

Table 11.2
Summary Statistics for General Aviation, 1970-96

Calendar year	Total number of aircraft	Hours flown (thousands)	Intercity passenger travel (billion passenger-miles)	Energy use (trillion btu)
1970	131,700 ^a	26,030 ^b	9.1	94.4
1971	131,100 ^a	25,512 ^b	9.2	91.6
1972	145,000 ^a	26,974 ^b	10.0	103.4
1973	148,000 ^a	28,599	10.7	90.4
1974	161,502	29,758	11.2	101.4
1975	168,475	30,298	11.4	121.5
1976	177,964	31,950	12.1	130.3
1977	184,294	33,679	12.8	149.7
1978	199,178	36,844	14.1	159.4
1979	210,339	40,432	15.5	167.2
1980	211,045	41,016	14.7	169.0
1981	213,226	40,704	14.6	162.4
1982	209,779	36,457	13.1	170.5
1983	213,293	35,249	12.7	143.9
1984	220,943	36,119	13.0	148.9
1985	196,500	31,456	12.3	144.0
1986	205,300	31,782	12.4	148.0
1987	202,700	30,883	12.1	139.1
1988	196,200	31,114	12.6	148.6
1989	205,000	32,332	13.1	134.0
1990	198,000	32,096	13.0	131.9
1991	196,874	29,862	12.2	120.4
1992	185,650	26,747	10.7	104.7
1993	177,120	24,455	10.1	97.5
1994	172,935	24,092	10.4	95.3
1995	182,605	25,667	10.5	106.6
1996	187,312	26,100	10.6	111.1
<i>Average Annual Percentage Change</i>				
1970-96	1.4%	0.0%	0.6%	0.6%
1986-96	-0.9%	-2.0%	-1.6%	-2.8%

Sources:

Intercity passenger-miles - Eno Foundation for Transportation, *Transportation in America 1997*, Fifteenth edition, Lansdowne, VA, 1998, p. 47, and annual.

All other- U.S. Department of Transportation, Federal Aviation Administration, *General Aviation Activity and Avionics Survey: Calendar Year 1996*, pp. 1-7, 1-14, 5-3, and annual.

(Additional resources: <http://www.faa.gov>)

^aActive fixed-wing general aviation aircraft only.

^bInclude rotocraft.



In the early seventies, domestic waterborne commerce accounted for over 60% of total tonnage, but by 1996 foreign tonnage grew to more than half of all waterborne tonnage.

Table 11.3
Tonnage Statistics for Domestic and
International Waterborne Commerce, 1970-96
(million tons shipped)

Year	Foreign and domestic total	Foreign total ^a	Domestic total ^b	Percent domestic of total
1970	1,532	581	951	62.1%
1971	1,513	566	947	62.6%
1972	1,617	630	987	61.0%
1973	1,762	767	994	56.4%
1974	1,747	764	983	56.3%
1975	1,695	749	946	55.8%
1976	1,835	856	979	53.4%
1977	1,908	935	973	51.0%
1978	2,021	946	1,075	53.2%
1979	2,073	993	1,080	52.1%
1980	1,999	921	1,077	53.9%
1981	1,942	887	1,054	54.3%
1982	1,777	820	957	53.9%
1983	1,708	751	957	56.0%
1984	1,836	803	1,033	56.3%
1985	1,788	774	1,014	56.7%
1986	1,874	837	1,037	55.3%
1987	1,967	891	1,076	54.7%
1988	2,088	976	1,112	53.3%
1989	2,140	1,038	1,103	51.5%
1990	2,164	1,042	1,122	51.8%
1991	2,092	1,014	1,079	51.6%
1992	2,132	1,037	1,095	51.4%
1993	2,128	1,060	1,068	50.2%
1994	2,215	1,116	1,099	49.6%
1995	2,240	1,147	1,093	48.8%
1996	2,284	1,183	1,101 ^c	48.2%
<i>Average annual percentage change</i>				
1970-96	1.5%	2.8%	0.6%	
1986-96	2.0%	3.5%	0.6%	

Source:

U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1996*, Part 5: National Summaries, New Orleans, Louisiana, 1997, Table 1-1, p. 1-3, and annual reports. Additional resources: <http://www.wrc-ndc.usace.army.mil/ndc>

^aAll movements between the U.S. and foreign countries and between Puerto Rico and the Virgin Islands and foreign countries are classified as foreign trade.

^bAll movements between U.S. ports, continental and noncontiguous, and on the inland rivers, canals, and connecting channels of the U.S., Puerto Rico, and the Virgin Islands, excluding the Panama Canal.

^cBeginning in 1996, fish was excluded for internal and intra port domestic traffic.



Table 11.4
Summary Statistics for Domestic Waterborne Commerce, 1970-96

Year	Number of vessels ^a	Ton-miles (billions)	Tons shipped ^b (millions)	Average length of haul (miles)	Energy intensity (Btu/ton-mile)	Energy use (trillion Btu)	
1970	25,832	596	949	628.2	545	324.8	
1971	26,063	593	944	628.1	506	300.0	
1972	27,347	604	985	612.8	522	315.1	
1973	28,431	585	990	590.7	576	337.0	
1974	29,328	586	979	599.1	483	283.3	
1975	31,666	566	944	599.9	549	311.0	
1976	33,204	592	976	606.3	468	277.3	
1977	35,333	599	969	618.0	458	274.3	
1978	35,723	827	1,072	771.6	383	316.6	
1979	36,264	829	1,076	770.0	457	378.7	
1980	38,792	922	1,074	856.4	358	329.8	
1981	42,079	929	1,051	884.0	360	334.5	
1982	42,079	886	954	929.0	310	274.9	
1983	41,784	920	953	964.6	319	293.7	
1984	41,784	888	1,029	862.5	346	307.3	
1985	41,672	893	1,011	883.5	446	398.6	
1986	40,308	873	1,033	845.3	463	404.0	
1987	40,000	895	1,072	835.0	402	370.7	
1988	39,192	890	1,106	804.3	361	321.3	
1989	39,209	816	1,097	743.2	403	328.6	
1990	39,233	834	1,118	745.7	388	323.2	
1991	39,233	848	1,074	789.9	386	327.5	
1992	39,210	857	1,090	785.7	398	341.0	
1993	39,064	790	1,063	742.7	389	307.0	
1994	39,064	815	1,093	745.5	369	300.7	
1995	39,641	808	1,086	743.6	374	302.2	
1996	41,104	765	1,093	699.4	412	314.9	
		<i>Average annual percentage change</i>					
1970-96	1.7%	1.2%	0.5%	0.7%	-1.1%	-0.1%	
1986-96	-0.5%	-1.0%	0.7%	-1.7%	-1.2%	-2.5%	

Source:

Number of vessels -

1970-92, 1995-96 - U.S. Department of the Army, Corps of Engineers, "Summary of U.S. Flag Passenger and cargo vessels, 1996," New Orleans, LA, 1998, and annual.

1993-94 - U.S. Dept of the Army, Corps of Engineers, *The U.S. Waterway System-Facts*, Navigation Data Center, New Orleans, Louisiana, January 1996.

Ton-miles, tons shipped, average length of haul - U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1996*, Part 5: National Summaries, New Orleans, LA, 1997, Table 1-4, pp. 1-6, 1-7, and annual.

Energy use - See Appendix A for Table 2.7.

(Additional resources: <http://www.wrc-ndc.usace.army.mil/ndc>)

^aGrand total for self-propelled and non-self-propelled.

^bThese figures are not consistent with the figures on Table 6.4 because intra-territory tons are not included in this table. Intra-territory traffic is traffic between ports in Puerto Rico and the Virgin Islands.



Fifty-seven percent of all domestic marine cargo in 1996 were energy-related products (petroleum, coal, coke). The majority of the energy-related products were shipped internally and locally (62%). Barge traffic accounted for 96% of all internal and local waterborne commerce.

Table 11.5
Breakdown of Domestic Marine Cargo by Commodity Class, 1996

Commodity class	Coastwise		Lakewise		Internal and local		Total domestic ^a	
	Tons shipped (millions)	Average haul ^b (miles)	Tons shipped (millions)	Average haul ^b (miles)	Tons shipped (millions)	Average haul ^b (miles)	Tons shipped (millions)	Percentage
Petroleum and products	197	1,636	2	322	193	190	392	35.8%
Chemicals and related products	16	2,133	°	320	64	480	80	7.3%
Crude materials	18	566	88	509	127	352	233	21.3%
Coal and coke	14	662	21	546	195	388	230	21.0%
Primary manufactured goods	8	813	3	297	27	731	38	3.4%
Food and farm products	8	1,869	°	969	90	1,002	98	9.0%
Manufactured equipment	7	1,583	°	°	10	89	17	1.6%
Waste and scrap	°	1,000	0	0	6	54	6	0.5%
Unknown	°	2,239	°	°	°	°	°	0.0%
Total	267	1,526	115	508	711	419	1,093	100.0%
Barge traffic (million tons)	107		9		681		796	
Percentage by barge	39.9%		7.5%		95.8%		72.8%	

Source:

U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1996*, Part 5: National Summaries, New Orleans, Louisiana, 1997, Tables 2-1, 2-2, and 2-3, pp. 2-1—2-8, and annual.

(Additional resources: <http://www.wrc-ndc.usace.army.mil/hdc>)

Note:

Coastwise applies to domestic traffic receiving a carriage over the ocean or between the Great Lakes ports and seacoast ports when having a carriage over the ocean.

Lakewise applies to traffic between United States ports on the Great Lakes. Internal applies to traffic between ports or landings wherein the entire movement takes place on inland waterways. Local applies to movements of freight within the confines of a port.

^aDoes not include intra-territory tons.

^bCalculated as ton-miles divided by tons shipped.

^cNegligible.



The Interstate Commerce Commission designates Class I railroads on the basis of annual gross revenues. In 1996, ten railroads were given this classification (see note below).

Table 11.6
Class I Railroad Freight Systems in the United States
Ranked by Revenue Ton-Miles, 1996

Railroad	Revenue ton-miles (billions)	Percent
Burlington Northern and Sante Fe Railway Company	411	30.3%
Union Pacific Railroad Company	333	24.6%
CSX Transportation	157	11.6%
Southern Pacific Transportation Company	156	11.5%
Norfolk Southern Corporation	130	9.6%
Consolidated Rail Corporation (Conrail)	95	7.0%
Soo Line Railroad Company	25	1.8%
Illinois Central Railroad Company	22	1.6%
Kansas City Southern Railway Company	18	1.3%
Grand Trunk Western Railroad Inc.	9	0.7%
Total	1,356	100.0%

Source:

Association of American Railroads, *Railroad Facts*, 1997 Edition, Washington, DC, September 1997, p. 66. (Additional resources: <http://www.aar.org>)

Note:

The Union Pacific Railroad Company merged with Southern Pacific Transportation on September 11, 1996. The two railroads reported separately for 1996.



Table 11.7
Summary Statistics for Class I Freight Railroads, 1970-96

Year	Number of locomotives in service ^a	Number of freight cars (thousands) ^b	Train-miles (millions)	Car-miles (millions)	Tons originated ^c (millions)	Average length of haul (miles)	Revenue ton-miles (millions)	Energy intensity (Btu/ton-mile)	Energy use (trillion Btu)
1970	27,077 ^d	1,424	427	29,890	1,485	515	764,809	691	528.1
1971	27,160 ^d	1,422	430	29,181	1,391	507	739,723	717	530.2
1972	27,044	1,411	451	30,309	1,448	511	776,746	714	554.4
1973	27,438	1,395	469	31,248	1,532	531	851,809	677	577.1
1974	27,627	1,375	469	30,719	1,531	527	850,961	681	579.1
1975	27,855	1,359	403	27,656	1,395	541	754,252	687	518.3
1976	27,233	1,332	425	28,530	1,407	540	794,059	680	540.3
1977	27,298	1,287	428	28,749	1,395	549	826,292	669	552.7
1978	26,959	1,226	433	29,076	1,390	617	858,105	641	550.4
1979	27,660	1,217	438	29,436	1,502	611	913,669	618	564.8
1980	28,094	1,168	428	29,277	1,492	616	918,621	597	548.7
1981	27,421	1,111	408	27,968	1,453	626	910,169	572	521.0
1982	26,795	1,039	345	23,952	1,269	629	797,759	553	440.8
1983	25,448	1,007	346	24,358	1,293	641	828,275	525	435.1
1984	24,117	948	369	26,409	1,429	645	921,542	510	470.0
1985	22,548	867	347	24,920	1,320	664	876,984	497	436.1
1986	20,790	799	347	24,414	1,306	664	867,722	486	421.5
1987	19,647	749	361	25,627	1,372	688	943,747	456	430.3
1988	19,364	725	379	26,339	1,430	697	996,182	443	441.4
1989	19,015	682	383	26,196	1,403	723	1,013,841	437	442.6
1990	18,835	659	380	26,159	1,425	726	1,033,969	420	434.7
1991	18,344	633	375	25,628	1,383	751	1,038,875	391	405.8
1992	18,004	605	390	26,128	1,399	763	1,066,781	393	419.2
1993	18,161	587	405	26,883	1,397	794	1,109,309	389	431.6
1994	18,505	591	441	28,485	1,470	817	1,200,701	388	465.4
1995	18,812	583	458	30,383	1,550	843	1,305,688	372	485.9
1996	19,269	571	469	31,715	1,611	842	1,355,975	368	499.4
1970-96	-1.3%	-3.5%	0.4%	0.2%	0.3%	1.9%	2.2%	-2.4%	-0.2%
1986-96	-0.8%	-3.3%	3.1%	2.7%	2.1%	2.4%	4.6%	-2.7%	1.7%

Source:

Association of American Railroads, *Railroad Facts*, 1997 Edition, Washington, DC, September 1997, pp. 27, 28, 33, 34, 36, 48, 50, 60.
(Additional resources: <http://www.aar.org>)

^aDoes not include self-powered units. From 1972 to 1979, the number of locomotives used in Amtrak passenger operations are subtracted from the total locomotives used in passenger and freight service to calculate the number of Class I locomotives in service.

^bDoes not include private or shipper-owned cars.

^cTons originated is a more accurate representation of total tonnage than revenue tons. Revenue tons often produces double-counting of loads switched between rail companies.

^dData represent total locomotives used in freight and passenger service. Separate estimates are not available.



The "other" category, which consists primarily of intermodal traffic, has grown 86% in carloads from 1974 to 1996. Coal continues to account for one quarter of all carloads.

Table 11.8
Railroad Revenue Carloads by Commodity Group, 1974 and 1996

Commodity group	Carloads (thousands)		Percent distribution		Percentage change 1974-96
	1974	1996	1974	1996	
Coal	4,544	6,746	17.0%	25.9%	48.5%
Farm products	3,021	1,530	11.3%	6.3%	-49.4%
Chemicals and allied products	1,464	1,668	5.5%	6.9%	13.9%
Nonmetallic minerals	821	1,176	3.1%	4.9%	43.2%
Food and kindred products	1,777	1,302	6.6%	5.4%	-26.7%
Lumber and wood products	1,930	682	7.2%	2.8%	-64.7%
Metallic ores	1,910	443	7.1%	1.8%	-76.8%
Stone, clay and glass	2,428	491	9.1%	2.0%	-79.8%
Pulp, paper, and allied products	1,180	589	4.4%	2.4%	-50.1%
Petroleum products	877	538	3.3%	2.2%	-38.7%
Primary metal products	1,366	626	5.1%	2.6%	-54.2%
Waste and scrap material	889	605	3.3%	2.5%	-31.9%
Transportation equipment	1,126	1,341	4.2%	5.6%	19.1%
Others	3,451	6,421	12.9%	26.6%	86.1%
Total	26,784	24,158	100.0%	100.0%	-9.8%

Source:

1974 - Association of American Railroads, *Railroad Facts*, 1976 Edition, Washington, DC, 1975, p. 26.

