels heat rate factors (see Table A6). **2014 forward**—U.S. Energy Information Administration (EIA), *Electric Power Monthly*, monthly reports, Tables 1.1, 1.2.C, 1.2.D, and 1.2.E. • **Utility-Scale Solar Generation: 1984–1988**—EIA, Form EIA-759, "Monthly Power Plant Report." **1989–1997**: EIA, Form EIA-759, "Monthly Power Plant Report," and Form EIA-867, "Annual Nonutility Power Producer Report." **1998–2000**: EIA, Form EIA-759, "Monthly Power Plant Report," and Form EIA-860B, "Annual Electric Generator Report—Nonutility." **2001–2003**: EIA, Form EIA-906, "Power Plant Report." **2004–2007**: EIA, Form EIA-906, "Power Plant Report," and Form EIA-920, "Combined Heat and Power Plant Report." **2008 forward**: EIA, Form EIA-923, "Power Plant Operations Report." • **Total**: Calculated as distributed solar generation plus utility-scale solar generation.

## Renewable Energy

### Note. Renewable Energy Production and Consumption.

In Tables 1.1, 1.3, and 10.1, renewable energy consumption consists of: conventional hydroelectricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6); geothermal electricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6), and geothermal heat pump and geothermal direct use energy; solar thermal and photovoltaic electricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6), and solar thermal direct use energy; wind electricity net generation (converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6); wood and wood-derived fuels consumption; biomass waste (municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural byproducts, and other biomass) consumption; fuel ethanol (minus denaturant) and biodiesel consumption; and losses and co-products from the production of fuel ethanol and biodiesel. In Tables 1.1, 1.2, and 10.1, renewable energy production is assumed to equal consumption for all renewable energy sources except biofuels and wood. Biofuels production comprises biomass inputs to the production of fuel ethanol and biodiesel. Wood production is the sum of wood consumption and densified biomass exports.

### Table 10.2a Sources

#### Residential Sector, Geothermal

1989–2011: Annual estimates by the U.S. Energy Information Administration (EIA) based on data from Oregon Institute of Technology, Geo-Heat Center.

2012 forward: Annual estimates assumed by EIA to be equal to that of 2011.

(For 1989 forward, monthly estimates are created by dividing the annual estimates by the number of days in the year and then multiplying by the number of days in the month.)

#### Residential Sector, Solar

1989 forward: Residential sector solar consumption is the sum of the values for “Distributed Solar Energy Consumption: Heat” (which includes solar thermal direct use energy in the residential, commercial, and industrial sectors) from Table 10.5 and “Distributed Solar Energy Consumption: Electricity, Residential Sector” from Table 10.5.

#### Residential Sector, Wood

1949–1979: Annual estimates are from EIA, *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*, Table A2.

1980–2013: Annual estimates are based on EIA, Form EIA-457, “Residential Energy Consumption Survey”; and National Oceanic and Atmospheric Administration regional heating degree-day data.

2014 forward: Annual estimates based on residential wood consumption growth rates from EIA’s *Annual Energy Outlook* data system.

(For 1973 forward, monthly estimates are created by dividing the annual estimates by the number of days in the year and then multiplying by the number of days in the month.)

#### Residential Sector, Total Renewable Energy

1949–1988: Residential sector total renewable energy consumption is equal to residential sector wood consumption.

1989 forward: Residential sector total renewable energy consumption is the sum of the residential sector consumption values for geothermal, solar, and wood.

#### Commercial Sector, Hydroelectric Power

1989 forward: Commercial sector conventional hydroelectricity net generation data from EIA, Form EIA-923, “Power Plant Operations Report,” and predecessor forms, are converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6.

#### Commercial Sector, Geothermal

1989–2011: Annual estimates by EIA based on data from Oregon Institute of Technology, Geo-Heat Center.

2012 forward: Annual estimates assumed by EIA to be equal to that of 2011.

(For 1989 forward, monthly estimates are created by dividing the annual estimates by the number of days in the year and then multiplying by the number of days in the month.)

#### Commercial Sector, Solar

1989 forward: Commercial sector solar consumption is the sum of the values for “Distributed Solar Energy Consumption: Electricity, Commercial Sector” from Table 10.5 and “Utility-Scale Solar Energy Consumption: Electricity, Commercial Sector” from Table 10.5.

