Table 2.2
United States Petroleum Production and Consumption, 1970-92
(million barrels per day)

Year	Domestic crude oil production	Gross imports			U.S. petroleum consumption[a]	World petroleum consumption	Imports as a percentage of U.S. petroleum consumption	Petroleum products as a percentage of gross imports	U.S. petroleum consumption as a percentage of world consumption	Transportation petroleum use as a percentage of domestic production[b]
		Crude oil	Petroleum products	Total						
1970	9.64	1.32	2.10	3.42	14.70	46.38	23.3	61.4	31.7	[c]
1971	9.46	1.68	2.25	3.93	15.21	50.00	25.8	57.3	30.4	[c]
1972	9.44	2.22	2.53	4.75	16.37	52.42	29.0	53.3	31.2	[c]
1973	9.21	3.24	3.01	6.25	17.31	56.39	36.1	48.2	30.7	91.5
1974	8.77	3.48	2.64	6.12	16.65	55.91	36.8	43.1	29.8	93.7
1975	8.37	4.10	1.95	6.05	16.32	55.48	37.1	32.2	29.4	99.4
1976	8.13	5.29	2.03	7.32	17.46	58.74	41.9	27.7	29.7	107.6
1977	8.25	6.61	2.19	8.80	18.43	61.63	47.7	24.9	29.9	110.2
1978	8.71	6.36	2.01	8.37	18.85	63.30	44.4	24.0	29.8	108.7
1979	8.55	6.52	1.94	8.46	18.51	65.17	45.7	22.9	28.4	109.6
1980	8.60	5.26	1.65	6.91	17.06	63.07	40.5	23.9	27.0	104.4
1981	8.57	4.40	1.60	6.00	16.06	60.87	37.4	26.7	26.4	103.7
1982	8.65	3.49	1.63	5.12	15.30	59.50	33.5	31.8	25.7	100.6
1983	8.69	3.33	1.72	5.05	15.23	58.74	33.2	34.1	25.9	101.1
1984	8.88	3.43	2.01	5.44	15.73	59.84	34.6	36.9	26.3	102.3
1985	8.97	3.20	1.87	5.07	15.73	60.10	32.2	36.9	26.2	102.6
1986	8.68	4.18	2.05	6.23	16.28	61.76	38.3	32.9	26.4	110.3
1987	8.35	4.67	2.00	6.68	16.67	63.01	40.0	30.0	26.5	118.1
1988	8.14	5.11	2.30	7.40	17.28	64.83	42.8	31.1	26.7	125.4
1989	7.61	5.84	2.22	8.06	17.33	66.03	46.5	27.5	26.2	135.7
1990	7.36	5.89	2.12	8.02	16.99	66.16	47.2	26.4	25.7	140.0
1991	7.42	5.78	1.84	7.63	16.71	66.60	45.7	24.1	25.5	136.6
1992	7.15	6.05	1.79	7.84	17.01	[c]	46.1	22.8	[c]	143.9
					Average annual percentage change					
1970-92	-1.3%	7.2%	-0.7%	3.8%	0.7%	1.7%[d]				
1982-92	-1.9%	5.7%	0.9%	4.4%	1.1%	1.3%[d]				

Sources:

U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1993, pp. 40-41.

World petroleum consumption - U.S. Department of Energy, Energy Information Administration, International Energy Annual 1991, December 1992, p. 24.

[a]Best estimate for U.S. petroleum consumption is the amount of petroleum products supplied to the U.S. in a given year.

[b]Transportation petroleum use can be found on Table 2.3.

[c]Data are not available.

[d]Average annual percentage change for years 1970-91 and 1982-91.