1996 - Association of American Railroads, *Railroad Facts*, 1997 Edition, Washington, DC, September 1997, p. 25.

(Additional resources: <http://www.aar.org>)



The number of trailers and containers moved by railroads has increased more than four-fold from 1965 to 1996. Containerization has increased in recent years, evidenced by the 52% increase in the number of containers from 1988 to 1996.

Table 11.9
Intermodal Rail Traffic, 1965-96

Year	Trailers & containers	Trailers	Containers
1965	1,664,929	a	a
1970	2,363,200	a	a
1975	2,238,117	a	a
1980	3,059,402	a	a
1981	3,150,522	a	a
1982	3,396,973	a	a
1983	4,090,078	a	a
1984	4,565,743	a	a
1985	4,590,952	a	a
1986	4,997,229	a	a
1987	5,503,819	a	a
1988	5,779,547	3,481,020	2,298,527
1989	5,987,355	3,496,262	2,491,093
1990	6,206,782	3,451,953	2,754,829
1991	6,246,134	3,201,560	3,044,574
1992	6,627,841	3,264,597	3,363,244
1993	7,156,628	3,464,126	3,692,502
1994	8,128,228	3,752,502	4,375,726
1995	8,070,309	3,519,664	4,550,645
1996 ^b	8,153,942	3,320,312	4,833,630
<i>Average annual percentage change</i>			
1965-96	5.3%	a	a
1988-96	4.4%	-0.6%	9.7%

Source:

Association of American Railroads, *Railroad Facts*,
1997 edition, Washington, DC, September 1997 p.26.
(Additional resources: <http://www.aar.org>)

^a Data are not available.

^b The Grand Trunk Western Railroad and the Soo Line Railroad Company data are excluded.



Table 11.10
Summary Statistics for the National Railroad Passenger Corporation (Amtrak), 1971-96

Year	Number of locomotives in service	Number of passenger cars	Train-miles (thousands)	Car-miles (thousands)	Revenue passenger-miles (millions)	Average trip length (miles)	Energy intensity (Btu per revenue passenger-mile)	Energy use (trillion Btu)
1971	^a	1,165	16,537	140,147	1,993	188	^a	^a
1972	285	1,571	26,302	213,261	3,039	183	^a	^a
1973	352	1,777	27,151	239,775	3,807	224	3,756	14.3
1974	457	1,848	29,538	260,060	4,259	233	3,240	13.8
1975	355	1,913	30,166	253,898	3,753	224	3,677	13.8
1976	379	2,062	30,885	263,589	4,268	229	3,397	14.5
1977	369	2,154	33,200	261,325	4,204	221	3,568	15.0
1978	441	2,084	32,451	255,214	4,154	217	3,683	15.3
1979	437	2,026	31,379	255,129	4,867	226	3,472	16.9
1980	448	2,128	29,487	235,235	4,503	217	3,176	14.3
1981	398	1,830	30,380	222,753	4,397	226	2,979	13.1
1982	396	1,929	28,833	217,385	3,993	220	3,156	12.6
1983	388	1,880	28,805	223,509	4,227	223	2,957	12.5
1984	387	1,844	29,133	234,557	4,427	227	3,027	13.4
1985	382	1,818	30,038	250,642	4,785	238	2,800	13.4
1986	369	1,793	28,604	249,665	5,011	249	2,574	12.9
1987	381	1,850	29,515	261,054	5,361	259	2,537	13.6
1988	391	1,845	30,221	277,774	5,686	265	2,462	14.0
1989	312	1,742	31,000	285,255	5,859	274	2,731	16.0
1990	318	1,863	33,000	300,996	6,057	273	2,609	15.8
1991	316	1,786	34,000	312,484	6,273	285	2,503	15.7
1992	336	1,796	34,000	307,282	6,091	286	2,610	15.9
1993	360	1,853	34,936	302,739	6,199	280	2,646	16.4
1994	411	1,874	34,940	305,600	5,869	276	2,351	13.8 ^b
1995	422	1,907	31,579	282,579	5,401	266	2,314	12.5 ^c
1996	348	1,501	30,542	277,750	5,066	257	2,389	12.1 ^c
1971-96	0.8% ^d	1.0%	2.5%	2.8%	3.8%	1.3%	-1.9% ^d	-0.7% ^d
1986-96	-0.6%	-1.8%	0.7%	1.1%	0.1%	0.3%	-0.7% ^d	-0.6% ^d

Source:

1971-83- Association of American Railroads, Economics and Finance Department, *Statistics of Class I Railroads*, Washington, DC, and annual.

1984-88- Association of American Railroads, *Railroad Facts*, 1988 Edition, Washington, DC, December 1989, p. 61, and annual.

1989-93- Personal communication with the Corporate Accounting Office of Amtrak, Washington, D.C.

1994-96- Number of locomotives in service, number of passenger cars, train-miles, car-miles, revenue passenger-miles, and average trip length - Association of American Railroads, *Railroad Facts*, 1997 Edition, Washington, DC, 1997, p. 78.

Energy use - Personal communication with the Amtrak, Washington, DC: (Additional resources: <http://www.amtrak.com>, <http://www.aar.org>)

^aData are not available.

^bEnergy use for 1994 on is not directly comparable to earlier years. Some commuter rail energy use may have been inadvertently included in earlier years.

^cEstimated using train-miles.

^dAverage annual percentage change is from earliest year available to 1996.



Table 11.11
Summary Statistics for Rail Transit Operations, 1970-96*

Year	Number of passenger vehicles	Vehicle-miles (millions)	Passenger trips (millions) ^b	Estimated passenger-miles (millions) ^c	Average trip length (miles) ^d	Energy intensity (Btu/passenger-mile) ^e	Energy use (trillion Btu)
1970	10,548	440.8	2,116	12,273	f	2,453	30.1
1971	10,550	440.4	2,000	11,600	f	2,595	30.1
1972	10,599	417.8	1,942	11,264	f	2,540	28.6
1973	10,510	438.5	1,921	11,142	f	2,460	27.4
1974	10,471	458.8	1,876	10,881	f	2,840	30.9
1975	10,617	446.9	1,797	10,423	f	2,962	31.1
1976	10,625	428.1	1,744	10,115	f	2,971	30.3
1977	10,579	381.7	1,713	10,071	5.8	2,691	27.1
1978	10,459	383.0	1,810	10,722	5.9	2,210	23.7
1979	10,429	399.6	1,884	11,167	5.9	2,794	31.2
1980	10,654	402.2	2,241	10,939	4.9	3,008	32.9
1981	10,824	436.6	2,217	10,590	4.8	2,946	31.2
1982	10,831	445.2	2,201	10,428	4.6	3,069	32.0
1983	10,904	423.5	2,304	10,741	4.7	3,212	34.5
1984	10,848	452.7	2,388	10,531	4.4	3,732	39.3
1985	11,109	467.8	2,422	10,777	4.4	3,461	37.3
1986	11,083	492.8	2,467	11,018	4.5	3,531	38.9
1987	10,934	508.6	2,535	11,603	4.6	3,534	41.0
1988	11,370	538.3	2,462	11,836	4.8	3,565	42.2
1989	11,261	553.4	2,704	12,539	4.6	3,397	42.6
1990	11,332	560.9	2,521	12,046	4.8	3,453	41.6
1991	11,426	554.8	2,356	11,190	4.7	3,727	41.7
1992	11,303	554.1	2,396	11,441	4.8	3,575	40.9
1993	11,286	549.8	2,234	10,936	4.9	3,687	42.2
1994	11,192	565.8	2,453	11,501	4.8	3,828	44.0
1995	11,156	571.8	2,284	11,419	5.0	3,818	43.6
1996	11,341	580.6	2,417	12,484	5.2	3,444	43.0
			<i>Average annual percentage change</i>				
1970-96	0.3%	1.1%	0.5%	0.1%	-0.6% ^g	1.3%	1.4%
1986-96	0.2%	1.7%	-0.2%	1.3%	1.5%	-0.2%	1.0%

Source:

American Public Transit Association, *1998 Transit Fact Book*, Washington, DC, February 1998, pp. 69, 71, 78, 83. (Additional resources: <http://www.apta.com>)
 Energy use - See Appendix A for Table 2.7.

*Series not continuous between 1983 and 1984 because of a change in data source by the American Public Transit Association (APTA). Beginning in 1984, data provided by APTA are taken from mandatory reports filed with the Urban Mass Transit Administration (UMTA). Data for prior years were provided on a voluntary basis by APTA members and expanded statistically.

^b1970-79 data represents total passenger rides; after 1979, data represents unlinked passenger trips.

^cEstimated for years 1970-76 based on an average trip length of 5.8 miles.

^dCalculated as the ratio of passenger-miles to passenger trips.

^eLarge system-to-system variations exist within this category.

^fData are not available.

^gAverage annual percentage change is calculated for years 1977-96.



APPENDIX A

SOURCES

This appendix contains documentation of the estimation procedures used by ORNL. The reader can examine the methodology behind the estimates and form an opinion as to their utility.

The appendix is arranged by table number and subject heading. Only tables which contain ORNL estimations are documented in Appendix A; all other tables have sources listed at the bottom of the table. Since abbreviations are used throughout the appendix, a list of abbreviations is also included.

List of Abbreviations Used in Appendix A

AAMA	American Automobile Manufacturers Association
AAR	Association of American Railroads
APTA	American Public Transit Association
Amtrak	National Railroad Passenger Corporation
Btu	British thermal unit
DOC	Department of Commerce
DOE	Department of Energy
DOT	Department of Transportation
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
gvw	gross vehicle weight
lpg	liquefied petroleum gas
mpg	miles per gallon
NHTSA	National Highway Traffic Safety Administration
NPTS	Nationwide Personal Transportation Study
ORNL	Oak Ridge National Laboratory
pmt	passenger-miles traveled
RECS	Residential Energy Consumption Survey
RTECS	Residential Transportation Energy Consumption Survey
TIUS	Truck Inventory and Use Survey
TSC	Transportation Systems Center
vmt	vehicle-miles traveled

Table 2.6
Domestic Consumption of Transportation Energy by Mode
and Fuel Type, 1996

Most of the source data were given in gallons. It was converted to Btu by using the conversion factors in Appendix B.

Highway

Automobiles

Total gallons of fuel taken from DOT, FHWA, *Highway Statistics 1995*, Table VM-1. These were distributed as follows: 97% gasoline, 1.0% gasohol, and 1.3% diesel. Percentages were derived from the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1994*, August 1997, p. 46. Natural gas data are from the DOE, EIA *Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Automobiles were assumed to use 25% of light vehicle natural gas use. Methanol use was estimated using data from DOE, EIA, *Alternatives to Traditional Transportation Fuels 1996*, Washington, DC, December 1997, p.22.

Motorcycles

DOT, FHWA, *Highway Statistics 1996*, Table VM-1. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Transit:

APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 132-135. Non-diesel fossil fuel consumption was assumed to be used by motor buses.

Intercity:

Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, 1997 Lansdowne, VA, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1996 data were estimated using vehicle travel information.)

School:

Gasoline and Diesel - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, 1996, Lansdowne, VA, p. 56. For conversion purposes, fuel for school buses was assumed to be 60% diesel fuel and 40% gasoline.

Methanol - Methanol use was estimated using data from DOE, EIA, *Alternatives to Traditional Transportation Fuels 1996*, Washington DC, December 1997, p. 22.

Trucks

Total:

Sum of light trucks and other trucks.

Light Trucks:

DOT, FHWA, *Highway Statistics 1996*, Table VM-1, for single-unit, 2-axle, 4-tire trucks. 96.2% of fuel assumed to be gasoline, 3.3% diesel, 0.3% lpg; percentages were generated from the 1992 TIUS Public Use Tape. Natural gas data are from the DOE, *EIA Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Light trucks were assumed to use 75% of light vehicle natural gas use.

Other Trucks:

DOT, FHWA, *Highway Statistics 1996*, Table VM-1. Total gallons for other trucks was the difference between total and 2-axle, 4-tire trucks. These gallons were distributed as follows based on data from the 1992 TIUS Public Use Tape: 16.2% of fuel assumed to be gasoline, 83.3% diesel, and 0.5% lpg.

Off Highway

Diesel:

Data supplied by Marianne Mintz, Argonne National Laboratory, from the Public Use Data Base, *National Energy Accounts*, DOC, OBA-NEA-10, August 1988.

Gasoline:

DOT, FHWA, *Highway Statistics 1996*, Table MF-24. Agriculture and Construction totals.

Nonhighway

Air

General Aviation:

DOT, FAA, *General Aviation Activity and Avionics Survey: Annual Summary Report Calendar Year 1996*, Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

Domestic and International Air Carrier:

DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals. Because the data for international included fuel purchased abroad, the international total was divided in half to estimate domestic fuel use for international flights.

Water

Freight:

Total - DOE, EIA, *Fuel Oil and Kerosene Sales 1996*, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

Recreational Boating:

Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, *Off-Highway Use of Gasoline in the United States* (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation is from the U.S. Coast Guard (numbered boats).

Pipeline

The sum of natural gas, crude petroleum and petroleum product, and coal slurry and water.

Natural Gas:

The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, *Natural Gas Annual 1996*, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft³. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., *End Use Energy Consumption DataBase: Transportation Sector*. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305 x 10⁻⁵ kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

Crude petroleum and petroleum product:

J. N. Hooker, *Oil Pipeline Energy Consumption and Efficiency*, ORNL-5697, ORNL, Oak Ridge, TN, 1981. (Latest available data.)

Coal slurry and water:

W. F. Banks, Systems, Science and Software, *Energy Consumption in the Pipeline Industry*, LaJolla, CA, October 1977. (Latest available data.)

Rail

Total:

Sum of freight and passenger rail.

Freight:

AAR, *Railroad Facts*, 1997 Edition, Washington, DC, 1997, p. 60.

Passenger:

Transit and Commuter - APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, p. 102-104. Transit was defined as the sum of "heavy rail," "light rail," and "other."

Intercity - Personal communication with Amtrak, Washington, DC. (1996 data were estimated using train-mile information.)

Table 2.8
Transportation Energy Consumption by Mode, 1970-96

Highway

Automobiles

Total gallons of fuel for automobiles was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A; and Table VM-1 in the 1996 annual edition. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

- 1970-80 - 94.7% gasoline, 5.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, June 1979 to December 1980*, p. 10.
- 1981-82 - 94.1% gasoline, 5.9% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, Supplement: January 1981 to September 1981*, pp. 11, 13.
- 1983-84 - 97.5% gasoline, 2.5% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles, 1983, Jan., 1985*, pp. 7, 9.
- 1985-87 - 98.5% gasoline, 1.5% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles 1985*, April 1987, pp. 25, 27.
- 1988-90 - 98.8% gasoline and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1988*, March 1990, p. 65.
- 1991-93 - 97.8% gasoline, 1.0% gasohol, and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1991*, December 1993, p. 46.
- 1994-96 - 97.7% gasoline, 1.0% gasohol, 1.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Household Vehicles Energy Consumption, 1994*, Washington, DC, August 1997, p. 46.
- 1993-96 - Methanol use was estimated using data from DOE, EIA, *Alternatives to Traditional Transportation Fuels 1996*, Washington, DC, December 1997, p. 22.
- 1993-96 - Natural gas data are from the DOE, EIA *Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Automobiles were assumed to use 25% of light vehicle natural gas use.