#### Commercial Sector, Wind

2009 forward: Commercial sector wind electricity net generation data from EIA, Form EIA-923, “Power Plant Operations Report,” are converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6.

#### Commercial Sector, Wood

1949–1979: Annual estimates are from EIA, *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*, Table A2.

1980–1983: Annual estimates are from EIA, *Estimates of U.S. Wood Energy Consumption 1980–1983*, Table ES1.

1984: Annual estimate assumed by EIA to be equal to that of 1983.

1985–1988: Annual estimates interpolated by EIA.

(For 1973–1988, monthly estimates are created by dividing the annual estimates by the number of days in the year and then multiplying by the number of days in the month.)

1989 forward: Monthly/annual commercial sector combined-heat-and-power (CHP) wood consumption data are from EIA, Form EIA-923, “Power Plant Operations Report,” and predecessor forms. Annual estimates for commercial sector non-CHP wood consumption are based on EIA, Form

EIA-871, “Commercial Buildings Energy Consumption Survey” (for 2014 forward, the annual estimates are based on commercial sector wood consumption growth rates from EIA’s *Annual Energy Outlook* data system). For 1989 forward, monthly estimates for commercial sector non-CHP wood consumption are created by dividing the annual estimates by the number of days in the year and then multiplying by the number of days in the month. Commercial sector total wood consumption is the sum of commercial sector CHP and non-CHP wood consumption.

### **Commercial Sector, Biomass Waste**

1989 forward: Table 7.4c.

### **Commercial Sector, Fuel Ethanol (Minus Denaturant)**

1981 forward: The commercial sector share of motor gasoline consumption is equal to commercial sector motor gasoline consumption from Table 3.7a divided by motor gasoline product supplied from Table 3.5. Commercial sector fuel ethanol (minus denaturant) consumption is equal to fuel ethanol (minus denaturant) consumption from Table 10.3 multiplied by the commercial sector share of motor gasoline consumption. Note that there is a discontinuity in this time series between 2014 and 2015 due to a change in the method for allocating motor gasoline consumption to the end-use sectors; beginning in 2015, the commercial and industrial sector shares of fuel ethanol consumption are larger than in 2014, while the transportation sector share is smaller.

### **Commercial Sector, Total Biomass**

1949–1980: Commercial sector total biomass consumption is equal to commercial sector wood consumption.

1981–1988: Commercial sector total biomass consumption is the sum of the commercial sector consumption values for wood and fuel ethanol (minus denaturant).

1989 forward: Commercial sector total biomass consumption is the sum of the commercial sector consumption values for wood, waste, and fuel ethanol (minus denaturant).

### **Commercial Sector, Total Renewable Energy**

1949–1988: Commercial sector total renewable energy consumption is equal to commercial sector total biomass consumption.

1989–2007: Commercial sector total renewable energy consumption is the sum of the commercial sector consumption values for conventional hydroelectric power, geothermal, and total biomass.

2008: Commercial sector total renewable energy consumption is the sum of the commercial sector consumption values for conventional hydroelectric power, geothermal, solar, and total biomass.

2009 forward: Commercial sector total renewable energy is the sum of the commercial sector consumption values for conventional hydroelectric power, geothermal, solar, wind, and total biomass.

## **Table 10.2b Sources**

### **Industrial Sector, Hydroelectric Power**

1949 forward: Industrial sector conventional hydroelectricity net generation data from Table 7.2c are converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6.

### **Industrial Sector, Geothermal**

1989–2009: Annual estimates by the U.S. Energy Information Administration (EIA) based on data from Oregon Institute of Technology, Geo-Heat Center.

2010 forward: Annual estimates assumed by EIA to be equal to that of 2009.

(For 1989 forward, monthly estimates are created by dividing the annual estimates by the number of days in the year and then multiplying by the number of days in the month.)

### **Industrial Sector, Solar**

1989 forward: Industrial sector solar consumption is the sum of the values for “Distributed Solar Energy Consumption: Electricity, Industrial Sector” from Table 10.5 and “Utility-Scale Solar Energy Consumption: Electricity, Industrial Sector” from Table 10.6.

### **Industrial Sector, Wind**

2011 forward: Industrial sector wind electricity net generation data from EIA, Form EIA-923, “Power Plant Operations Report,” are converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6.

### **Industrial Sector, Wood**

1949–1979: Annual estimates are from EIA, *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*, Table A2.