Table 2.16
Retail Prices for Motor Fuel, 1978-92
(cents per gallon, including tax)

Year	Diesel Fuel [a]		Unleaded regular gasoline [b]		Unleaded premium gasoline [b]		Average for all gasoline types [b]	
	Current	Constant 1990[c]	Current	Constant 1990[c]	Current	Constant 1990[c]	Current	Constant 1990[c]
1978	[d]	[d]	67.0	134.2	[d]	[d]	65.2	130.6
1979	[d]	[d]	90.3	162.6	[d]	[d]	88.2	158.8
1980	101.0	160.2	124.5	197.4	[d]	[d]	122.1	193.6
1981	118.0	169.5	137.8	198.0	147.0	211.2	135.3	194.4
1982	116.0	157.0	129.6	175.5	141.5	191.6	128.1	173.4
1983	120.0	157.4	124.1	162.8	138.3	181.4	122.5	160.7
1984	122.0	153.5	121.2	152.5	136.6	171.9	119.8	150.7
1985	122.0	148.2	120.2	146.0	134.0	162.8	119.6	145.3
1986	94.0	112.0	92.7	110.5	108.5	129.3	93.1	111.0
1987	96.0	110.4	94.8	109.0	109.3	125.7	95.7	110.0
1988	95.0	104.9	94.6	104.5	110.7	122.3	96.3	106.4
1989	102.0	107.5	102.1	107.6	119.7	126.2	106.0	111.7
1990	99.0	99.0	116.4	116.4	134.9	134.9	121.7	121.7
1991	91.0	87.3	114.0	109.3	132.1	126.7	119.6	114.7
1992	106.0	98.7	112.7	104.9	131.6	122.5	119.0	110.8
			Average annual percentage change					
1978-92	0.4% [e]	-4.0% [e]	3.8%	-1.7%	-1.0% [f]	-4.8% [f]	4.4%	-1.2%
1982-92	-0.9%	-4.5%	-1.4%	-5.0%	-0.7%	4.4%-	-0.7%	-4.4%

Sources:
Gasoline - U.S. Department of Energy, Energy Information Administration, Monthly Energy Review March 1993, Washington, DC, Table 9.4, p. 108.
Diesel - U.S. Department of Energy, Energy Information Administration, International Energy Annual 1991, Washington, DC, December 1992, pp. 153.

[a]Collected from a survey of prices on January 1 of the current year.

[b]These prices were collected from a sample of service stations in 85 urban areas selected to represent all urban consumers. Urban consumers make up about 80% of the total U.S. population.

[c]Adjusted by the Consumer Price Inflation Index.

[d]Data are not available.

[e]Average annual percentage change is for years 1980-92.

[f]Average annual percentage change is for years 1981-92.

*The fuel prices shown here are **refiner sales prices** of transportation fuels to end users, excluding tax. Sales to end users are those made directly to the ultimate consumer, including bulk consumers. Bulk sales to utility, industrial, and commercial accounts previously included in the wholesale category are now counted as sales to end users.*

Table 2.17
Prices for Selected Transportation Fuels, 1978-92
(cents per gallon, excluding tax)

	Propane[a]		Finished Aviation gasoline		Kerosene-type jet fuel		Diesel fuel oil[b]	
Year	Current	Constant 1990[c]	Current	Constant 1990[c]	Current	Constant 1990[c]	Current	Constant 1990[c]
1978	33.5	67.1	51.6	103.4	38.7	77.5	37.9	75.9
1979	35.7	64.3	68.9	124.0	54.7	98.5	57.6	103.7
1980	48.2	76.4	108.4	171.9	86.6	137.3	83.0	131.6
1981	56.5	81.2	130.3	187.2	102.4	147.1	100.2	144.0
1982	59.2	80.1	131.2	177.6	96.3	130.4	95.4	129.2
1983	70.9	93.0	125.5	164.6	87.8	115.2	83.1	109.0
1984	73.7	92.7	123.4	155.3	84.2	105.9	82.6	103.9
1985	71.7	87.1	120.1	145.9	79.6	96.7	78.3	95.1
1986	74.5	88.8	101.1	120.5	52.9	63.0	49.2	58.6
1987	70.1	80.6	90.7	104.3	54.3	62.4	53.8	61.9
1988	71.4	78.9	89.1	98.4	51.3	56.7	49.2	54.4
1989	61.5	64.8	99.5	104.9	59.2	62.4	56.3	59.3
1990	74.5	74.5	112.0	112.0	76.6	76.6	69.2	69.2
1991	73.0	70.0	104.7	100.4	65.2	62.6	67.2	64.4
1992	66.2	61.6	102.7	95.6	61.0	58.3	[d]	[d]
				Average annual percentage change				
1978-92	5.0%	-0.6%	5.0%	-0.6%	3.3%	-2.0%	4.5%[e]	-1.3%
1982-92	1.0%	-2.6%	-2.4%	-6.0%	-4.5%	-7.7%	-3.8%[e]	-7.4%