Motorcycles

Department of Transportation, Federal Highway Administration, *Highway Statistics Summary to 1995*, Table VM-201A; and Table VM-1 in the 1996 annual edition. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Sum of transit, intercity and school.

Transit:

APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 102-104, and annual.

Non-diesel fossil fuel consumption was assumed to be used by motor buses. For the years 1988-92, motor bus gasoline use was estimated as 5% of "other" fuels, based on personal communication with the APTA Research and Statistics Department.

Intercity:

1970-84 - American Bus Association, *Annual Report*, Washington, DC, annual.

1985-96- Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, 1997, Lansdowne, VA, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1996 data were estimated using vehicle travel information.)

School:

1970-84 - DOT, FHWA, *Highway Statistics 1984*, Washington, DC, Table VM-1, and annual.

1985-86 - DOT, Research and Special Programs Administration, *National Transportation Statistics*, Figure 2, p. 5, and annual.

1987-96- Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, 1997, Lansdowne, VA, p. 56. For conversion purposes, fuel for school buses was assumed to be 60% diesel fuel and 40% gasoline. (1996 data were estimated using vehicle travel information.)

Trucks

Light Trucks:

Defined as 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 annual edition. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-87 was distributed among fuel types as follows: 95.3% gasoline; 3.5% diesel; and 1.2% lpg. Fuel use for 1988-93 was distributed based on the 1987 TIUS: 96.6% gasoline; 3.3% diesel; and 0.1% lpg. Fuel use for 1994-96 was distributed based on the 1992 TIUS: 96.4% gasoline; 3.3% diesel; 0.3% lpg. Natural gas data are from the DOE, *EIA Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Light trucks were assumed to use 75% of light vehicle natural gas use.

Other Trucks:

Defined as the difference between total trucks and 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 annual editions. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-87 was distributed among fuel types as follows: 39.6% gasoline; 59.4% diesel; and 1.0% lpg. Fuel use for 1988-93 was distributed based on the 1987 TIUS: 19.4% gasoline; 80.4% diesel; and 0.2% lpg. Fuel use for 1994-96 was distributed based on the 1992 TIUS: 16.2% gasoline; 83.3% diesel; and 0.5% lpg.

Total Highway

Sum of autos, motorcycles, buses, light trucks, and other trucks.

Nonhighway**Air**

Sum of fuel use by General Aviation and Certificated Route Air Carrier.

General Aviation:

1970-74 - DOT, TSC, *National Transportation Statistics*, Cambridge, MA, 1981.

1975-85 - DOT, FAA, *FAA Aviation Forecasts*, Washington, DC, annual.

1985-96 - DOT, FAA, *General Aviation Activity and Avionics Survey: Annual Summary Report, Calendar Year 1996*, Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

Certificated Route Air Carrier:

1970-81 - DOT, Civil Aeronautics Board, *Fuel Cost and Consumption*, Washington, DC, annual.

1982-96 - DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals. Because the data for international included fuel purchased abroad, the international total was divided in half to estimate domestic fuel use for international flights.

Water

Sum of vessel bunkering fuel (i.e., freight) and fuel used by recreational boats.

Freight:

Total - DOE, EIA, *Fuel Oil and Kerosene Sales 1996*, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

Recreational Boating:

1970-84 - DOT, FHWA, *Highway Statistics*, Washington, DC, Table MF-24, annual.

1985-96 - Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, *Off-Highway Use of Gasoline in the United*

States (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation is from the U.S. Coast Guard (numbered boats).

Pipeline

The sum of natural gas, crude petroleum and petroleum product, and coal slurry and water.

Natural Gas:

The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, *Natural Gas Annual 1996*, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft³. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., *End Use Energy Consumption DataBase: Transportation Sector*. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305×10^{-5} kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

Crude petroleum and petroleum product:

J. N. Hooker, *Oil Pipeline Energy Consumption and Efficiency*, ORNL-5697, ORNL, Oak Ridge, Tennessee, 1981. (Latest available data.)

Coal slurry and water:

W. F. Banks, Systems, Science and Software, *Energy Consumption in the Pipeline Industry*, LaJolla, California, October 1977. (Latest available data.)

Rail

Total:

Sum of freight and passenger rail.

Freight:

AAR, *Railroad Facts*, 1997 Edition, Washington, DC, p. 60.

Passenger:

Transit and Commuter - APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, p. 102-104, annual. Transit was defined as the sum of "heavy rail," "light rail," and "other."

Intercity - Personal communication with Amtrak, Washington, DC. (1995 and 1996 data were estimated using train-mile information.)

Table 2.12
Passenger Travel and Energy Use in the United States, 1996

Highway

Automobiles

Number of Vehicles - DOT, FHWA, *Highway Statistics 1996*, Table VM-1.

Vmt - DOT, FHWA, *Highway Statistics 1996*, Table VM-1.

Pmt - Calculated by ORNL (load factor times vmt).

Load Factor - DOT, FHWA, Office of Highway Information Management, 1995 NPTS, Public Use Tape, 1997.

Energy Use - Total gallons of fuel taken from DOT, FHWA, *Highway Statistics 1996*, Table VM-1. These were distributed as follows: 97.8% gasoline, 1.0% gasohol, and 1.2% diesel. Percentages were derived from the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1991*, December 1993, p. 46. Natural gas data are from the DOE, EIA *Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Automobiles were assumed to use 25% of light vehicle natural gas use. Methanol use was estimated using data from DOE, EIA, *Alternatives to Traditional Transportation Fuels 1996*, Washington, DC, December 1997, p. 22.

Personal Trucks

Number of Vehicles - Based on the 1992 TIUS, 73.9% of total 2-axle, 4-tire trucks and 15.5% of total other trucks were for personal use. Therefore, 73.9% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1996*, Table VM-1) and 15.5% of total other trucks were estimated to be for personal use.

Vmt - 68.8% of total vehicle miles traveled by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1996*, Table VM-1) and 7.1% of total vehicle miles traveled by other trucks were for personal use. The percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD.

Pmt - Calculated by ORNL as vmt multiplied by load factor.

Load Factor - DOT, FHWA, Office of Highway Information Management, 1995 NPTS, Public Use Tape, 1997.

Energy Use - Assuming that there is no difference in fuel economy (measured in miles per gallon) between personal-use trucks and non-personal use trucks, 66.0% of total fuel consumption by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1996*, Table VM-1) and 3.5% of total other truck fuel consumption was for personal use. These percentages were derived by ORNL from the 1992 TIUS Public Use tape. Total truck energy use was the sum of light truck and other truck energy use.

Light Trucks: DOT, FHWA, *Highway Statistics 1996*, Table VM-1, for single-unit, 2-axle, 4-tire trucks. 96.4% of fuel assumed to be gasoline, 3.3% diesel, 0.3% lpg; percentages were generated from the 1992 TIUS Micro Data File on CD. Natural gas data are from the DOE, EIA *Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Light trucks were assumed to use 75% of light vehicle natural gas use.

Other Trucks: DOT, FHWA, *Highway Statistics 1996*, Table VM-1. Total gallons for other trucks was the difference between total and 2-axle, 4-tire trucks. These values were distributed based on data from the 1992 TIUS Public Use Tape: 16.2% of fuel assumed to be gasoline, 83.3% diesel, and 0.5% lpg.

Motorcycles

Number of Vehicles and Vmt - DOT, FHWA, *Highway Statistics 1996*, Table VM-1.

Pmt - Calculated by ORNL as vmt multiplied by load factor.

Load Factor - DOT, FHWA, Office of Highway Information Management, 1995 NPTS, Public Use Tape, 1997.

Energy Use - DOT, FHWA, *Highway Statistics 1996*, Table VM-1. For conversion purposes, fuel for all motorcycles was assumed to be gasoline.

Buses

Transit:

Number of Vehicles, Vmt, Pmt, and Energy Use - Motor bus only. APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 71, 78, 83, 102, 104.

Load Factor - Calculated by ORNL as pmt/vmt.

Intercity:

Number of Vehicles - Estimated by ORNL as 18% of commercial bus registrations, DOT, FHWA, *Highway Statistics 1996*, Table MV-10.

Pmt - Eno Transportation Foundation, *Transportation in America, 1997*, Fifteenth Edition, Lansdowne, VA, 1997, p. 47.

Vmt - Estimated using passenger travel and an average load factor of 23.2 persons/vehicle.

Load Factor - Estimated as 23.2 based on historical data.

Energy Use - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, 1997, Lansdowne, VA, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1996 data were estimated using vehicle travel information.)

School:

Number of Vehicles - School and other nonrevenue as reported in DOT, FHWA, *Highway Statistics 1996*, Table MV-10.

Vmt, Pmt - National Safety Council, *Accident Facts*, 1997 Edition, Chicago, IL, pp. 94-95.

Load Factor - Calculated by ORNL as pmt/vmt.

Energy Use - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, 1997, Lansdowne, VA, p. 56. For conversion purposes, fuel for school buses was assumed to be 60% diesel fuel and 40% gasoline. (1996 data were estimated using vehicle travel information.)

Nonhighway

Air

Large Certified Route Air Carriers:

Vmt, Pmt - DOT, Bureau of Transportation Statistics, *Air Carrier Traffic Statistics Monthly*, December 1996/1995, Washington, DC, p.2.

Load Factor - Calculated by ORNL as pmt/vmt .

Energy Use - DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals for domestic only.

General Aviation:

Number of Vehicles, Vmt, Energy Use - DOT, FAA, *General Aviation Activity and Avionics, Survey: Calendar Year 1996*, pp. 1-7, 3-11, 5-3.

Pmt - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, 1997, p. 47.

Load Factor - Calculated by ORNL as pmt/vmt .

Recreational Boating

Number of Vehicles - U.S. Coast Guard, Office of Boating Safety, Washington, DC, March, 1997.

Energy Use - Fuel use by recreational boating was calculated using the methodology developed by D. L. Greene in the report, *Off-Highway Use of Gasoline in the United States* (DOT, FHWA, July 1986, p. 3-22). Results from Model 1 in the report indicated an average annual consumption of 205 gallons per boat. Total consumption in gallons was then calculated using the following equation: Total = 0.95 (Gal/boat) (number of boats). An estimate of number of recreational boats in operation is from the U.S. Coast Guard (numbered boats).

Rail

Intercity:

Number of Vehicles, Vmt and Pmt - AAR, *Railroad Facts*, 1997 Edition, Washington, DC, p. 78.

Load Factor - Calculated by ORNL as pmt/vmt .

Energy Use - Personal communication with Amtrak, Washington, DC. (1996 data estimated using train-mile information.)

Transit and Commuter:

Number of Vehicles, Vmt and Pmt - APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 71, 78, 83.

Load Factor - Calculated by ORNL as pmt/vmt .

Energy Use - APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 102-104. Transit was defined as the sum of "heavy rail," "light rail," and "other."

Table 2.13
Intercity Freight Movement and Energy Use in the
United States, 1996

Highway

Trucks

Vehicles - 0.3% of total 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1996*, Table VM-1) and 24% of total other trucks were engaged in intercity freight movement. These percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD. Intercity freight trucks were defined as any truck whose:

- greatest share of miles were traveled more than 50 miles away from the vehicle's home base; **and**
- principal use was not personal or passenger transportation; **and**
- body type was not pickup, minivan, or utility vehicle.

Vmt - 0.6% of total vehicle miles traveled by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1996*, Table VM-1) and 59.5% of total vehicle miles traveled by other trucks were used in intercity freight movement. These percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD.

Ton Miles, Tons Shipped and Average Length of Haul - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, 1997, pp. 44, 46, 71.

Energy Intensity - Energy use divided by ton-miles.

Energy Use - 0.9% of total fuel consumption by 2-axle, 4-tire trucks (as reported by DOT, FHWA in *Highway Statistics 1996*, Table VM-1) and 67.2% of total other truck fuel consumption were used in intercity freight movement. These percentages were derived by ORNL from the 1992 TIUS Micro Data File on CD.

Nonhighway

Waterborne Commerce

Vehicles - U.S. Department of the Army, Army Corps of Engineers, "Summary of U.S. Flag Passenger and Cargo Vessels, 1996," New Orleans, LA, 1998.

Ton Miles, Tons Shipped, and Average Length of Haul - U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1996, Part 5: National Summaries*, New Orleans, LA, 1997, pp. 1-6, 1-7.

Energy Intensity - Energy use divided by ton miles.

Energy Use - DOE, EIA, *Fuel Oil and Kerosene Sales 1996*, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

Domestic freight energy use was calculated as:

Distillate fuel - 77.5% domestic

Residual fuel - 9.3% domestic.

Percentages were derived from the DOC, U.S. Foreign Trade, *Bunker Fuels*, "Oil and Coal Laden in the U.S. on Vessels Engaged in Foreign Trade," 1988. This report was discontinued in 1989. No other source for these data has been located.

Pipeline

Natural Gas:

Tons shipped - DOE, EIA, *Natural Gas Annual 1996*, Washington, DC, 1997, Table 1. Total natural gas disposition divided by 44,870 ft³/ton.

Energy use - The amount of natural gas used to transport natural gas was defined as "pipeline fuel" as reported in DOE, EIA, *Natural Gas Annual 1996*, Table 1. Cubic feet were converted to Btu using 1,031 Btu/ft³. Electricity use was estimated using the following procedure as reported on p. 5-110 of J. N. Hooker et al., *End Use Energy Consumption DataBase: Transportation Sector*. The energy consumption of a natural gas pipeline was taken to be the energy content of the fuel used to drive the pumps. Some 94% of the installed pumping horsepower was supplied by natural gas. The remaining 6% of the horse power was generated more efficiently, mostly by electric motors. The energy consumed by natural gas pipeline pumps that were electrically powered was not known. In order to estimate the electricity consumed, the Btu of natural gas pipeline fuel consumed was multiplied by a factor of 0.015. From this computed value, electricity efficiency and generation loss must be taken into account. The electricity energy use in Btu must be converted to kWhr, using the conversion factor 29.305 x 10⁻⁵ kWhr/Btu. Electricity generation and distribution efficiency was 29%. When generation and distribution efficiency are taken into account, 1 kWhr equals 11,765 Btu.

Crude Oil and Petroleum Product:

Ton Miles and Tons Shipped - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, 1997 pp. 44, 46.

Energy Use - W. F. Banks, Systems, Science, and Software, Inc., *Energy Consumption in the Pipeline Industry*, LaJolla, CA, 1977.

Rail

Vehicles, Vmt, Ton Miles; Average Length of Haul - AAR, *Railroad Facts*, 1997 Edition, Washington, DC, 1997, pp. 27, 34, 36, 50.

Tons shipped - AAR, *Analysis of Class I Railroads 1996*, 1997, p. 31.

Energy Use - AAR, *Railroad Facts*, 1997 Edition, Washington, DC, 1997, p. 60.