1980–1983: Annual estimates are from EIA, *Estimates of U.S. Wood Energy Consumption 1980–1983*, Table ES1.

1984: Annual estimate is from EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 1.

1985 and 1986: Annual estimates interpolated by EIA.

1987: Annual estimate is from EIA, *Estimates of Biofuels Consumption in the United States During 1987*, Table 2.

1988: Annual estimate interpolated by EIA.

(For 1973–1988, monthly estimates are created by dividing the annual estimates by the number of days in the year and then multiplying by the number of days in the month.)

1989 forward: Monthly/annual industrial sector combined-heat-and-power (CHP) wood consumption data are from EIA, Form EIA-923, “Power Plant Operations Report,” and predecessor forms. Annual estimates for industrial sector non-CHP wood consumption are based on EIA, Form EIA-846, “Manufacturing Energy Consumption Survey” (for 2014 forward, the annual estimates are assumed by EIA to be equal to that of 2013). For 1989 forward, monthly estimates for industrial sector non-CHP wood consumption are created by dividing the annual estimates by the number of days in the year and then multiplying by the number of days in the month. Industrial sector total wood consumption

is the sum of industrial sector CHP and non-CHP wood consumption.

### **Industrial Sector, Biomass Waste**

1981: Annual estimate is calculated as total waste consumption (from EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 8) minus electric power sector waste consumption (from MER Table 10.2c).

1982 and 1983: Annual estimates are calculated as total waste consumption (based on *Estimates of U.S. Biofuels Consumption 1990*, Table 8) minus electric power sector waste consumption (from MER, Table 10.2c).

1984: Annual estimate is calculated as total waste consumption (from EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 8) minus electric power sector waste consumption (from MER, Table 10.2c).

1985 and 1986: Annual estimates interpolated by EIA.

1987: Annual estimate is calculated as total waste consumption (from EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 8) minus electric power sector waste consumption (from MER, Table 10.2c).

1988: Annual estimate interpolated by EIA.

(For 1973–1988, monthly estimates are created by dividing the annual estimates by the number of days in the year and then multiplying by the number of days in the month.)

1989 forward: Monthly/annual industrial sector combined-heat-and-power (CHP) consumption data are from Table 7.4c. Annual estimates for industrial sector non-CHP waste consumption are based on information presented in Government Advisory Associates, *Resource Recovery Yearbook* and *Methane Recovery Yearbook*, and information provided by the U.S. Environmental Protection Agency, Landfill Methane Outreach Program (for 2014 forward, the annual estimates are assumed by EIA to be equal to that of 2013). For 1989 forward, monthly estimates for industrial sector non-CHP waste consumption are created by dividing the annual estimates by the number of days in the year and then multiplying by the number of days in the month. Industrial sector total waste consumption is the sum of industrial sector CHP and non-CHP waste consumption.

### **Industrial Sector, Fuel Ethanol (Minus Denaturant)**

1981 forward: The industrial sector share of motor gasoline consumption is equal to industrial sector motor gasoline consumption from Table 3.7b divided by motor gasoline product supplied from Table 3.5. Industrial sector fuel ethanol (minus denaturant) consumption is equal to fuel ethanol (minus denaturant) consumption from Table 10.3 multiplied by the industrial sector share of motor gasoline consumption. Note that there is a discontinuity in this time series between 2014 and 2015 due to a change in the method for allocating motor gasoline consumption to the end-use sectors; beginning in 2015, the commercial and industrial sector shares of fuel ethanol consumption are larger than in 2014, while the transportation sector share is smaller.

### **Industrial Sector, Biomass Losses and Co-products**

1981 forward: Calculated as fuel ethanol losses and co-products from Table 10.3 plus biodiesel losses and co-products from Table 10.4.

### **Industrial Sector, Total Biomass**

1949–1980: Industrial sector total biomass consumption is equal to industrial sector wood consumption.

1981 forward: Industrial sector total biomass consumption is the sum of the industrial sector consumption values for wood, waste, fuel ethanol (minus denaturant), and biomass losses and co-products.

### **Industrial Sector, Total Renewable Energy**

1949–1988: Industrial sector total renewable energy consumption is the sum of the industrial sector consumption values for conventional hydroelectric power and total biomass.