Sources:
U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, March 1992, Washington, DC, Table 9.7, p. 113.
Diesel fuel oil - Association of American Railroads, Railroad Facts, 1991 edition, Washington, DC, September 1991, p. 60.

[a]Consumer grade.
[b]Wholesale cost.
[c]Adjusted by the Consumer Price Inflation Index.
[d]Data are not available.
[e]Average annual percentage change is for years 1978-91 and 1982-91.

The total cost of operating an automobile is the sum of the fixed cost (depreciation, insurance, finance charge, and license fee) and the variable cost, which is related to the amount of travel. The cost of operating a car in 1992 was approximately 43 cents per mile. From 1985 to 1992 the fixed costs have risen an average of 5.6% per year while the variable costs have declined at an average annual rate of 2.0%.

Table 2.23
Automobile Operating Costs, 1975-92

Year[c]	Variable costs (Constant 1990 cents per mile[a])				Constant 1990 dollars per 10,000 miles[a]			Total cost per mile[b] (Constant 1990 cents[a])
	Gas and oil	Percentage gas and oil of total cost	Maintenance	Tires	Variable cost	Fixed cost	Total cost	
1975	11.70	26.3%	2.36	1.60	1,566	2,880	4,446	44.46
1977	8.86	20.3%	2.22	1.42	1,251	3,103	4,354	43.54
1979	7.40	17.1%	1.98	1.17	1,055	3,260	4,315	43.15
1980	9.29	21.0%	1.78	1.01	1,208	3,224	4,433	44.33
1981	9.01	19.6%	1.70	1.03	1,174	3,413	4,586	45.86
1982	9.12	21.5%	1.35	0.97	1,133	3,145	4,243	42.43
1983	8.71	19.9%	1.36	0.89	1,097	3,287	4,384	43.84
1984	7.79	19.8%	1.31	0.79	989	2,952	3,940	39.40
1985	7.48	22.6%	1.49	0.79	977	2,328[d]	3,304[d]	33.04[d]
1986	5.34	15.1%	1.63	0.80	777	2,750[d]	3,577[d]	35.27[d]
1987	5.52	14.7%	1.84	0.92	828	2,925[d]	3,753[d]	37.53[d]
1988	5.74	15.6%	1.77	0.88	840	2,851[d]	3,691[d]	36.91[d]
1989	5.48	13.6%	2.00	0.84	833	3,194[d]	4,027[d]	40.27[d]
1990	5.40	13.2%	2.10	0.90	840	3,256[d]	4,096[d]	40.96[d]
1991	6.43	15.4%	2.11	0.86	940	3,245[d]	4,185[d]	41.85[d]
1992	5.59	13.1%	2.05	0.84	847	3,414[d]	4,261[d]	42.61[d]
				Average annual percentage change				
1975-84	-4.4%		-6.3%	-7.5%	-5.0%	0.3%	-1.3%	-1.3%
1985-92	-4.1%		4.7%	0.9%	-2.0%	5.6%	3.7%	3.7%

Source:
American Automobile Association, "Your Driving Costs," 1993 Edition, Falls Church, VA, and annual.

[a]Adjusted by the Consumer Price Inflation Index.
[b]Based on 10,000 miles per year.
[c]Data for 1976 and 1978 are not available.
[d]Fixed and total operating costs preceeding 1985 are not comparable with figures after 1985. Fixed cost depreciation from 1975-84 was based on four years or 60,000 miles. After 1984, the depreciation was based on six years or 60,000 miles.