Table 2.14
Energy Intensities of Passenger Modes, 1970-96

In reference to transportation, the energy intensity of a mode is the ratio of the energy inputs to a process to a measure of the useful outputs from that process; for example, Btu per pmt or Btu per ton-mile. The energy intensity ratios were calculated for each passenger mode using the following data sources:

Highway

Automobiles

Vmt - DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 edition.

Pmt - *vmt* multiplied by the load factor.

Energy Use - Total gallons of fuel for automobiles was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A; and Table VM-1 in the 1996 annual edition. Fuel for automobiles was distributed between fuel types for conversion into Btu's as follows:

1970-80 - 94.7% gasoline, 5.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, June 1979 to December 1980*, p. 10.

1981-82 - 94.1% gasoline, 5.9% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Energy Consumption Survey: Consumption Patterns of Household Vehicles, Supplement: January 1981 to September 1981*, pp. 11, 13.

1983-84 - 97.5% gasoline, 2.5% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles, 1983, Jan., 1985*, pp. 7, 9.

1985-87 - 98.5% gasoline, 1.5% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Residential Transportation Energy Consumption Survey: Consumption Patterns of Household Vehicles 1985*, April 1987, pp. 25, 27.

1988-90 - 98.8% gasoline and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1988*, March 1990, p. 65.

1991-93 - 97.8% gasoline, 1.0% gasohol, and 1.2% diesel as reported in the DOE, EIA, Office of Markets and End Use, Energy End Use Division, *Household Vehicles Energy Consumption 1991*, December 1993, p. 46.

1994-96 - 97.7% gasoline, 1.0% gasohol, 1.3% diesel as reported in the DOE, EIA, Office of Energy Markets and End Use, *Household Vehicles Energy Consumption 1994*, Washington, DC, August 1997, p. 46.

1993-96 - Methanol use was estimated using data from DOE, EIA, *Alternatives to Traditional Transportation Fuels 1996*, Washington, DC, December 1997, p. 22.

1993-96 - Natural gas data are from the DOE, EIA *Natural Gas Annual 1996*, Table 1; transit bus natural gas was subtracted from the total and the remainder was assumed to be light vehicle use. Automobiles were assumed to use 25% of light vehicle natural gas use.

Light Trucks

Vmt - DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 edition. Light trucks were defined as 2-axle, 4-tire trucks.

Energy Use - Light trucks were defined as 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 annual edition. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-87 was distributed among fuel types as follows: 95.3% gasoline; 3.5% diesel; and 1.2% lpg. Fuel use for 1988-93 was distributed based on the 1987 TIUS: 96.6% gasoline; 3.3% diesel; and 0.1% lpg. Fuel use for 1994-95 was distributed based on the 1992 TIUS: 96.2% gasoline; 3.3% diesel; 0.3% lpg; and 0.2% cng.

Buses

Transit:

Vmt, Pmt, Energy Use - APTA, 1998 *Transit Fact Book*, February 1998, Washington, DC, pp. 71, 78, 102-104, and annual.

Non-diesel fossil fuel consumption was assumed to be used by motor buses. For the years 1988-94, motor bus gasoline use was estimated as 5% of "other" fuels, based on personal communication with the APTA Research and Statistics Department.

Intercity:

Pmt - 1970-84 - American Bus Association, *Annual Report*, Washington, DC, annual.

1985-95 - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, 1997, p. 47.

Energy Use - 1970-84 - American Bus Association, *Annual Report*, Washington, DC, annual.

1985-96 - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, p. 56, and annual. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1996 data were estimated using vehicle travel information.)

School:

Vmt - 1970-84 - DOT, FHWA, *Highway Statistics 1984*, Washington, DC, Table VM-1, p. 175, and annual.

1985-87 - DOT, TSC, *National Transportation Statistics*, 1989, Figure 2, p. 7, and annual.

1988-95 - National Safety Council, *Accident Facts*, 1996 Edition, Chicago, IL, p. 95, and annual.

Energy Use - 1970-84 - DOT, FHWA, *Highway Statistics 1984*, Washington, DC, Table VM-1, and annual.

1985-86 - DOT, TSC, *National Transportation Statistics*, Figure 2, p. 5, and annual.

1987-96 - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth Edition, Lansdowne, VA, p. 56, and annual. For conversion purposes, fuel for school buses was assumed to be 60% diesel fuel and 40% gasoline. (1996 data were estimated using vehicle travel information.)

Nonhighway

Air

Certificated Air Carriers:

Pmt - DOT, Bureau of Transportation Statistics, *Air Carrier Traffic Statistics Monthly*, December 1996/95, Washington, DC, p. 2.

Energy Use - 1970-81 - DOT, Civil Aeronautics Board, *Fuel Cost and Consumption*, Washington, DC, annual.

1982-96 - DOT, Bureau of Transportation Statistics, "Fuel Cost and Consumption Tables;" annual figures were obtained by summing monthly totals for domestic only.

General Aviation:

Pmt - Eno Transportation Foundation, *Transportation In America 1997*, Fifteenth Edition, Washington, DC, 1997, p.47.

Energy Use - 1970-74 - DOT, TSC, *National Transportation Statistics*, Cambridge, MA, 1981.

1975-85 - DOT, FAA, *FAA Aviation Forecasts*, Washington, DC, annual.

1985-96 - DOT, FAA, *General Aviation Activity and Avionics Survey: Calendar Year 1996*, Table 5.1. Jet fuel was converted from gallons to Btu using 135,000 Btu/gallon (kerosene-type jet fuel).

Rail

Passenger (Amtrak):

Pmt - 1971-83 - AAR, *Statistics of Class I Railroads*, Washington, DC, annual.

1984-88, 1995-96 - AAR, *Railroad Facts*, 1987 Edition, Washington, DC, December 1987, p. 78, and annual.

1989-94 - Personal communication with Amtrak.

Energy Use - Personal communication with Amtrak. (1995 and 1996 data were estimated using train-mile information.)

Transit:

Pmt and Energy Use - APTA, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 71, 102-104. Transit was defined as the sum of "heavy rail," "light rail," and "other."

Table 2.15
Energy Intensities of Freight Modes, 1970-96

In reference to transportation, the energy intensity of a mode is the ratio of the energy inputs to a process to a measure of the useful outputs from that process; for example, Btu per pmt or Btu per ton-mile. The energy intensity ratios were calculated for each freight mode using the following data sources:

Highway

Heavy Single-Unit and Combination Trucks

Vmt - DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 edition. Heavy single-unit and combination trucks were defined as the difference between total trucks and 2-axle, 4-tire trucks.

Energy Use - Heavy single-unit and combination trucks were defined as the difference between total trucks and 2-axle, 4-tire trucks. Total gallons of fuel was taken from DOT, FHWA, *Highway Statistics Summary to 1995*, Table VM-201A, and Table VM-1 of the 1996 annual edition. Based on data from the 1982 TIUS Public Use Tape, fuel use for 1970-87 was distributed among fuel types as follows: 39.6% gasoline; 59.4% diesel; and 1.0% lpg. Fuel use for 1988-93 was distributed based on the 1987 TIUS: 19.4% gasoline; 80.4% diesel; and 0.2% lpg. Fuel use for 1994-96 was distributed based on the 1992 TIUS: 16.2% gasoline; 83.3% diesel; and 0.5% lpg.

Nonhighway

Water

Ton Miles - U.S. Department of the Army, Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1996, Part 5: National Summaries*, New Orleans, LA, 1997, p. 1-6, and annual.

Energy Use - Calculated as the difference between total water freight energy use and foreign water freight energy use.

Total - DOE, EIA, *Fuel Oil and Kerosene Sales 1996*, Table 23. Adjusted sales of distillate and residual fuel oil for vessel bunkering. (This may include some amounts of bunker fuels used for recreational purposes.)

Rail

Freight Car Miles, Ton Miles and Energy Use - AAR, *Railroad Facts*, 1997 Edition, Washington, DC, 1997, pp. 27, 36, 60, and annual.

Table 5.4
Vehicle Stock and New Sales in the
United States, 1996 Calendar Year

Highway

Automobiles

Stock - The number of vehicles in use by EPA size class were derived as follows: Market Shares by EPA size class for new car sales from 1970-75 were taken from the DOT, NHTSA, *Automotive Characteristics Historical DataBase*, Washington, DC. Market shares for the years 1976-90 were found in Linda S. Williams and Patricia S. Hu, *Highway Vehicle MPG and Market Shares Report: Model Year 1990*, ORNL-6672, April 1991, and Table 7 and the ORNL MPG and Market Shares Database, thereafter. These data were assumed to represent the number of cars registered in each size class for each year. These percentages were applied to the automobiles in operation for that year as reported by R. L. Polk and Company (FURTHER REPRODUCTION PROHIBITED) and summed to calculate the total mix. This method assumed that all vehicles, large and small, were scrapped at the same rate.

Sales - Domestic, import, and total sales were from AAMA, *Facts and Figures 1997*, p. 19. The domestic sales were distributed by size class according to the following percentages: Two seater, 0.3%; Minicompact, 0%; Subcompact, 13.5%; Compact 38.8%; Midsize, 29.4%; and Large, 18.0%. The import sales were distributed by size class according to the following percentages: Two-seater, 2.1%; Minicompact, 2.9%; Subcompact, 35.5%; Compact, 32.7%; Midsize, 25.3%; and Large, 1.5%. These percentages were derived from the ORNL MPG and Market Shares Database. Domestic-sponsored imports (captive imports) were included in the import figure only.

Business fleet autos - Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 1997*, Redondo Beach, CA, 1997.

Personal autos - Difference between total vehicle stock and business fleet autos.

See Glossary for definition of Automobile Size Classifications.

Motorcycles

Stock - DOT, FHWA, *Highway Statistics 1996*, Table VM-1, 1997.

Recreational Vehicles

Sales - *Ward's Automotive Yearbook 1997*, U.S. Recreation Vehicle Shipments by Type, "Total," p. 205.

Trucks

Stock - Vehicles in use by weight class were determined by applying the percentage in use by weight class as reported in DOC, Bureau of the Census, 1992 TIUS, (0-10,000 lbs, 93.3%; 10,001-19,500 lbs, 2.1%; 19,501-26,000 lbs, 1.2%; 26,001 lbs and over, 3.4%) to the total number of trucks in use as reported by R. L. Polk and Company (FURTHER REPRODUCTION PROHIBITED).

Sales - AAMA, *Facts and Figures 1997*, p. 20.

Business fleet trucks - Bobit Publishing Company, Automotive Fleet Research Department, *Automotive Fleet Factbook 1997*, Redondo Beach, CA, 1997.

Personal trucks - Difference between total stock and business fleet trucks.

Table 7.13
Summary Statistics on Buses by Type, 1970-96

Number in Operation

Transit buses:

American Public Transit Association, *1998 Transit Fact Book*, Washington, DC, February 1998, p. 83, and annual.

Intercity buses:

1970-80 - American Bus Association, *1984 Annual Report*, Washington, DC, and annual.
1985 - U.S. Department of Transportation, Transportation Systems Center, *National Transportation Statistics*, Cambridge, MA, August 1990, Figure 5, p. 8, and annual.
1990-96 - Estimated as 38% of commercial buses (less transit motor buses). Commercial bus total found in *Highway Statistics 1996*, Table MV-10, and annual.

School buses:

U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1996*, Washington, DC, 1997, Table MV-10, p. II-6, and annual.

Vehicle-miles and Passenger-miles

Transit buses:

American Public Transit Association, *1998 Transit Fact Book*, Washington, DC, February 1998, pp. 71, 78, and annual.

Intercity buses:

1970-80 - American Bus Association, *Annual Report*, Washington, DC, annual.
1985-95 - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth edition, Lansdowne, VA, 1997, p. 47.
1990-96 vehicle travel - Estimated using passenger travel and an average load factor of 23.2.

School buses:

1970-80 - U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1984*, Washington, DC, Table VM-1, p. 175, and annual.
1985 - U.S. Department of Transportation, Research and Special Programs Administration, *National Transportation Statistics*, 1989, Figure 2, p. 7, and annual.
1990-96 - National Safety Council, *Accident Facts*, 1997 Edition, Chicago, IL, pp. 94-95, and annual.

Energy Use

Transit buses:

American Public Transit Association, *1998 Transit Fact Book*, February 1998, Washington, DC, pp. 102-104. Non-diesel fossil fuel consumption was assumed to be used by motor buses. For the years 1988-92, motor bus gasoline use was estimated as 5% of "other" fuels, based on personal communication with the APTA Research and Statistics Department.

Intercity buses:

1970-80 - American Bus Association, *Annual Report*, Washington, DC, annual.

1985-95 - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth edition, Lansdowne, VA, p. 56. For conversion purposes, fuel for all intercity buses was assumed to be diesel fuel. (1996 data were estimated using vehicle travel information.)

School buses:

1970-80 - DOT, FHWA, *Highway Statistics 1984*, Washington, DC, Table VM-1, and annual.

1985-86 - DOT, Research and Special Programs Administration, *National Transportation Statistics*, Figure 2, p. 5, and annual.

1987-96 - Eno Transportation Foundation, *Transportation in America 1997*, Fifteenth edition, Lansdowne, VA, p. 56. For conversion purposes, fuel for school was assumed to be 60% diesel fuel and 40% gasoline. (1996 data were estimated using vehicle travel information.)

APPENDIX B

CONVERSIONS

A Note About Heating Values

The heat content of a fuel is the quantity of energy released by burning a unit amount of that fuel. However, this value is not absolute and can vary according to several factors. For example, empirical formulae for determining the heating value of liquid fuels depend on the fuels' American Petroleum Institute (API) gravity. The API gravity varies depending on the percent by weight of the chemical constituents and impurities in the fuel, both of which are affected by the combination of raw materials used to produce the fuel and by the type of manufacturing process. Temperature and climatic conditions are also factors.

Because of these variations, the heating values in Table B.1 may differ from values in other publications. The figures in this report are representative or average values, not absolute ones. The gross heating values used here agree with those used by the Energy Information Administration (EIA).

Heating values fall into two categories, gross and net. If the products of fuel combustion are cooled back to the initial fuel-air or fuel-oxidizer mixture temperature and the water formed during combustion is condensed, the energy released by the process is the higher (gross) heating value. If the products of combustion are cooled to the initial fuel-air temperature, but the water is considered to remain as a vapor, the energy released by the process is lower (net) heating value. Usually the difference between the gross and net heating values for fuels used in transportation is around 5 to 8 percent; however, it is important to be consistent in their use.