1989–2009: Industrial sector total renewable energy consumption is the sum of the industrial sector consumption values for conventional hydroelectric power, geothermal, and total biomass.

2010: Industrial sector total renewable energy consumption is the sum of the industrial sector consumption values for conventional hydroelectric power, geothermal, solar, and total biomass.

2011 forward: Industrial sector total renewable energy consumption is the sum of the industrial sector consumption values for conventional hydroelectric power, geothermal, solar, wind, and total biomass.

### **Transportation Sector, Fuel Ethanol (Minus Denaturant)**

1981 forward: The transportation sector share of motor gasoline consumption is equal to transportation sector motor gasoline consumption from Table 3.7c divided by motor gasoline product supplied from Table 3.5. Transportation sector fuel ethanol (minus denaturant) consumption is equal to fuel ethanol (minus denaturant) consumption from Table 10.3 multiplied by the transportation sector share of motor gasoline consumption. Note that there is a discontinuity in this time series between 2014 and 2015 due to a change in the method for allocating motor gasoline consumption to the end-use sectors; beginning in 2015, the commercial and industrial sector shares of fuel ethanol consumption are larger than in 2014, while the transportation sector share is smaller.

### **Transportation Sector, Biodiesel**

2001 forward: Table 10.4. Transportation sector biodiesel consumption is assumed to equal total biodiesel consumption.

### **Transportation Sector, Other Renewable Fuels**

2009 forward: Table 10.4.

## Transportation Sector, Total Renewable Energy

1981–2000: Transportation sector total renewable energy consumption is equal to transportation sector fuel ethanol (minus denaturant) consumption.

2001–2008: Transportation sector total renewable energy consumption is the sum of the transportation sector consumption values for fuel ethanol (minus denaturant) and biodiesel.

2009 forward: Transportation sector total renewable energy consumption is the sum of the transportation sector consumption values for fuel ethanol (minus denaturant), biodiesel, and other renewable fuels.

## Table 10.3 Sources

### Feedstock

1981 forward: Calculated as fuel ethanol production (in thousand barrels) minus denaturant, and then multiplied by the fuel ethanol feedstock factor—see Table A3.

### Losses and Co-products

1981 forward: Calculated as fuel ethanol feedstock plus denaturant minus fuel ethanol production.

### Denaturant

1981–2008: Data in thousand barrels for petroleum denaturant in fuel ethanol produced are estimated as 2% of fuel ethanol production; these data are converted to Btu by multiplying by 4.645 million Btu per barrel (the estimated quantity-weighted factor of pentanes plus and conventional motor gasoline used as denaturant).

2009–2015: U.S. Energy Information Administration (EIA), *Petroleum Supply Annual (PSA)*, annual reports, Table 1. Data in thousand barrels for net production of pentanes plus at renewable fuels and oxygenate plants are multiplied by -1; these data are converted to Btu by multiplying by 4.620 million Btu per barrel (the approximate heat content of pentanes plus). Data in thousand barrels for net production of conventional motor gasoline and motor gasoline blending components at renewable fuels and oxygenate plants are multiplied by -1; these data are converted to Btu by multiplying by 5.253 million Btu per barrel (the approximate heat content of conventional motor gasoline). Total denaturant is the sum of the values for pentanes plus, conventional motor gasoline, and motor gasoline blending components.

2016 and 2017: EIA, *Petroleum Supply Monthly (PSM)*, monthly reports, Table 1. Data in thousand barrels for net production of pentanes plus at renewable fuels and oxygenate plants are multiplied by -1; these data are converted to Btu by multiplying by 4.620 million Btu per barrel (the approximate heat content of pentanes plus). Data in thousand barrels for net production of conventional motor gasoline and motor gasoline blending components at renewable fuels and oxygenate plants are multiplied by -1; these data are converted to Btu by multiplying by 5.253 million Btu per barrel (the approximate heat content of conventional motor gasoline). Total denaturant is the sum of the values for pentanes plus,

conventional motor gasoline, and motor gasoline blending components.

### Production

1981–1992: Fuel ethanol production is assumed to equal fuel ethanol consumption—see sources for "Consumption."

1993–2004: Calculated as fuel ethanol consumption plus fuel ethanol stock change minus fuel ethanol net imports. These data differ slightly from the original production data from EIA, Form EIA-819, "Monthly Oxygenate Report," and predecessor form, which were not reconciled and updated to be consistent with the final balance.