Table 3.28
Automobile Fleets by Use, 1970-92
(thousands)

Year	Cars in fleets of 10 or more								Cars in fleets of 4 or more
	Business fleets[a]	Individual leased	Government[b]	Utilities	Police	Taxi	Daily rental	Total cars	
1970	2,529	803	674	416	207	171	314	5,114	9,992
1971	2,573	834	695	421	218	174	319	5,234	10,070
1972	2,664	925	670	438	236	177	341	5,451	10,094
1973	2,890	974	686	467	249	182	364	5,812	10,214
1974	2,928	1,008	701	482	261	185	361	5,926	10,324
1975	2,934	1,072	715	497	278	193	354	6,043	10,398
1976	3,066	1,217	727	508	286	202	373	6,379	10,403
1977	3,093	1,385	735	518	292	202	385	6,610	10,414
1978	3,148	1,610	747	523	294	205	448	6,975	10,423
1979	3,195	1,690	752	529	291	207	462	7,126	10,428
1980	3,279	1,708	752	532	288	205	500	7,264	10,433
1981	3,306	1,713	757	537	284	198	462	7,257	10,436
1982	3,324	1,645	603	530	223	141	457	6,923	10,076
1983	3,383	1,653	606	533	221	139	466	7,001	10,400
1984	3,422	1,657	638	540	228	140	755[c]	7,380	10,475
1985	3,484	1,800	643	540	233	140	760	7,600	10,508
1986	3,530	1,975	647	545	238	143	790	7,868	10,560
1987	3,564	2,098	650	550	240	144	800	8,046	10,578
1988	3,689	2,160	658	553	242	144	870	8,314	10,597
1989	3,787	2,140	658	553	244	144	907	8,431	10,592
1990	3,823	2,020	657	551	249	141	990	8,427	10,607
1991	3,466	2,008	617	544	250	141	1,160	8,188	10,514
1992	3,460	2,126	629[d]	548	264	140	1,448	8,502	10,468
				Average annual percentage change					
1970-92	1.4%	4.5%	0.4%	1.3%	1.1%	-0.9%	7.2%[e]	2.3%	0.2%
1982-92	0.4%	2.6%	-0.3%	0.3%	1.7%	-0.1%	12.2%[e]	2.1%	0.4%

Source:
Bobit Publishing Company, Automotive Fleet Research Department, 1993 Automotive Fleet Fact Book, Redondo Beach, CA, 1993, pp. 15, 20, and annual.

[a]Includes driver schools.

[b]Data from Automotive Fleet Fact Book does not include all Federal Government fleet vehicles. Federal fleet data are added from Federal Motor Vehicle Fleet Report, General Services Administration, Table 1 (all agencies - domestic sedans and station wagons).

[c]Major adjustment by Automotive Fleet Fact Book with new data for 1984. Daily rentals were underestimated from 1970 to 1983.

[d]Federal government data for 1992 are not available; therefore, the data are assumed to be equal to the 1991 federal government figures.

[e]Average annual percentage change is misleading due to the data change in daily rentals in 1984.

Although sedans comprised only 20% of the vehicles in large domestic federal fleets in 1991, they accounted for 33% of the miles driven. Sedans were driven on average nearly twice as much as trucks were in 1991.

Table 3.30
Operating and Cost Data for Large Domestic Federal Fleets, 1986-91[a]

Year	Number of Vehicles	Miles Operated (thousands)	Average Annual Miles per Vehicle	Fleet Average Cost per Mile (dollars)
		Sedans		
1986	86,069	1,130,843	13,139	0.21
1987	89,894	1,069,124	11,893	0.20
1988	85,928	1,119,343	13,027	0.19
1989	90,254	1,170,370	12,968	0.20
1990	93,510	1,226,674	13,118	0.22
1991	98,259	1,297,651	13,206	0.23
		Trucks		
1986	292,256	2,095,079	7,168	0.43
1987	303,275	2,195,017	8,238	0.45
1988	316,443	2,242,075	7,085	0.44
1989	336,617	2,292,593	6,811	0.43
1990	354,392	2,423,131	6,837	0.44
1991	266,471	2,498,190	6,818	0.45
		All Vehicles[b]		
1986	403,855	3,477,730	8,611	0.36
1987	414,575	3,461,332	8,349	0.37
1988	424,286	3,576,421	8,429	0.36
1989	448,836	3,681,314	8,202	0.35
1990	467,678	3,855,984	8,245	0.38
1991	484,552	3,984,175	8,222	0.38