Table B.1
Approximate Heat Content for Various Fuels

Automotive gasoline	125,000 Btu/gal(gross) = 115,400 Btu/gal(net)
Diesel motor fuel	138,700 Btu/gal (gross) = 128,700 Btu/gal (net)
Methanol	64,600 Btu/gal (gross) = 56,560 Btu/gal (net)
Ethanol	84,600 Btu/gal (gross) = 75,670 Btu/gal (net)
Gasohol	120,900 Btu/gal (gross) = 112,417 Btu/gal (net)
Aviation gasoline	120,200 Btu/gal (gross) = 112,000 Btu/gal (net)
Propane	91,300 Btu/gal (gross) = 83,500 Btu/gal (net)
Butane	103,000 Btu/gal (gross) = 93,000 Btu/gal (net)
Jet fuel (naphtha)	127,500 Btu/gal (gross) = 118,700 Btu/gal (net)
Jet fuel (kerosene)	135,000 Btu/gal (gross) = 128,100 Btu/gal (net)
Lubricants	144,400 Btu/gal (gross) = 130,900 Btu/gal (net)
Waxes	131,800 Btu/gal (gross) = 120,200 Btu/gal (net)
Asphalt and road oil	158,000 Btu/gal (gross) = 157,700 Btu/gal (net)
Petroleum coke	143,400 Btu/gal (gross) = 168,300 Btu/gal (net)
Natural gas	
Wet	1,109 Btu/ft ³
Dry	1,027 Btu/ft ³
Compressed	20,551 Btu/pound
	960 Btu/cubic foot
Liquid	90,800 Btu/gal (gross) = 87,600 Btu/gal (net)
Crude petroleum	138,100 Btu/gal (gross) = 131,800 Btu/gal (net)
Fuel Oils	
Residual	149,700 Btu/gal (gross) = 138,400 Btu/gal (net)
Distillate	138,700 Btu/gal (gross) = 131,800 Btu/gal (net)
Coal	
Anthracite - Consumption	21.711 x 10 ⁶ Btu/short ton
Bituminous and lignite - Consumption	21.012 x 10 ⁶ Btu/short ton
Production average	21.352 x 10 ⁶ Btu/short ton
Consumption average	21.015 x 10 ⁶ Btu/short ton

Table B.2
Fuel Equivalents

1 million bbl crude oil/day	= 0.3650 billion bbl crude oil/year = 2.117 quadrillion Btu/year = 99.45 million short tons coal/year = 90.22 million metric tons coal/year = 2.061 trillion ft ³ natural gas/year = 2.233 exajoule/year
1 billion bbl crude oil/year	= 2.740 million bbl crude oil/day = 5.800 quadrillion Btu/year = 272.5 million short tons coal/year = 247.2 million metric tons coal/year = 5.648 trillion ft ³ natural gas/year = 6.119 exajoule/year
1 quadrillion Btu/year	= 0.4724 million bbl crude oil/day = 172.4 million bbl crude oil/year = 46.98 million short tons coal/year = 42.62 million metric tons coal/year = 973.7 billion ft ³ natural gas/year = 1.055 × 10 ⁻³ exajoule/year
1 billion short tons coal/year	= 0.9072 billion metric tons coal/year = 10.06 million bbl crude oil/day = 3.670 billion bbl crude oil/year = 21.29 quadrillion Btu/year = 20.73 trillion ft ³ natural gas/year = 22.46 exajoule/year
1 billion metric tons coal/year	= 1.102 billion short tons coal/year = 9.122 million bbl crude oil/day = 3.330 billion bbl crude oil/year = 19.31 quadrillion btu/year = 18.80 trillion ft ³ natural gas/year = 20.37 exajoules/year
1 trillion ft ³ natural gas/year	= 0.4851 million bbl crude oil/day = 0.1771 billion bbl crude oil/year = 1.027 quadrillion Btu/year = 48.25 million short tons coal/year = 43.77 million metric tons coal/year = 1.083 × 10 ⁻³ exajoules/year
1 exajoule/year	= 0.4477 million bbl crude oil/day = 0.1634 billion bbl crude oil/year = 947.9 trillion Btu/year = 44.53 million short tons coal/year = 40.40 million metric tons coal/year = 0.9229 trillion ft ³ natural gas/year

Table B.3
Energy Unit Conversions

<p>1 Btu = 778.2 ft-lb = 107.6 kg-m = 1055 J = 39.30×10^{-5} hp-h = 39.85×10^{-5} metric hp-h = 29.31×10^{-5} kWhr</p>	<p>1 kWhr = 3412 Btu^a = 2.655×10^6 ft-lb = 3.671×10^5 kg-m = 3.600×10^6 J = 1.341 hp-h = 1.360 metric hp-h</p>
<p>1 kg-m = 92.95×10^{-4} Btu = 7.233 ft-lb = 9.806 J = 36.53×10^{-7} hp-h = 37.04×10^{-7} metric hp-h = 27.24×10^{-7} kWhr</p>	<p>1 Joule = 94.78×10^{-5} Btu = 0.7376 ft-lb = 0.1020 kg-m = 37.25×10^{-8} hp-h = 37.77×10^{-8} metric hp-h = 27.78×10^{-8} kWhr</p>
<p>1 hp-h = 2544 Btu = 1.98×10^6 ft-lb = 2.738×10^6 kgm = 2.685×10^6 J = 1.014 metric hp-h = 0.7475 kWhr</p>	<p>1 metric hp-h = 2510 Btu = 1.953×10^6 ft-lb = 27.00×10^4 kg-m = 2.648×10^6 J = 0.9863 hp-h = 0.7355 kWhr</p>

^aThis figure does not take into account the fact that electricity generation and distribution efficiency is approximately 29%. If generation and distribution efficiency are taken into account, 1 kWhr = 11,765 Btu.

Table B.4
Distance and Velocity Conversions

1 in.	= 83.33 x 10 ⁻³ ft	1 ft	= 12.0 in.
	= 27.78 x 10 ⁻³ yd		= 0.33 yd
	= 15.78 x 10 ⁻⁶ mile		= 189.4 x 10 ⁻³ mile
	= 25.40 x 10 ⁻³ m		= 0.3048 m
	= 0.2540 x 10 ⁻⁶ km		= 0.3048 x 10 ⁻³ km
1 mile	= 63360 in.	1 km	= 39370 in.
	= 5280 ft		= 3281 ft
	= 1760 yd		= 1093.6 yd
	= 1609 m		= 0.6214 mile
	= 1.609 km		= 1000 m
	1 ft/sec = 0.3048 m/s = 0.6818 mph = 1.0972 km/h		
	1 m/sec = 3.281 ft/s = 2.237 mph = 3.600 km/h		
	1 km/h = 0.9114 ft/s = 0.2778 m/s = 0.6214 mph		
	1 mph = 1.467 ft/s = 0.4469 m/s = 1.609 km/h		

Table B.5
Alternative Measures of Greenhouse Gases

1 pound methane, measured in carbon units (CH ₄)	=	1.333 pounds methane, measured at full molecular weight (CH ₄)
1 pound carbon dioxide, measured in carbon units (CO ₂ -C)	=	3.6667 pounds carbon dioxide, measured at full molecular weight (CO ₂)
1 pound carbon monoxide, measured in carbon units (CO-C)	=	2.333 pounds carbon monoxide, measured at full molecular weight (CO)
1 pound nitrous oxide, measured in nitrogen units (N ₂ O-N)	=	1.571 pounds nitrous oxide, measured at full molecular weight (N ₂ O)

Table B.6
Volume and Flow Rate Conversions^a

1 U.S. gal	= 231 in. ³	1 liter	= 61.02 in. ³
	= 0.1337 ft ³		= 3.531 x 10 ⁻² ft ³
	= 3.785 liters		= 0.2624 U.S. gal
	= 0.8321 imperial gal		= 0.2200 imperial gal
	= 0.0238 bbl		= 6.29 x 10 ⁻³ bbl
	= 0.003785 m ³		= 0.001 m ³

A U.S. gallon of gasoline weighs 6.2 pounds

1 imperial gal	= 277.4 in. ³	1 bbl	= 9702 in. ³
	= 0.1606 ft ³		= 5.615 ft ³
	= 4.545 liters		= 158.97 liters
	= 1.201 U.S. gal		= 42 U.S. gal
	= 0.0286 bbl		= 34.97 imperial gal
	= 0.004546 m ³		= 0.15897 m ³

1 U.S. gal/hr	= 3.209 ft ³ /day	= 1171 ft ³ /year
	= 90.84 liter/day	= 33157 liter/year
	= 19.97 imperial gal/day	= 7289 imperial gal/year
	= 0.5712 bbl/day	= 207.92 bbl/year

For Imperial gallons, multiply above values by 1.201

1 liter/hr	= 0.8474 ft ³ /day	= 309.3 ft ³ /year
	= 6.298 U.S. gal/day	= 2299 U.S. gal/year
	= 5.28 imperial gal/day	= 1927 imperial gal/year
	= 0.1510 bbl/day	= 55.10 bbl/year
1 bbl/hr	= 137.8 ft ³ /year	= 49187 ft ³ /year
	= 1008 U.S. gal/day	= 3.679 x 10 ⁵ U.S. gal/year
	= 839.3 imperial gal/day	= 3.063 x 10 ⁵ imperial gal/year
	= 3815 liter/day	= 1.393 x 10 ⁶ liter/day

^aThe conversions for flow rates are identical to those for volume measures, if the time units are identical.

Table B.7
Power Conversions

FROM	TO					
	Horsepower	Kilowatts	Metric horsepower	Ft-lb per sec	Kilocalories per sec	Btu per sec
Horsepower	1	0.7457	1.014	550	0.1781	0.7068
Kilowatts	1.341	1	1.360	737.6	0.239	0.9478
Metric horsepower	0.9863	0.7355	1	542.5	0.1757	0.6971
Ft-lb per sec	1.36×10^{-3}	1.356×10^{-3}	1.84×10^{-3}	1	0.3238×10^{-3}	1.285×10^{-3}
Kilocalories per sec	5.615	4.184	5.692	3088	1	3.968
Btu per sec	1.415	1.055	1.434	778.2	0.2520	1

Table B.8
Mass Conversions

FROM	TO				
	Pound	Kilogram	Short ton	Long ton	Metric ton
Pound	1	0.4536	5.0×10^{-4}	4.4643×10^{-4}	4.5362×10^{-4}
Kilogram	2.205	1	1.1023×10^{-3}	9.8425×10^{-4}	1.0×10^{-3}
Short ton	2000	907.2	1	0.8929	0.9072
Long ton	2240	1016	1.12	1	1.016
Metric ton	2205	1000	1.102	0.9842	1

Table B.9
Fuel Efficiency Conversions*

MPG	Miles/liter	Kilometers/L	L/100 kilometers
10	2.64	4.25	23.52
15	3.96	6.38	15.68
20	5.28	8.50	11.76
25	6.60	10.63	9.41
30	7.92	12.75	7.84
35	9.25	14.88	6.72
40	10.57	17.00	5.88
45	11.89	19.13	5.23
50	13.21	21.25	4.70
55	14.53	23.38	4.28
60	15.85	25.51	3.92
65	17.17	27.63	3.62
70	18.49	29.76	3.36
75	19.81	31.88	3.14
80	21.13	34.01	2.94
85	22.45	36.13	2.77
90	23.77	38.26	2.61
95	25.09	40.38	2.48
100	26.42	42.51	2.35
105	27.74	44.64	2.24
110	29.06	46.76	2.14
115	30.38	48.89	2.05
120	31.70	51.01	1.96
125	33.02	53.14	1.88
130	34.34	55.26	1.81
135	35.66	57.39	1.74
140	36.98	59.51	1.68
145	38.30	61.64	1.62
150	39.62	63.76	1.57

*To convert fuel efficiency from miles per gallon (mpg) to liters per hundred kilometers, divide mpg into 235.24.

Table B.10
SI Prefixes and Their Values

	Value	Prefix	Symbol
One million million millionth	10^{-18}	atto	a
One thousand million millionth	10^{-15}	femto	f
One million millionth	10^{-12}	pico	p
One thousand millionth	10^{-9}	nano	n
One millionth	10^{-6}	micro	μ
One thousandth	10^{-3}	milli	m
One hundredth	10^{-2}	centi	c
One tenth	10^{-1}	deci	
One	10^0		
Ten	10^1	deca	
One hundred	10^2	hecto	
One thousand	10^3	kilo	k
One million	10^6	mega	M
One billion ^a	10^9	giga	G
One trillion ^a	10^{12}	tera	T
One quadrillion ^a	10^{15}	peta	P
One quintillion ^a	10^{18}	exa	E

^aCare should be exercised in the use of this nomenclature, especially in foreign correspondence, as it is either unknown or carries a different value in other countries. A "billion," for example, signifies a value of 10^{12} in most other countries.

Table B.11
Metric Units and Abbreviations

Quantity	Unit name	Symbol
Energy	joule	J
Specific energy	joule/kilogram	J/kg
Specific energy consumption	joule/kilogram•kilometer	J/(kg•km)
Energy consumption	joule/kilometer	J/km
Energy economy	kilometer/kilojoule	km/kJ
Power	kilowatt	Kw
Specific power	watt/kilogram	W/kg
Power density	watt/meter ³	W/m ³
Speed	kilometer/hour	km/h
Acceleration	meter/second ²	m/s ²
Range (distance)	kilometer	km
Weight	kilogram	kg
Torque	newton•meter	N•m
Volume	meter ³	m ³
Mass; payload	kilogram	kg
Length; width	meter	m
Brake specific fuel consumption	kilogram/joule	kg/J
Fuel economy (heat engine)	liters/100 km	L/100 km

Conversion of Constant Dollar Values

Many types of information in this data book are expressed in dollars. Generally, constant dollars are used—that is, dollars of a fixed value for a specific year, such as 1990 dollars. Converting current dollars to constant dollars, or converting constant dollars for one year to constant dollars for another year, requires conversion factors (Table B.12 and B.13). Table B.12 shows conversion factors for the Consumer Price Index inflation factors. Table B.13 shows conversion factors using the Gross National Product inflation factors.

Due to the size of the tables, the data in Tables B.12 and B.13 were changed to two decimal places starting with Edition 17. However, three decimal places were used to calculate all constant dollar values.