2005–2008: EIA, Form EIA-819, "Monthly Oxygenate Report."

2009–2015: EIA, PSA, annual reports, Table 1, data for net production of fuel ethanol at renewable fuels and oxygenate plants.

2016 and 2017: EIA, PSM, monthly reports, Table 1, data for net production of fuel ethanol at renewable fuels and oxygenate plants.

### Trade, Stocks, and Stock Change

1992–2015: EIA, PSA, annual reports, Table 1.

2016 and 2017: EIA, PSM, monthly reports, Table 1.

### Consumption

1981–1989: EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 10; and interpolated values for 1982, 1983, 1985, 1986, and 1988.

1990–1992: EIA, *Estimates of U.S. Biomass Energy Consumption 1992*, Table D2; and interpolated value for 1991.

1993–2004: EIA, PSA, annual reports, Tables 2 and 16. Calculated as 10% of oxygenated finished motor gasoline field production (Table 2), plus fuel ethanol refinery input (Table 16).

2005–2008: EIA, PSA, annual reports, Tables 1 and 15. Calculated as motor gasoline blending components adjustments (Table 1), plus finished motor gasoline adjustments (Table 1), plus fuel ethanol refinery and blender net inputs (Table 15).

2009–2015: EIA, PSA, annual reports, Table 1. Calculated as fuel ethanol refinery and blender net inputs minus fuel ethanol adjustments.

2016 and 2017: EIA, PSM, monthly reports, Table 1. Calculated as fuel ethanol refinery and blender net inputs minus fuel ethanol adjustments.

### Consumption Minus Denaturant

1981 forward: Calculated as fuel ethanol consumption minus the amount of denaturant in fuel ethanol consumed. Denaturant in fuel ethanol consumed is estimated by multiplying denaturant in fuel ethanol produced by the fuel ethanol consumption-to-production ratio.

## Table 10.4 Sources

### Biodiesel Feedstock

2001 forward: Calculated as biodiesel production in thousand barrels multiplied by 5.433 million Btu per barrel

(the biodiesel feedstock factor—see “Biodiesel Feedstock” entry in the “Thermal Conversion Factor Source Documentation” at the end of Appendix A).

### **Biodiesel Losses and Co-products**

2001 forward: Calculated as biodiesel feedstock minus biodiesel production.

### **Biodiesel Production**

2001–2005: U.S. Department of Agriculture, Commodity Credit Corporation, Bioenergy Program records. Annual data are derived from quarterly data. Monthly data are estimated by dividing the annual data by the number of days in the year and then multiplying by the number of days in the month.

2006: U.S. Department of Commerce, U.S. Census Bureau, “M311K—Fats and Oils: Production, Consumption, and Stocks,” data for soybean oil consumed in methyl esters (biodiesel). In addition, the U.S. Energy Information Administration (EIA) estimates that 14.4 million gallons of yellow grease were consumed in methyl esters (biodiesel).

2007: U.S. Department of Commerce, U.S. Census Bureau, “M311K—Fats and Oils: Production, Consumption, and Stocks,” data for all fats and oils consumed in methyl esters (biodiesel).

2008: EIA, *Monthly Biodiesel Production Report*, December 2009 (release date October 2010), Table 11. Monthly data for 2008 are estimated based on U.S. Department of Commerce, U.S. Census Bureau, M311K data, multiplied by the EIA 2008 annual value’s share of the M311K 2008 annual value.

2009 and 2010: EIA, *Monthly Biodiesel Production Report*, monthly reports, Table 1.

2011–2015: EIA, *Petroleum Supply Annual (PSA)*, annual reports, Table 1, data for renewable fuels except fuel ethanol.

2016 and 2017: EIA, *Petroleum Supply Monthly (PSM)*, monthly reports, Table 1, data for renewable fuels except fuel ethanol.

### **Biodiesel Trade**

2001–2011: For imports, U.S. Department of Agriculture, data for the following Harmonized Tariff Schedule codes: 3824.90.40.20, “Fatty Esters Animal/Vegetable Mixture” (data through June 2010); and 3824.90.40.30, “Biodiesel/Mixes” (data for July 2010–2011). For exports, U.S. Department of Agriculture, data for the following Schedule B codes: 3824.90.40.00, “Fatty Substances Animal/Vegetable/Mixture” (data through 2010); and 3824.90.40.30, “Biodiesel <70%” (data for 2011). (The data above are converted from pounds to gallons by dividing by 7.4.) Although these categories include products other than biodiesel (such as biodiesel coprocessed with petroleum feedstocks; and products destined for soaps, cosmetics, and other items), biodiesel is the largest component. In the absence of other reliable data for biodiesel trade, EIA sees these data as good substitutes.