Source:
U.S. General Services Administrations, Federal Supply Service, Federal Motor Fleet Report, Washington, DC, 1993, p. 26.

[a]Agencies or bureaus with 2,000 or more vehicles.
[b]Includes sedans, station wagons, ambulances, buses and all trucks.

Except for the automobile fuel economy in model year 1984, the sales-weighted fuel economies of automobiles and light trucks have, on average, met the fuel economy standards set by the federal government. This does not mean, however, that each manufacturer is meeting the standards each year. Some manufacturers still fall short, while others exceed the standards. The domestic automobile CAFE estimate did not meet the 1992 standard, but the import estimate exceeded the standard, pulling the combined automobile CAFE estimate above the standard.

Table 3.35
Corporate Average Fuel Economy (CAFE)
Standards versus Sales-Weighted Fuel Economy Estimates
for Automobiles and Light Trucks, 1978-93[a]
(miles per gallon)

	Automobiles				Light Trucks[b]			
Model	CAFE	CAFE Estimates[c]			CAFE	CAFE Estimates[c]		
Year	Standards	Domestic	Import	Combined	Standards	Domestic	Import	Combined
1978	18.0	18.7	27.3	19.9	[d]	[e]	[e]	[e]
1979	19.0	19.3	26.1	20.3	17.2	17.7	20.8	18.2
1980	20.0	22.6	29.6	24.3	[d]	16.8	24.3	18.5
1981	22.0	24.2	31.5	25.9	[d]	18.3	27.4	20.1
1982	24.0	25.0	31.1	26.6	17.5	19.2	27.0	20.5
1983	26.0	24.4	32.4	26.4	19.0	19.6	27.1	20.7
1984	27.0	25.5	32.0	26.9	20.0	19.3	26.7	20.6
1985	27.5	26.3	31.5	27.6	19.5	19.6	26.5	20.7
1986	26.0	26.9	31.6	28.2	20.0	19.9	25.9	21.5
1987	26.0	27.0	31.2	28.5	20.5	20.5	25.2	21.7
1988	26.0	27.4	31.5	28.8	20.5	20.6	24.6	21.3
1989	26.5	27.2	30.8	28.4	20.5	20.4	23.5	20.9
1990	27.5	26.9	29.9	28.0	20.0	20.3	23.0	20.7
1991	27.5	27.3	30.0	28.3	20.2	20.9	23.0	21.3
1992	27.5	27.1	29.1	27.9	20.2	20.5	22.4	20.8
1993	27.5	27.7	29.5	28.3	20.2	20.4	22.6	20.8

Source:
U.S. Department of Transportation, NHTSA, "Summary of Fuel Economy Performance," Washington, DC, September 1993.

[a]Only vehicles with at least 75 percent domestic content can be counted in the average domestic fuel economy for a manufacturer.

[b]Represents two- and four-wheel drive trucks combined. Gross vehicle weight of 0-6,000 pounds for model year 1979 and 0-8,500 pounds for subsequent years.

[c]All CAFE calculations are sales-weighted.

[d]Standards were set for two-wheel drive and four-wheel drive light trucks separately, but no combined standard was set in this year.

[e]Data are not available.

Table 3.36
Corporate Average Fuel Economy (CAFE) Fines Collected, 1983-92
(Thousands)

Model year	Current dollars	1990 constant dollars[a]
1983	58	76
1984	5,958	7,496
1985	15,565	18,908
1986	29,872	35,603
1987	31,261	35,945
1988	44,519	49,181
1989	47,381	49,946
1990	48,449	48,449
1991	39,178	37,572
1992[b]	525	489
Total	262,766	283,663

Source:
U.S. Department of Transportation, National Highway Traffic Safety Administration, Office of Vehicle Safety Compliance, Washington, DC, October 1993.