Table B.12
Consumer Price Inflation (CPI) Index

From	To	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1970	1970	1.00	1.04	1.08	1.14	1.27	1.39	1.47	1.56	1.68	1.87	2.12	2.34	2.49	2.57	2.68	2.77	2.82	2.93	3.05	3.19	3.37	3.51	3.61	3.72	3.82	3.93	4.04	4.13
1971	1971	0.96	1.00	1.03	1.10	1.22	1.33	1.41	1.50	1.61	1.79	2.04	2.25	2.38	2.46	2.56	2.65	2.71	2.81	2.92	3.06	3.23	3.36	3.47	3.57	3.66	3.76	3.87	3.96
1972	1972	0.93	0.97	1.00	1.06	1.18	1.29	1.36	1.45	1.56	1.74	1.97	2.17	2.31	2.38	2.48	2.57	2.62	2.72	2.83	2.96	3.12	3.26	3.35	3.45	3.54	3.64	3.75	3.84
1973	1973	0.87	0.91	0.94	1.00	1.11	1.21	1.28	1.36	1.47	1.63	1.86	2.05	2.17	2.24	2.34	2.42	2.47	2.56	2.66	2.79	2.94	3.07	3.16	3.25	3.34	3.43	3.53	3.61
1974	1974	0.79	0.82	0.85	0.90	1.00	1.09	1.15	1.23	1.32	1.47	1.67	1.84	1.96	2.02	2.11	2.18	2.22	2.31	2.40	2.51	2.65	2.76	2.85	2.93	3.01	3.09	3.18	3.26
1975	1975	0.72	0.75	0.78	0.83	0.92	1.00	1.06	1.13	1.21	1.35	1.53	1.69	1.79	1.85	1.93	2.00	2.04	2.11	2.20	2.30	2.43	2.53	2.61	2.68	2.75	2.83	2.92	2.98
1976	1976	0.68	0.71	0.74	0.78	0.87	0.95	1.00	1.07	1.15	1.28	1.45	1.60	1.70	1.75	1.82	1.89	1.93	2.00	2.08	2.18	2.30	2.39	2.47	2.54	2.60	2.68	2.76	2.82
1977	1977	0.64	0.67	0.69	0.73	0.81	0.89	0.94	1.00	1.08	1.20	1.36	1.50	1.59	1.65	1.72	1.78	1.81	1.88	1.95	2.05	2.16	2.25	2.32	2.38	2.45	2.52	2.59	2.65
1978	1978	0.60	0.62	0.64	0.68	0.76	0.83	0.87	0.93	1.00	1.11	1.27	1.40	1.48	1.53	1.59	1.65	1.68	1.74	1.81	1.90	2.00	2.09	2.15	2.21	2.27	2.34	2.40	2.46
1979	1979	0.54	0.56	0.58	0.61	0.68	0.74	0.78	0.84	0.90	1.00	1.14	1.25	1.33	1.37	1.43	1.48	1.51	1.57	1.63	1.71	1.80	1.88	1.93	1.99	2.04	2.10	2.16	2.21
1980	1980	0.47	0.49	0.51	0.54	0.60	0.65	0.69	0.74	0.79	0.88	1.00	1.10	1.17	1.21	1.26	1.31	1.33	1.38	1.44	1.50	1.59	1.65	1.70	1.75	1.80	1.85	1.90	1.95
1981	1981	0.43	0.45	0.46	0.49	0.54	0.59	0.63	0.67	0.72	0.80	0.91	1.00	1.06	1.10	1.14	1.18	1.21	1.25	1.30	1.36	1.44	1.50	1.54	1.59	1.63	1.68	1.73	1.77
1982	1982	0.40	0.42	0.43	0.46	0.51	0.56	0.59	0.63	0.68	0.75	0.85	0.94	1.00	1.03	1.08	1.11	1.14	1.18	1.23	1.28	1.35	1.41	1.45	1.50	1.54	1.58	1.63	1.66
1983	1983	0.39	0.41	0.42	0.45	0.50	0.54	0.57	0.61	0.66	0.73	0.83	0.91	0.97	1.00	1.04	1.08	1.10	1.14	1.19	1.24	1.31	1.37	1.41	1.45	1.49	1.53	1.57	1.61
1984	1984	0.37	0.39	0.40	0.43	0.48	0.52	0.55	0.58	0.63	0.70	0.79	0.88	0.93	0.96	1.00	1.04	1.06	1.09	1.14	1.19	1.26	1.31	1.35	1.39	1.43	1.47	1.51	1.55
1985	1985	0.36	0.38	0.39	0.41	0.46	0.50	0.53	0.56	0.61	0.68	0.77	0.85	0.90	0.93	0.97	1.00	1.02	1.06	1.10	1.15	1.22	1.27	1.30	1.34	1.38	1.42	1.46	1.49
1986	1986	0.35	0.37	0.38	0.41	0.45	0.49	0.52	0.55	0.60	0.66	0.75	0.83	0.88	0.91	0.95	0.98	1.00	1.04	1.08	1.13	1.19	1.24	1.28	1.32	1.35	1.39	1.43	1.46
1987	1987	0.34	0.36	0.37	0.39	0.43	0.47	0.50	0.53	0.57	0.64	0.73	0.80	0.85	0.88	0.91	0.95	0.96	1.00	1.04	1.09	1.15	1.20	1.24	1.27	1.30	1.34	1.38	1.41
1988	1988	0.33	0.34	0.35	0.38	0.42	0.46	0.48	0.51	0.55	0.61	0.70	0.77	0.82	0.84	0.88	0.91	0.93	0.96	1.00	1.05	1.11	1.15	1.19	1.22	1.25	1.29	1.33	1.36
1989	1989	0.31	0.33	0.34	0.36	0.40	0.43	0.46	0.49	0.53	0.59	0.67	0.73	0.78	0.80	0.84	0.87	0.88	0.92	0.95	1.00	1.05	1.10	1.13	1.17	1.20	1.23	1.27	1.29
1990	1990	0.30	0.31	0.32	0.34	0.38	0.41	0.44	0.46	0.50	0.56	0.63	0.70	0.74	0.76	0.80	0.82	0.84	0.87	0.91	0.95	1.00	1.04	1.07	1.11	1.13	1.17	1.20	1.23
1991	1991	0.29	0.30	0.31	0.33	0.36	0.40	0.42	0.45	0.48	0.53	0.61	0.67	0.71	0.73	0.76	0.79	0.81	0.83	0.87	0.91	0.96	1.00	1.03	1.06	1.09	1.12	1.15	1.18
1992	1992	0.28	0.29	0.30	0.32	0.35	0.38	0.41	0.43	0.47	0.52	0.59	0.65	0.69	0.71	0.74	0.77	0.78	0.81	0.84	0.88	0.93	0.97	1.00	1.03	1.06	1.09	1.12	1.14
1993	1993	0.27	0.28	0.29	0.31	0.34	0.37	0.39	0.42	0.45	0.50	0.57	0.63	0.67	0.69	0.72	0.75	0.76	0.79	0.82	0.86	0.91	0.94	0.97	1.00	1.03	1.06	1.09	1.11
1994	1994	0.26	0.27	0.28	0.30	0.33	0.36	0.38	0.41	0.44	0.49	0.56	0.61	0.65	0.67	0.70	0.73	0.74	0.77	0.80	0.84	0.88	0.92	0.95	0.98	1.00	1.03	1.06	1.08
1995	1995	0.26	0.27	0.27	0.29	0.32	0.35	0.37	0.40	0.43	0.48	0.54	0.60	0.63	0.65	0.68	0.71	0.72	0.75	0.78	0.81	0.86	0.89	0.92	0.95	0.97	1.00	1.03	1.05
1996	1996	0.25	0.26	0.27	0.28	0.31	0.34	0.36	0.39	0.42	0.46	0.53	0.58	0.62	0.64	0.66	0.69	0.70	0.72	0.75	0.79	0.83	0.87	0.89	0.92	0.94	0.97	1.00	1.02
1997	1997	0.24	0.25	0.26	0.28	0.31	0.34	0.35	0.38	0.41	0.45	0.51	0.57	0.60	0.62	0.65	0.67	0.68	0.71	0.74	0.77	0.81	0.85	0.87	0.90	0.92	0.95	0.98	1.00

Source:

Personal contact with the Bureau of Labor Statistics.

Table B.13
Gross National Product (GNP) Implicit Price Deflator

From	To	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1970	1970	1.00	1.05	1.10	1.16	1.26	1.38	1.45	1.53	1.65	1.79	1.95	2.14	2.27	2.36	2.45	2.53	2.60	2.67	2.76	2.87	2.99	3.12	3.23	3.29	3.36	3.47	3.54	3.63
1971	1971	0.95	1.00	1.04	1.10	1.20	1.31	1.38	1.46	1.57	1.70	1.86	2.04	2.16	2.24	2.33	2.41	2.48	2.54	2.63	2.72	2.84	2.97	3.07	3.13	3.19	3.30	3.37	3.45
1972	1972	0.91	0.96	1.00	1.06	1.15	1.26	1.32	1.40	1.50	1.63	1.79	1.96	2.07	2.15	2.24	2.32	2.38	2.44	2.52	2.62	2.73	2.85	2.95	3.01	3.07	3.17	3.24	3.31
1973	1973	0.86	0.91	0.95	1.00	1.09	1.19	1.25	1.32	1.42	1.54	1.69	1.85	1.96	2.03	2.12	2.19	2.24	2.30	2.38	2.47	2.58	2.69	2.79	2.84	2.90	3.00	3.06	3.13
1974	1974	0.79	0.83	0.87	0.92	1.00	1.09	1.15	1.22	1.31	1.42	1.55	1.70	1.80	1.87	1.95	2.01	2.06	2.12	2.19	2.28	2.37	2.48	2.56	2.61	2.67	2.76	2.81	2.88
1975	1975	0.73	0.76	0.80	0.84	0.92	1.00	1.05	1.11	1.20	1.30	1.42	1.55	1.65	1.71	1.78	1.84	1.89	1.94	2.01	2.08	2.17	2.27	2.34	2.39	2.44	2.52	2.57	2.63
1976	1976	0.69	0.73	0.76	0.80	0.87	0.95	1.00	1.06	1.14	1.24	1.35	1.48	1.57	1.63	1.70	1.75	1.80	1.84	1.91	1.98	2.06	2.15	2.23	2.27	2.32	2.40	2.44	2.50
1977	1977	0.65	0.69	0.71	0.76	0.82	0.90	0.95	1.00	1.07	1.17	1.27	1.40	1.48	1.54	1.60	1.65	1.70	1.74	1.80	1.87	1.95	2.03	2.11	2.15	2.19	2.26	2.31	2.37
1978	1978	0.61	0.64	0.67	0.70	0.77	0.84	0.88	0.93	1.00	1.09	1.19	1.30	1.38	1.43	1.49	1.54	1.58	1.62	1.68	1.74	1.81	1.89	1.96	2.00	2.04	2.11	2.15	2.20
1979	1979	0.56	0.59	0.61	0.65	0.70	0.77	0.81	0.86	0.92	1.00	1.09	1.20	1.27	1.32	1.37	1.42	1.45	1.49	1.54	1.60	1.67	1.74	1.80	1.84	1.88	1.94	1.98	2.03
1980	1980	0.51	0.54	0.56	0.59	0.65	0.71	0.74	0.78	0.84	0.92	1.00	1.10	1.16	1.21	1.26	1.30	1.33	1.36	1.41	1.47	1.53	1.60	1.65	1.68	1.72	1.78	1.81	1.86
1981	1981	0.47	0.49	0.51	0.54	0.59	0.64	0.68	0.72	0.77	0.84	0.91	1.00	1.06	1.10	1.15	1.18	1.21	1.25	1.29	1.34	1.40	1.46	1.51	1.54	1.57	1.62	1.66	1.70
1982	1982	0.44	0.46	0.48	0.51	0.56	0.61	0.64	0.68	0.73	0.79	0.86	0.94	1.00	1.04	1.08	1.12	1.15	1.18	1.22	1.26	1.32	1.38	1.42	1.45	1.48	1.53	1.56	1.60
1983	1983	0.42	0.45	0.46	0.49	0.53	0.58	0.61	0.65	0.70	0.76	0.83	0.91	0.96	1.00	1.04	1.08	1.10	1.13	1.17	1.22	1.27	1.32	1.37	1.40	1.42	1.47	1.50	1.54
1984	1984	0.41	0.43	0.45	0.47	0.51	0.56	0.59	0.62	0.67	0.73	0.80	0.87	0.92	0.96	1.00	1.04	1.06	1.08	1.12	1.16	1.21	1.27	1.31	1.34	1.37	1.41	1.44	1.47
1985	1985	0.40	0.42	0.43	0.46	0.50	0.54	0.57	0.61	0.65	0.71	0.77	0.85	0.90	0.93	0.94	1.00	1.03	1.05	1.09	1.13	1.18	1.23	1.28	1.30	1.33	1.37	1.40	1.43
1986	1986	0.39	0.40	0.42	0.45	0.49	0.53	0.56	0.59	0.63	0.69	0.75	0.82	0.87	0.91	0.94	0.97	1.00	1.03	1.06	1.10	1.15	1.20	1.24	1.27	1.29	1.34	1.36	1.40
1987	1987	0.38	0.40	0.41	0.44	0.47	0.52	0.54	0.58	0.62	0.67	0.73	0.80	0.85	0.89	0.92	0.95	0.98	1.00	1.04	1.08	1.12	1.17	1.21	1.24	1.26	1.30	1.33	1.36
1988	1988	0.36	0.38	0.40	0.42	0.46	0.50	0.53	0.56	0.60	0.65	0.71	0.77	0.82	0.85	0.89	0.92	0.94	0.97	1.00	1.04	1.08	1.13	1.17	1.19	1.22	1.26	1.28	1.31
1989	1989	0.35	0.37	0.38	0.40	0.44	0.48	0.51	0.54	0.58	0.62	0.68	0.75	0.79	0.82	0.86	0.88	0.91	0.93	0.96	1.00	1.04	1.09	1.13	1.15	1.17	1.21	1.24	1.27
1990	1990	0.34	0.35	0.37	0.39	0.42	0.46	0.49	0.51	0.55	0.60	0.66	0.72	0.76	0.79	0.83	0.85	0.87	0.89	0.93	0.96	1.00	1.05	1.08	1.10	1.13	1.16	1.19	1.22
1991	1991	0.32	0.34	0.35	0.37	0.40	0.44	0.47	0.49	0.53	0.57	0.63	0.69	0.73	0.76	0.79	0.81	0.83	0.86	0.89	0.92	0.96	1.00	1.04	1.06	1.08	1.11	1.14	1.16
1992	1992	0.31	0.33	0.34	0.36	0.39	0.43	0.45	0.48	0.51	0.55	0.61	0.66	0.70	0.73	0.76	0.78	0.81	0.83	0.86	0.89	0.92	0.97	1.00	1.02	1.04	1.08	1.10	1.12
1993	1993	0.30	0.32	0.33	0.35	0.38	0.42	0.44	0.47	0.50	0.54	0.59	0.65	0.69	0.72	0.75	0.77	0.79	0.81	0.84	0.87	0.91	0.95	0.98	1.00	1.02	1.05	1.08	1.10
1994	1994	0.30	0.31	0.33	0.35	0.38	0.41	0.43	0.46	0.49	0.53	0.58	0.64	0.68	0.70	0.73	0.75	0.77	0.79	0.82	0.85	0.89	0.93	0.96	0.98	1.00	1.03	1.05	1.08
1995	1995	0.29	0.30	0.32	0.33	0.36	0.40	0.42	0.44	0.47	0.52	0.56	0.62	0.65	0.68	0.71	0.73	0.75	0.77	0.80	0.83	0.86	0.90	0.93	0.95	0.97	1.00	1.02	1.05
1996	1996	0.28	0.30	0.31	0.33	0.36	0.39	0.41	0.43	0.46	0.51	0.55	0.60	0.64	0.67	0.69	0.71	0.73	0.75	0.78	0.81	0.84	0.88	0.91	0.93	0.95	0.98	1.00	1.02
1997	1997	0.28	0.29	0.30	0.32	0.35	0.38	0.40	0.42	0.45	0.49	0.54	0.59	0.63	0.65	0.68	0.70	0.72	0.74	0.76	0.79	0.82	0.86	0.89	0.91	0.93	0.96	0.98	1.00

Source:

U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, Washington, DC, monthly.