2012–2015: EIA, PSA, annual reports, Tables 25 and 31, data for biomass-based diesel fuel.

2016 and 2017: EIA, PSM, monthly reports, Tables 37 and 49, data for biomass-based diesel fuel.

### **Biodiesel Stocks and Stock Change**

2009 forward: EIA, biodiesel data from EIA-22M, “Monthly Biodiesel Production Survey”; and biomass-based diesel fuel data from EIA-810, “Monthly Refinery Report,” EIA-812, “Monthly Product Pipeline Report,” and EIA-815, “Monthly Bulk Terminal and Blender Report.”

### **Biodiesel Consumption**

2001–2008: Calculated as biodiesel production plus biodiesel net imports.

January and February 2009: EIA, PSA, Table 1, data for refinery and blender net inputs of renewable fuels except fuel ethanol.

March 2009 forward: Calculated as biodiesel production plus biodiesel net imports minus biodiesel stock change.

### **Other Renewable Fuels**

2009 forward: Imports data for “Other Renewable Diesel Fuel” are from EIA, PSA Table 25 and PSM Table 37 (data are converted to Btu by multiplying by the other renewable diesel fuel heat content factor in Table A1). Imports data for “Other Renewable Fuels” are from EIA, PSA Table 25 and PSM Table 37 (data are converted to Btu by multiplying by the biodiesel heat content factor in Table A1). Stock change data for “Other Renewable Diesel Fuel” are from EIA, EIA-810, “Monthly Refinery Report,” EIA-812, “Monthly Product Pipeline Report,” and EIA-815, “Monthly Bulk Terminal and Blender Report” (data are converted to Btu by multiplying by the other renewable diesel heat content factor in Table A1). “Other Renewable Fuels” in Table 10.4 is calculated as other renewable diesel fuel imports plus other renewable fuels imports minus other renewable diesel fuel stock change.

## **Table 10.5 Sources**

### **Distributed Solar Energy Consumption: Heat Annual Data**

1989–2009: Annual estimates by the U.S. Energy Information Administration (EIA) based on EIA, Form EIA-63A, “Annual Solar Thermal Collector/Reflector Shipments Report.” Solar energy consumption by solar thermal non-electric applications (mainly in the residential sector, but with some in the commercial and industrial sectors) is based on assumptions about the stock of equipment in place and other factors.

2010 forward: Annual estimates based on commercial sector solar thermal growth rates from EIA’s *Annual Energy Outlook (AEO)* data system. (Annual estimates are subject to revision when a new AEO is released.)

### Monthly Data

1989–2013: Monthly estimates for each year are obtained by allocating a given year’s annual value to the months in that year. Each month’s allocator is the average of that month’s “Distributed Solar Energy Consumption: Electricity, Total” values in 2014 and 2015. The allocators, when rounded, are as follows: January—5%; February—6%; March—8%; April—9%; May—10%; June—10%; July—10%; August—10%; September—9%; October—9%; November—7%; and December—7%.

2014 forward: Initial monthly estimates for each year are obtained as described above. Once all 12 months of “Distributed Solar Energy Consumption: Electricity, Total” data are available for a given year, they are used as allocators and applied to the annual estimate in order to revise the initial monthly estimates.

### Distributed Solar Energy Consumption: Electricity, Residential Sector

Beginning in 2014, monthly and annual data for residential sector distributed (small-scale) solar photovoltaic generation are from EIA, *Electric Power Monthly*, Table 1.2.E. Those data are converted to consumption data in Btu by multiplying by the total fossil fuels heat rate factors in MER Table A6.

Backcasts for earlier periods are developed as follows:

#### Annual Data

1989–2003: Annual growth rates are calculated based on distributed (small-scale) solar electricity consumption in all sectors. Consumption is estimated using information on shipments of solar panels from EIA, Form EIA-63B, “Annual Photovoltaic Cell/Module Shipments Report,” and assumptions about the stock of equipment in place and other factors. The growth rates are applied to more recent data to create historical annual estimates.