Table 3.37
Tax Receipts from the Sale of Gas Guzzlers, 1980-92
(Thousands)

Fiscal year	Current dollars	1990 constant dollars[a]
1980	740	1,174
1981	780	1,121
1982	1,720	2,329
1983	4,020	5,273
1984	8,820	11,097
1985	39,790	48,336
1986	147,660	175,987
1987	145,900	167,759
1988	116,780	129,008
1989	109,640	115,575
1990	103,200	103,200
1991	118,400	113,546
1992	144,200	134,250
Total	941,650	1,008,654

Source:
Motor Vehicle Manufacturers Association, Motor Vehicle Facts and Figures '93, Detroit, MI, 1993, p. 87.

[a]Adjusted using the Consumer Price Inflation Index.
[b]Includes only those fines collected through October 1993.

Table 4.1
Population and Vehicle Profile, 1950-92

Year	Resident population[a] (thousands)	Total households (thousands)	Number of vehicles in operation (thousands)	Number of licensed drivers (thousands)	Number of civilian employed persons (thousands)	Vehicles per capita	Vehicle miles per capita	Licensed drivers per household	Vehicles per licensed driver	Vehicles per civilian employed persons
1950	151,271	43,554	43,256	62,194	58,918	0.29	3,029	1.43	0.70	0.73
1955	165,069	47,874	55,804	74,686	62,170	0.34	3,656	1.56	0.75	0.90
1960	179,979	52,799	66,582	87,253	65,778	0.36	3,994	1.65	0.76	1.01
1965	193,526	57,251	82,067	98,502	71,088	0.42	4,587	1.72	0.83	1.15
1970	203,984	63,401	98,136	111,543	78,678	0.48	5,440	1.76	0.88	1.25
1975	215,465	71,120	120,054	129,791	85,846	0.56	6,162	1.82	0.92	1.40
1980	227,225	80,776	139,832	145,295	99,303	0.62	6,722	1.80	0.96	1.41
1981	229,466	82,368	141,908	147,075	100,397	0.62	6,767	1.79	0.96	1.41
1982	231,664	83,527	143,854	150,234	99,526	0.62	6,885	1.80	0.96	1.45
1983	233,792	83,918	147,104	154,389	100,834	0.63	7,069	1.83	0.95	1.46
1984	235,825	85,407	152,162	155,424	105,005	0.65	7,295	1.82	0.98	1.45
1985	237,924	86,789	157,048	156,868	107,150	0.66	7,457	1.81	1.00	1.47
1986	240,133	88,458	162,094	159,487	109,597	0.68	7,655	1.80	1.02	1.48
1987	242,289	89,479	167,193	161,975	112,440	0.69	7,929	1.81	1.03	1.49
1988	244,499	91,061	171,741	162,853	114,968	0.70	8,286	1.79	1.05	1.49
1989	246,819	92,830	175,960	165,555	117,342	0.71	8,494	1.78	1.06	1.50
1990	249,391	93,347	179,299	167,015	117,914	0.72	8,598	1.79	1.07	1.52
1991	252,160	94,312	181,438	168,995	116,877	0.72	8,614	1.79	1.07	1.55
1992	255,082	95,669	181,519	173,125	117,598	0.71	8,781	1.81	1.05	1.54
					Average annual percentage change					
1950-92	1.3%	1.9%	3.5%	2.5%	1.7%	2.2%	2.6%	0.6%	1.0%	1.8%
1970-92	1.0%	1.9%	2.8%	2.0%	1.8%	1.8%	2.2%	0.1%	0.8%	1.0%
1982-92	1.0%	1.4%	2.4%	1.4%	1.7%	1.4%	2.5%	0.1%	0.9%	0.6%

Sources:

Resident population, total households, and civilian employed persons - U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States, 113th edition, 1993, Washington, DC, pp. 8, 55, 395, and annual.