APPENDIX C

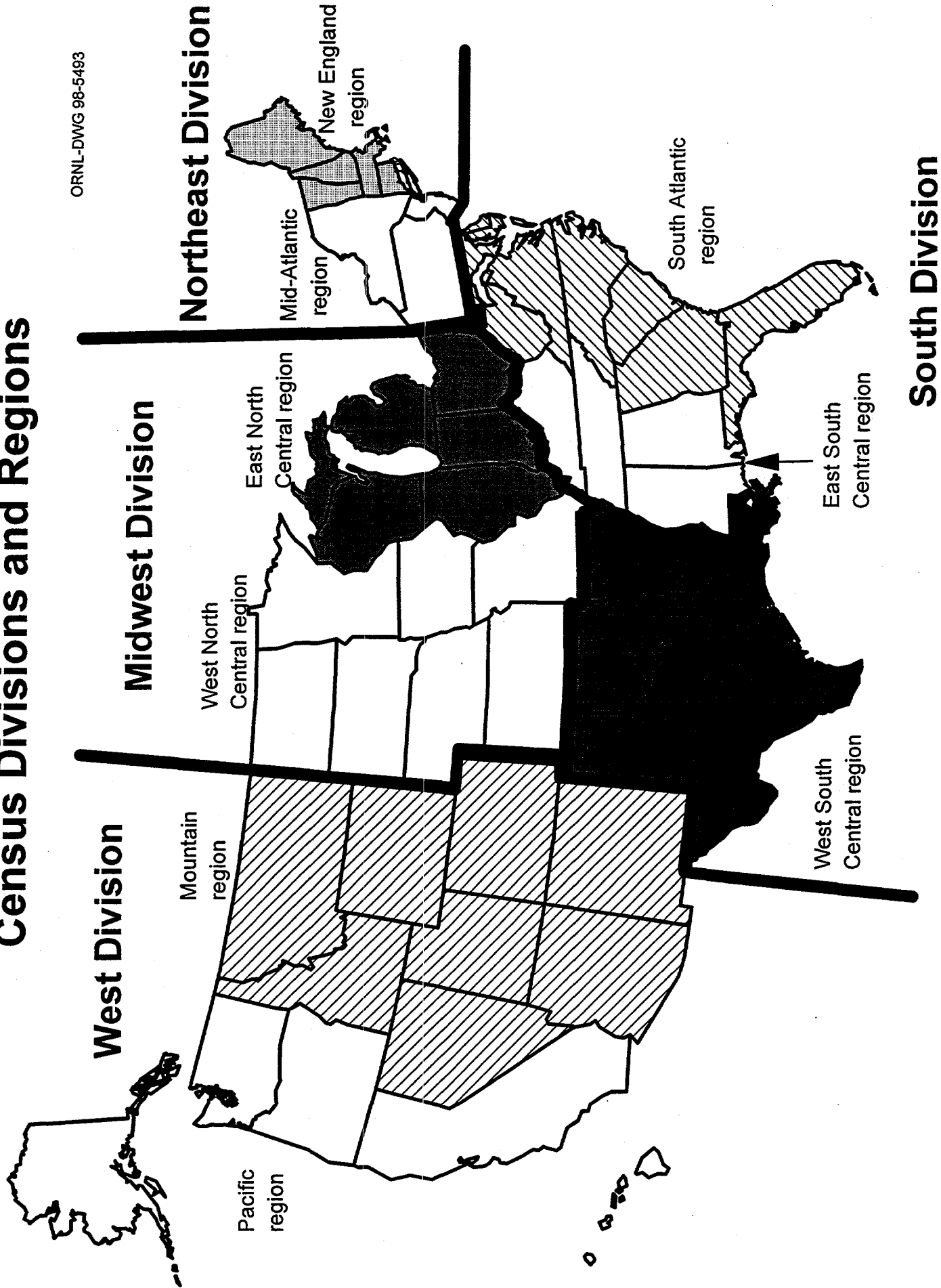
CENSUS DIVISIONS AND REGIONS

**Table C.1
Census Divisions and Regions**

Northeast Division			
Mid-Atlantic region		New England region	
New Jersey New York	Pennsylvania	Connecticut Maine Massachusetts	New Hampshire Rhode Island Vermont
South Division			
West South Central region	East South Central region	South Atlantic region	
Arkansas Louisiana Oklahoma Texas	Alabama Kentucky Mississippi Tennessee	Delaware Florida Georgia Maryland North Carolina	South Carolina Virginia Washington, DC West Virginia
West Division			
Pacific region		Mountain region	
Alaska California Hawaii	Oregon Washington	Arizona Colorado Idaho Montana	Nevada New Mexico Utah Wyoming
Midwest Division			
West North Central region		East North Central region	
Iowa Kansas Minnesota Missouri	Nebraska North Dakota South Dakota	Illinois Indiana Michigan	Ohio Wisconsin

Census Divisions and Regions

ORNL-DWG 98-5493



GLOSSARY

Acceleration power - Measured in kilowatts. Pulse power obtainable from a battery used to accelerate a vehicle. This is based on a constant current pulse for 30 seconds at no less than 2/3 of the maximum open-circuit-voltage, at 80% depth-of-discharge relative to the battery's rated capacity and at 20° C ambient temperature.

Air Carrier - The commercial system of air transportation consisting of certificated air carriers, air taxis (including commuters), supplemental air carriers, commercial operators of large aircraft, and air travel clubs.

Certificated route air carrier: An air carrier holding a Certificate of Public Convenience and Necessity issued by the Department of Transportation to conduct scheduled interstate services. Nonscheduled or charter operations may also be conducted by these carriers. These carriers operate large aircraft (30 seats or more, or a maximum payload capacity of 7,500 pounds or more) in accordance with Federal Aviation Regulation part 121.

Domestic air operator: Commercial air transportation within and between the 50 States and the District of Columbia. Includes operations of certificated route air carriers, Pan American, local service, helicopter, intra-Alaska, intra-Hawaii, all-cargo carriers and other carriers. Also included are transborder operations conducted on the domestic route segments of U.S. air carriers. Domestic operators are classified based on their operating revenue as follows:

- Majors - over \$1 billion
- Nationals - \$100-1,000 million
- Large Regionals - \$10-99.9 million
- Medium Regionals - \$0-9.99 million

International air operator: Commercial air transportation outside the territory of the United States, including operations between the U.S. and foreign countries and between the U.S. and its territories and possessions.

Supplemental air carrier: A class of air carriers which hold certificates authorizing them to perform passenger and cargo charter services supplementing the scheduled service of the certificated route air carriers. Supplemental air carriers are often referred to as nonscheduled air carriers or "nonskeds".

Alcohol - The family name of a group of organic chemical compounds composed of carbon, hydrogen, and oxygen. The molecules in the series vary in chain length and are composed of a hydrocarbon plus a hydroxyl group. Alcohol includes methanol and ethanol.

Amtrak - See *Rail*.

Automobile size classifications - Size classifications of automobiles are established by the Environmental Protection Agency (EPA) as follows:

Minicompact - less than 85 cubic feet of passenger and luggage volume.

Subcompact - between 85 to 100 cubic feet of passenger and luggage volume.

Compact - between 100 to 110 cubic feet of passenger and luggage volume.

Midsize - between 110 to 120 cubic feet of passenger and luggage volume.

Large - more than 120 cubic feet of passenger and luggage volume.

Two seater - automobiles designed primarily to seat only two adults.

Station wagons are included with the size class for the sedan of the same name.

Aviation - See *General aviation*.

Aviation gasoline - All special grades of gasoline for use in aviation reciprocating engines, as given in the American Society for Testing and Materials (ASTM) Specification D 910. Includes all refinery products within the gasoline range that are to be marketed straight or in blends as aviation gasoline without further processing (any refinery operation except mechanical blending). Also included are finished components in the gasoline range which will be used for blending or compounding into aviation gasoline.

Barges - Shallow, nonself-propelled vessels used to carry bulk commodities on the rivers and the Great Lakes.

Battery efficiency - Measured in percentage. Net DC energy delivered on discharge, as a percentage of the total DC energy required to restore the initial state-of-charge. The efficiency value must include energy losses resulting from self-discharge, cell equalization, thermal loss compensation, and all battery-specific auxiliary equipment.

Btu - The amount of energy required to raise the temperature of 1 pound of water 1 degree Fahrenheit at or near 39.2 degrees Fahrenheit. An average Btu content of fuel is the heat value per quantity of fuel as determined from tests of fuel samples.

Bunker - A storage tank.

Bunkering fuels - Fuels stored in ship bunkers.

Bus -

Intercity bus: A standard size bus equipped with front doors only, high backed seats, luggage compartments separate from the passenger compartment and usually with restroom facilities, for high-speed long distance service.

Motor bus: Rubber-tired, self-propelled, manually-steered bus with fuel supply on board the vehicle. Motor bus types include intercity, school, and transit.

School and other nonrevenue bus: Bus services for which passengers are not directly charged for transportation, either on a per passenger or per vehicle basis.

Transit bus: A bus designed for frequent stop service with front and center doors, normally with a rear-mounted diesel engine, low-back seating, and without luggage storage compartments or restroom facilities. Includes motor bus and trolley coach.

Trolley coach: Rubber-tired electric transit vehicle, manually-steered, propelled by a motor drawing current, normally through overhead wires, from a central power source not on board the vehicle.

Calendar year - The period of time between January 1 and December 31 of any given year.

Captive imports - Products produced overseas specifically for domestic manufacturers.

Carbon dioxide (CO₂) - A colorless, odorless, non-poisonous gas that is a normal part of the ambient air. Carbon dioxide is a product of fossil fuel combustion.

Carbon monoxide (CO) - A colorless, odorless, highly toxic gas that is a normal by-product of incomplete fossil fuel combustion. Carbon monoxide, one of the major air pollutants, can be harmful in small amounts if breathed over a certain period of time.

Car-mile (railroad) - A single railroad car moved a distance of one mile.

Cargo ton-mile - See *Ton-mile*.

Certificated route air carriers - See *Air carriers*.

Class I freight railroad - See *Rail*.

Clean Fuel Vehicle - Vehicle meeting the clean fuel vehicle exhaust emissions standards with no restriction on fuel type.

Coal slurry - Finely crushed coal mixed with sufficient water to form a fluid.

Combination trucks - Consist of a power unit (a truck tractor) and one or more trailing units (a semi-trailer or trailer). The most frequently used combination is popularly referred to as a "tractor-semitrailer" or "tractor trailer".

Commercial sector - See *Residential and Commercial sector*.

Commuter railroad - See *Rail*.

Compact car - See *Automobile size classifications*.

Constant dollars - A series of figures is expressed in constant dollars when the effect of change in the purchasing power of the dollar has been removed. Usually the data are expressed in terms of dollars of a selected year or the average of a set of years.

Consumer Price Index (CPI) - An index issued by the U.S. Department of Labor, Bureau of Labor Statistics. The CPI is designed to measure changes in the prices of goods and services bought by wage earners and clerical workers in urban areas. It represents the cost of a typical consumption bundle at current prices as a ratio to its cost at a base year.

Continuous discharge capacity - Measured as percent of rated energy capacity. Energy delivered in a constant power discharge required by an electric vehicle for hill climbing and/or high-speed cruise, specified as the percent of its rated energy capacity delivered in a one hour constant-power discharge.

Corporate Average Fuel Economy (CAFE) standards - CAFE standards were originally established by Congress for new automobiles, and later for light trucks, in Title V of the Motor Vehicle Information and Cost Savings Act (15 U.S.C.1901, et seq.) with subsequent amendments. Under CAFE, automobile manufacturers are required by law to produce vehicle fleets with a composite sales-weighted fuel economy which cannot be lower than the CAFE standards in a given year, or for every vehicle which does not meet the standard, a fine of \$5.00 is paid for every one-tenth of a mpg below the standard.

Crude oil - A mixture of hydrocarbons that exists in the liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Crude oil production is measured at the wellhead and includes lease condensate.

Crude oil imports - The volume of crude oil imported into the 50 States and the District of Columbia, including imports from U.S. territories, but excluding imports of crude oil into the Hawaiian Foreign Trade Zone.

Curb weight - The weight of a vehicle including all standard equipment, spare tire and wheel, all fluids and lubricants to capacity, full tank of fuel, and the weight of major optional accessories normally found on the vehicle.

Current dollars - Represents dollars current at the time designated or at the time of the transaction. In most contexts, the same meaning would be conveyed by the use of the term "dollars".

Disposable personal income - See *Income*.

Distillate fuel oil - The lighter fuel oils distilled off during the refining process. Included are products known as ASTM grades numbers 1 and 2 heating oils, diesel fuels, and number 4 fuel oil. The major uses of distillate fuel oils include heating, fuel for on-and off-highway diesel engines, and railroad diesel fuel.

Domestic air operator - See *Air carrier*.

Domestic water transportation - See *Internal water transportation*.

Electric utilities sector - Consists of privately and publicly owned establishments which generate electricity primarily for resale.

Emission standards - Standards for the levels of pollutants emitted from automobiles and trucks. Congress established the first standards in the Clean Air Act of 1963. Currently, standards are set for four vehicle classes - automobiles, light trucks, heavy-duty gasoline trucks, and heavy-duty diesel trucks.

Energy capacity - Measured in kilowatt hours. The energy delivered by the battery, when tested at C/3 discharge rate, up to termination of discharge specified by the battery manufacturer. The required acceleration power must be delivered by the battery at any point up to 80% of the battery's energy capacity rating.

Energy efficiency - In reference to transportation, the inverse of energy intensiveness: the ratio of outputs from a process to the energy inputs; for example, miles traveled per gallon of fuel (mpg).

Energy intensity - In reference to transportation, the ratio of energy inputs to a process to the useful outputs from that process; for example, gallons of fuel per passenger-mile or Btu per ton-mile.

Ethanol (C₂H₅OH) - Otherwise known as ethyl alcohol, alcohol, or grain-spirit. A clear, colorless, flammable oxygenated hydrocarbon with a boiling point of 78.5 degrees Celsius in the anhydrous state. In transportation, ethanol is used as a vehicle fuel by itself (E100), blended with gasoline (E85), or as a gasoline octane enhancer and oxygenate (10% concentration).

Fixed operating cost - See *Operating cost*.

Fleet vehicles -

Private fleet vehicles: Ideally, a vehicle could be classified as a member of a fleet if it is:

- a) operated in mass by a corporation or institution,
- b) operated under unified control, or
- c) used for non-personal activities.

However, the definition of a fleet is not consistent throughout the fleet industry. Some companies make a distinction between cars that were bought in bulk rather than singularly, or whether they are operated in bulk, as well as the minimum number of vehicles that constitute a fleet (i.e. 4 or 10).

Government fleet vehicles: Includes vehicles owned by all federal (GSA), state, county, city, and metro units of government, including toll road operations.

Foreign freight - Movements between the United States and foreign countries and between Puerto Rico, the Virgin Islands, and foreign countries. Trade between U.S. territories and possessions (e.g. Guam, Wake, American Samoa) and foreign countries is excluded. Traffic to or from the Panama Canal Zone is included.

Gas Guzzler Tax - Originates from the 1978 Energy Tax Act (Public Law 95-618). A new car purchaser is required to pay the tax if the car purchased has a combined city/highway fuel economy rating that is below the standard for that year. For model years 1986 and later, the standard is 22.5 mpg.

Gasohol - A mixture of 10% anhydrous ethanol and 90% gasoline by volume. There are other fuels that contain methanol and gasoline, but these fuels are not referred to as gasohol.

Gasoline - See *Motor gasoline*.

General aviation - That portion of civil aviation which encompasses all facets of aviation except air carriers. It includes any air taxis, commuter air carriers, and air travel clubs which do not hold Certificates of Public Convenience and Necessity.

Gross National Product - A measure of monetary value of the goods and services becoming available to the nation from economic activity. Total value at market prices of all goods and services produced by the nation's economy. Calculated quarterly by the Department of Commerce, the Gross National Product is the broadest available measure of the level of economic activity.

Gross vehicle weight (gvw) - The weight of the empty vehicle plus the maximum anticipated load weight.

Heavy-heavy truck - See *Truck size classifications*.

Household - Consists of all persons who occupy a housing unit, including the related family members and all unrelated persons, if any, who share the housing unit.

Housing unit - A house, apartment, a group of rooms, or a single room occupied or intended for occupancy as separate living quarters. Separate living quarters are those in which the occupants do not live and eat with any other persons in the structure and which have either (1) direct access from the outside of the building or through a common hallway intended to be used by the occupants of another unit or by the general public, or (2) complete kitchen facilities for the exclusive use of the occupants. The occupants may be a single family, one person living alone, two or more families living together, or any other group of related or unrelated persons who share living arrangements.