2004–2008: Annual growth rates based on commercial sector solar photovoltaic growth rates from EIA’s *Annual Energy Outlook (AEO)* data system are applied to more recent data to create historical annual estimates. (Annual estimates are subject to revision when a new AEO is released.)

2009–2013: Annual growth rates based on residential sector solar photovoltaic growth rates from EIA’s *Annual Energy Outlook (AEO)* data system are applied to more recent data to create historical annual estimates. (Annual estimates are subject to revision when a new AEO is released.)

#### Monthly Data

1989–2013: See “Distributed Solar Energy Consumption: Heat, Monthly Data.”

### Distributed Solar Energy Consumption: Electricity, Commercial Sector

Beginning in 2014, monthly and annual data for commercial sector distributed (small-scale) solar photovoltaic generation are from EIA, *Electric Power Monthly*, Table 1.2.C. Those data are converted to consumption data in Btu by multiplying by the total fossil fuels heat rate factors in MER Table A6.

Backcasts for earlier periods are developed as follows:

### Annual Data

1989–2003: Annual growth rates based on EIA, Form EIA-63B, “Annual Photovoltaic Cell/Module Shipments Report,” are applied to more recent data to create historical annual estimates. (See “Distributed Solar Energy Consumption: Electricity, Residential Sector” sources above for details.)

2004–2013: Annual growth rates based on commercial sector solar photovoltaic growth rates from EIA’s *Annual Energy Outlook (AEO)* data system are applied to more recent data to create historical annual estimates. (Annual estimates are subject to revision when a new AEO is released.)

#### Monthly Data

1989–2013: See “Distributed Solar Energy Consumption: Heat, Monthly Data.”

### Distributed Solar Energy Consumption: Electricity, Industrial Sector

Beginning in 2014, monthly and annual data for industrial sector distributed (small-scale) solar photovoltaic generation are from EIA, *Electric Power Monthly*, Table 1.2.D. Those data are converted to consumption data in Btu by multiplying by the total fossil fuels heat rate factors in MER Table A6.

Backcasts for earlier periods are developed as follows:

#### Annual Data

1989–2003: Annual growth rates based on EIA, Form EIA-63B, “Annual Photovoltaic Cell/Module Shipments Report,” are applied to more recent data to create historical annual estimates. (See “Distributed Solar Energy Consumption: Electricity, Residential Sector” sources above for details.)

2004–2013: Annual growth rates based on commercial sector solar photovoltaic growth rates from EIA’s *Annual Energy Outlook (AEO)* data system are applied to more recent data to create historical annual estimates. (Annual estimates are subject to revision when a new AEO is released.)

#### Monthly Data

1989–2013: See “Distributed Solar Energy Consumption: Heat, Monthly Data.”

### Distributed Solar Energy Consumption: Electricity, Total

1989 forward: Distributed (small-scale) solar energy consumption for total electricity is the sum of the distributed solar energy consumption (for electricity) values for the residential, commercial, and industrial sectors.

### Distributed Solar Energy Consumption: Total

1989 forward: Distributed (small-scale) solar energy consumption total is the sum of distributed solar energy consumption values for heat and total electricity.

### Utility-Scale Solar Energy Consumption: Electricity, Commercial Sector

2008 forward: Commercial sector solar photovoltaic and solar thermal electricity net generation data from EIA, Form



EIA-923, "Power Plant Operations Report," are converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6.

**Utility-Scale Solar Energy Consumption: Electricity, Industrial Sector**

2010 forward: Industrial sector solar photovoltaic and solar thermal electricity net generation data from EIA, Form EIA-923, "Power Plant Operations Report," are converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6.

**Utility-Scale Solar Energy Consumption: Electricity, Electric Power Sector**

1984 forward: Electric power sector solar photovoltaic and solar thermal electricity net generation data from Table 7.2b

are converted to Btu by multiplying by the total fossil fuels heat rate factors in Table A6.

**Utility-Scale Solar Energy Consumption: Electricity, Total**

1984 forward: Utility-scale solar energy consumption for total electricity is the sum of the utility-scale solar energy consumption (for electricity) values for the commercial, industrial, and electric power sectors.

**Solar Energy Consumption: Total**

1984 forward: Total solar energy consumption is the sum of the values for total distributed solar energy consumption and total utility-scale solar energy consumption.

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