Vehicles in operation - R. L. Polk and Company. **FURTHER REPRODUCTION PROHIBITED.**

Licensed drivers and vehicle miles - U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1992, Table DL-1, and annual.

[a]Estimates as of July 1. Includes Armed Forces stationed in the United States.

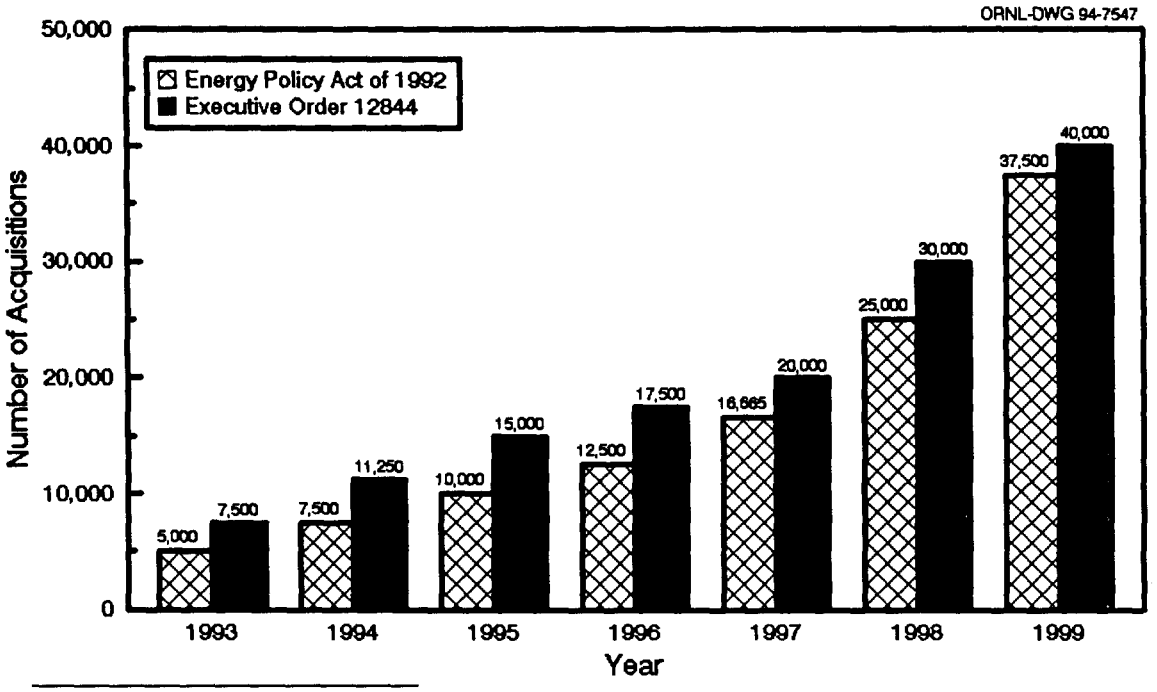
Although the Energy Policy Act of 1992 (EPAct) set alternative fuel vehicle purchase requirements for Federal and State Governments, fuel providers and the private sector, the Federal fleet requirements have since been increased by Executive Order 12844. A comparison of the two requirements is shown in the graph below.

Table 5.6
Energy Policy Act Purchase Requirements of Light-Duty Alternative Fuel Vehicles

Year	Federal	State	Fuel providers	Private[a]
1993	5,000	-	-	-
1994	7,500	-	-	-
1995	10,000	-	-	-
1996	25%	10%	30%	-
1997	33%	15%	50%	-
1998	50%	25%	70%	-
1999	75%	50%	90%	20%
2000	75%	75%	90%	20%
2001	75%	75%	90%	20%
2002	75%	75%	90%	30%
2003	75%	75%	90%	40%
2004	75%	75%	90%	50%
2005	75%	75%	90%	60%
2006 on	75%	75%	90%	70%

Source:
National Alternative Fuels Hotline for Transportation Technologies, 1993.