Hydrocarbon (HC) - A compound that contains only hydrogen and carbon. The simplest and lightest forms of hydrocarbon are gaseous. With greater molecular weights they are liquid, while the heaviest are solids.

Income -

Disposable personal income: Personal income less personal tax and non-tax payments.

National income - The aggregate earnings of labor and property which arise in the current production of goods and services by the nation's economy.

Personal income: The current income received by persons from all sources, net of contributions for social insurance.

Industrial sector - Construction, manufacturing, agricultural and mining establishments.

Inertia weight - The curb weight of a vehicle plus 300 pounds.

Intercity bus - See *Bus*.

Internal water transportation - Includes all local (intraport) traffic and traffic between ports or landings wherein the entire movement takes place on inland waterways. Also termed internal are movements involving carriage on both inland waterways and the water of the Great Lakes, and inland movements that cross short stretches of open water that link inland systems.

International air operator - See *Air carrier*.

International freight - See *Foreign freight*.

Jet fuel - Includes both naphtha-type and kerosene-type fuels meeting standards for use in aircraft turbine engines. Although most jet fuel is used in aircraft, some is used for other purposes such as generating electricity in gas turbines.

Kerosene-type jet fuel: A quality kerosene product with an average gravity of 40.7 degrees API and 10% to 90% distillation temperatures of 217 to 261 degrees centigrade. Used primarily as fuel for commercial turbojet and turboprop aircraft engines. It is a relatively low freezing point distillate of the kerosene type.

Naphtha-type jet fuel: A fuel in the heavy naphtha boiling range with an average gravity of 52.8 degrees API and 10% to 90% distillation temperatures of 117 to 233 degrees centigrade used for turbojet and turboprop aircraft engines, primarily by the military. Excludes ramjet and petroleum.

Kerosene - A petroleum distillate in the 300 to 500 degrees Fahrenheit boiling range and generally having a flash point higher than 100 degrees Fahrenheit by the American Society of Testing and Material (ASTM) Method D56, a gravity range from 40 to 46 degrees API, and a burning point in the range of 150 to 175 degrees Fahrenheit. It is a clean-burning product suitable for use as an illuminant when burned in wick lamps. Includes grades of kerosene called range oil having properties similar to Number 1 fuel oil, but with a gravity of about 43 degrees API and an end point of 625 degrees Fahrenheit. Used in space heaters, cooking stoves, and water heaters.

Kerosene-type jet fuel - See *Jet fuel*.

Large car - See *Automobile size classifications*.

Lease Condensate - A liquid recovered from natural gas at the well or at small gas/oil separators in the field. Consists primarily of pentanes and heavier hydrocarbons (also called field condensate).

Light duty vehicles - Automobiles and light trucks combined.

Light truck - Unless otherwise noted, light trucks are defined in this publication as two-axle, four-tire trucks. The U.S. Bureau of Census classifies all trucks with a gross vehicle weight less than 10,000 pounds as light trucks (See *Truck size classifications*).

Light-heavy truck - See *Truck size classifications*.

Liquefied petroleum gas (lpg) - Consists of propane and butane and is usually derived from natural gas. In locations where there is no natural gas and the gasoline consumption is low, naphtha is converted to lpg by catalytic reforming.

Load factor - A term relating the potential capacity of a system relative to its actual performance. Is often calculated as total passenger miles divided by total vehicle miles.

Low-emission vehicle - A clean fuel vehicle meeting the low-emission vehicle standards.

Medium truck - See *Truck size classifications*.

Methanol (CH₃OH) - A colorless poisonous liquid with essentially no odor and very little taste. It is the simplest alcohol and boils at 64.7 degrees Celsius. In transportation, methanol is used as a vehicle fuel by itself (M100), or blended with gasoline (M85).

Midsize car - See *Automobile size classifications*.

Minicompact car - See *Automobile size classifications*.

Model year - In this publication, model year is referring to the "sales" model year, the period from October 1 to the next September 31.

Motor bus - See *Bus*.

Motor Gasoline - A mixture of volatile hydrocarbons suitable for operation of an internal combustion engine whose major components are hydrocarbons with boiling points ranging from 78 to 217 degrees centigrade and whose source is distillation of petroleum and cracking, polymerization, and other chemical reactions by which the naturally occurring petroleum hydrocarbons are converted into those that have superior fuel properties.

Naphtha-type jet fuel - See *Jet fuel*.

National income - See *Income*.

Nationwide Personal Transportation Study (NPTS) - A nationwide home interview survey of households that provides information on the characteristics and personal travel patterns of the U.S. population. Surveys were conducted in 1969, 1977, 1983 and 1990 by the U.S. Bureau of Census for the U.S. Department of Transportation.

Natural gas - A mixture of hydrocarbon compounds and small quantities of various non-hydrocarbons existing in the gaseous phase or in solution with crude oil in natural underground reservoirs at reservoir conditions.

Natural Gas Plant Liquids - Products obtained from processing natural gas at natural gas processing plants, including natural gasoline plants, cycling plants, and fractionators. Products obtained include ethane, liquefied petroleum gases, (propanes, butane, propane-butane mixtures, and ethane-propane mixtures), isopentane, natural gasoline, unfractionated streams, plant condensate, and other minor quantities of finished products, such as motor gasoline, special naphthas, jet fuel, kerosene, and distillate fuel oil.

Nitrogen Oxides (NO_x) - A product of combustion of fossil fuels whose production increases with the temperature of the process. It can become an air pollutant if concentrations are excessive.

Oil Stocks - Oil stocks include crude oil (including strategic reserves), unfinished oils, natural gas plant liquids, and refined petroleum products.

Operating cost -

Fixed operating cost: In reference to passenger car operating cost, refers to those expenditures that are independent of the amount of use of the car, such as insurance costs, fees for license and registration, depreciation and finance charges.

Variable operating cost: In reference to passenger car operating cost, expenditures which are dependent on the amount of use of the car, such as the cost of gas and oil, tires, and other maintenance.

Organization for Economic Cooperation and Development (OECD) - Consists of Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, South Korea, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States. Total OECD includes the United States Territories (Guam, Puerto Rico, and the U.S. Virgin Islands). Total OECD excludes data for Czech Republic, Hungary, Mexico, Poland, and South Korea which are not yet available.

OECD Europe: Consists of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Turkey, and United Kingdom. OECD Europe excludes data for Czech Republic, Hungary, and Poland which are not yet available.

OECD Pacific: Consists of Australia, Japan, and New Zealand.

Organization for Petroleum Exporting Countries (OPEC) - Includes Saudi Arabia, Iran, Venezuela, Libya, Indonesia, United Arab Emirates, Algeria, Nigeria, Ecuador, Gabon, Iraq, Kuwait, and Qatar. Data for Saudi Arabia and Kuwait include their shares from the Partitioned Zone (formerly the Neutral Zone).

Arab OPEC - Consists of Algeria, Iraq, Kuwait, Libya, Qatar, Saudi Arabia and the United Arab Emirates.

Other single-unit truck - See *Single-unit truck*.

Oxygenate - A substance which, when added to gasoline, increases the amount of oxygen in that gasoline blend. Includes fuel ethanol, methanol, and methyl tertiary butyl ether (MTBE).

Particulates - Carbon particles formed by partial oxidation and reduction of the hydrocarbon fuel. Also included are trace quantities of metal oxides and nitrides, originating from engine wear, component degradation, and inorganic fuel additives. In the transportation sector, particulates are emitted mainly from diesel engines.

Passenger-miles traveled (PMT) - One person traveling the distance of one mile. Total passenger-miles traveled, thus, give the total mileage traveled by all persons.

Passenger rail - See *Rail, "Amtrak" and "Transit Railroad"*.

Persian Gulf countries: Consists of Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Emirates.

Personal Consumption Expenditures (PCE) - As used in the national accounts, the market value of purchases of goods and services by individuals and nonprofit institutions and the value of food, clothing, housing, and financial services received by them as income in kind. It includes the rental value of owner-occupied houses but excludes purchases of dwellings, which are classified as capital goods (investment).

Personal income - See *Income*.

Petroleum - A generic term applied to oil and oil products in all forms, such as crude oil, lease condensate, unfinished oil, refined petroleum products, natural gas plant liquids, and non-hydrocarbon compounds blended into finished petroleum products.

Petroleum consumption: A calculated demand for petroleum products obtained by summing domestic production, imports of crude petroleum and natural gas liquids, imports of petroleum products, and the primary stocks at the beginning of the period and then subtracting the exports and the primary stocks at the end of the period.

Petroleum exports: Shipments of petroleum products from the 50 States and the District of Columbia to foreign countries, Puerto Rico, the Virgin Islands, and other U.S. possessions and territories.

Petroleum imports: All imports of crude petroleum, natural gas liquids, and petroleum products from foreign countries and receipts from Guam, Puerto Rico, the Virgin Islands, and the Hawaiian Trade Zone. The commodities included are crude oil, unfinished oils, plant condensate, and refined petroleum products.

Petroleum inventories: The amounts of crude oil, unfinished oil, petroleum products, and natural gas liquids held at refineries, at natural gas processing plants, in pipelines, at bulk terminals operated by refining and pipeline companies, and at independent bulk terminals. Crude oil held in storage on leases is also included; these stocks are known as primary stocks. Secondary stocks - those held by jobbers, dealers, service station operators, and consumers - are excluded. Prior to 1975, stock held at independent bulk terminals were classified as secondary stocks.

Petroleum products supplied: For each petroleum product, the amount supplied is calculated by summing production, crude oil burned directly, imports, and net withdrawals from primary stocks and subtracting exports.

Processing Gain - The amount by which the total volume of refinery output is greater than the volume of input for given period of time. The processing gain arises when crude oil and other hydrocarbons are processed into products that are, on average, less dense than the input.

Processing Loss - The amount by which the total volume of refinery output is less than the volume of input for given period of time. The processing loss arises when crude oil and other hydrocarbons are processed into products that are, on average, more dense than the input.

Proved Reserves of Crude Oil - The estimated quantities of all liquids defined as crude oil, which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions.

Quad - Quadrillion, 10^{15} . In this publication, a Quad refers to Quadrillion Btu.

Rail -

Amtrak (American Railroad Tracks): Operated by the National Railroad Passenger Corporation of Washington, DC. This rail system was created by President Nixon in 1970, and was given the responsibility for the operation of intercity, as distinct from suburban, passenger trains between points designated by the Secretary of Transportation.

Class I freight railroad: Defined by the Interstate Commerce Commission each year based on annual operating revenue. A railroad is dropped from the Class I list if it fails to meet the annual earnings threshold for three consecutive years.

Commuter railroad: Those portions of mainline railroad (not electric railway) transportation operations which encompass urban passenger train service for local travel between a central city and adjacent suburbs. Commuter railroad service - using both locomotive-hauled and self-propelled railroad passenger cars - is characterized by multi-trip tickets, specific station-to-station fares, and usually only one or two stations in the central business district. Also known as suburban railroad.

Transit railroad: Includes "heavy" and "light" transit rail. **Heavy transit rail** is characterized by exclusive rights-of-way, multi-car trains, high speed rapid acceleration, sophisticated signaling, and high platform loading. Also known as subway, elevated railway, or metropolitan railway (metro). **Light transit rail** may be on exclusive or shared rights-of-way, high or low platform loading, multi-car trains or single cars, automated or manually operated. In generic usage, light rail includes streetcars, trolley cars, and tramways.

Residential and Commercial sector - Consists of housing units, non-manufacturing business establishments (e.g., wholesale and retail businesses), health and educational institutions, and government offices.

Residential Transportation Energy Consumption Survey (RTECS) - This survey was designed by the Energy Information Administration of the Department of Energy to provide information on how energy is used by households for personal vehicles. It has been conducted five times since 1979, the most recent being 1991.

Residual fuel oil - The heavier oils that remain after the distillate fuel oils and lighter hydrocarbons are boiled off in refinery operations. Included are products known as ASTM grade numbers 5 and 6 oil, heavy diesel oil, Navy Special Fuel Oil, Bunker C oil, and acid sludge and pitch used as refinery fuels. Residual fuel oil is used for the production of electric power, for heating, and for various industrial purposes.

Rural - Usually refers to areas with population less than 5,000.

Sales period - October 1 of the previous year to September 30 of the given year. Approximately the same as a model year.

Sales-weighted miles per gallon (mpg) - Calculation of a composite vehicle fuel economy based on the distribution of vehicle sales.

Scrapage rate - As applied to motor vehicles, it is usually expressed as the percentage of vehicles of a certain type in a given age class that are retired from use (lacking registration) in a given year.

School and other nonrevenue bus - See *Bus*.

Single unit truck - Includes two-axle, four-tire trucks and other single unit trucks.

Two-axle, four tire truck: A motor vehicle consisting primarily of a single motorized device with two axles and four tires.

Other single-unit truck: A motor vehicle consisting primarily of a single motorized device with more than two axles or more than four tires.

Special fuels - Consist primarily of diesel fuel with small amount of liquified petroleum gas, as defined by the Federal Highway Administration.

Specific acceleration power - Measured in watts per kilogram. Acceleration power divided by the battery system weight. Weight must include the total battery system.

Specific energy - Measured in watt hours per kilogram. The rated energy capacity of the battery divided by the total battery system weight.

Subcompact car - See *Automobile size classifications*.

Supplemental air carrier - See *Air carrier*.

Test weight - The weight setting at which a vehicle is tested on a dynamometer by the U.S. Environmental Protection Agency (EPA). This weight is determined by the EPA using the inertia weight of the vehicle.

Ton-mile - The movement of one ton of freight the distance of one mile. Ton-miles are computed by multiplying the weight in tons of each shipment transported by the distance hauled.

Transmission types -

A3 - Automatic three speed

A4 - Automatic four speed

A5 - Automatic five speed

L4 - Automatic lockup four speed

M5 - Manual five speed

Transit bus - See *Bus*.

Transit railroad - See *Rail*.

Transportation sector - Consists of both private and public passenger and freight transportation, as well as government transportation, including military operations.

Truck Inventory and Use Survey (TIUS) - Survey designed to collect data on the characteristics and operational use of the nation's truck population. It is conducted every five years by the U.S. Bureau of the Census. Surveys were conducted in 1963, 1967, 1972, 1977, 1982, 1987, and 1992. The 1992 data have not yet been released.

Trolley coach - See *Bus*.

Truck size classifications - U.S. Bureau of the Census has categorized trucks by gross vehicle weight (gvw) as follows:

Light - Less than 10,000 pounds gvw (Also see *Light Truck*.)

Medium - 10,001 to 20,000 pounds gvw

Light-heavy - 20,001 to 26,000 pounds gvw

Heavy-heavy - 26,001 pounds gvw or more.

Two-axle, four-tire truck - See *Single-unit truck*.

Two seater car - See *Automobile size classifications*.

Ultra-low emission vehicle - A clean fuel vehicle meeting the more stringent Ultra-low emission standards.

Urban - Usually refers to areas with population of 5,000 or greater.

Variable operating cost - See *Operating cost*.

Vehicle-miles traveled (vmt) - One vehicle traveling the distance of one mile. Total vehicle miles, thus, is the total mileage traveled by all vehicles.

Zero-emission vehicle - A clean fuel vehicle meeting even more stringent zero-emission vehicle standards.

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