Figure 5.1. Federal Fleet Alternative Fuel Vehicle Purchase Requirements[b]



[a]Under the early rulemaking scenario. Additional rulemaking is required by December 15, 1996 for this to take effect.

[b]Based on 50,000 vehicle acquisitions per year.

U.S. ADVANCED BATTERY CONSORTIUM

Electric vehicles are the subject of intense research and development because they are required to be sold in California in 1998 (2% rising to 10% in 2003) under the California Low-Emission Vehicle (LEV) program. Other states have indicated that they will also enforce the LEV program. One of the greatest advantages in using electric vehicles is that there are no vehicle emissions. The U.S. Advanced Battery Consortium (USABC) was established in January 1991 to concentrate efforts on battery development for future electric vehicles. The USABC consists of the Big Three U.S. auto manufacturers (Chrysler, Ford, General Motors), the Electric Power Research Institute, the electric utility industry, and the U.S. Department of Energy.

The USABC has established research contracts with several companies for the development of advanced batteries. Also, a series of Cooperative Research and Development Agreements (CRADAs) with several DOE National Laboratories have been established.

Table 5.7
U.S. Advanced Battery Consortium Research Agreements

Battery type	Organization
	Research contracts
Nickel-metal hydride	Ovonic Battery Corporation, Troy, MI
Sodium-sulfur	Silent Power GmbH, Essen, Germany
Nickel-metal hydride	Saft America, Cockeysville, MD
Lithium-iron disulfide	Saft America, Cockeysville, MD
Lithium-polymer	W. R. Grace, Boca Raton, FL
	CRADAs
Lithium-polymer	Lawrence Berkeley Laboratory, Berkeley, CA
Advanced battery thermal enclosure	National Renewable Energy Laboratory, Golden, CO
Nickel-metal hydride	Argonne National Laboratory, Argonne, IL
Sodium-sulfur	Argonne National Laboratory, Argonne, IL
Lithium-iron disulfide	Argonne National Laboratory, Argonne, IL
Sodium-beta sulfur	Argonne National Laboratory, Argonne, IL
Lithium-polymer	Sandia National Laboratory, Albuquerque, NM
Sodium-sulfur	Sandia National Laboratory, Albuquerque, NM

Source: U.S. Adanced Battery Consortium Fact Sheet.

In FY 1992 the USABC reviewed the development criteria for mid-term goals. Reassessment of these criteria, which were originally defined in early 1991, resulted in no significant changes. Concerns about the potential for advanced batteries to meet the high power requirements demanded by the automotive customer and the ability of batteries to rapidly recharge are reflected in the revised goals.

Table 5.8
Advanced Battery Technology Goals of the U.S. Advanced Battery Consortium

	Mid-term goal (1995-1998)	Long-term goal[a]
Power density W/L	250	600
Specific power (charge) W/kg (80% DoD/30 sec)	150 (200 desired)	400
Specific power (recharge) W/kg (20% DoD/10 sec)	75	
Energy density Wh/L (C/3 discharge rate)	135	300
Specific energy Wh/kg (C/3 discharge rate)	80 (100 desired)	200
Power/energy ratio	1.5-2.5	
Life (years)	5	10
Cycle life (cycles) (80% DoD)	600	1000
Power and capacity degradation (% of rated spec)	20%	20%
Ultimate price ($/kWh) (10,000 units @ 40 kWh)	<$150	<$100
Operating environment	-30 to 65° C	-40 to 85° C
Normal recharge time	<6 hours	3 to 6 hours
Fast recharge time	50% of capacity in <30 minutes	
Continuous discharge in 1 hour (no failure) energy	75% (of rated energy capacity)	75% (of rated capacity)

Note: w=watt; kg=kilogram; L=liter; DoD=depth of discharge; wh=watt-hour; kwh=kilowatt-hour

Source:
U.S. Department of Energy, Office of Transportation Technologies, Washington, DC, 1991.

[a]Competitive with today's internal combustion engine vehicles.

While properties such as Reid vapor pressure and octane number can be determined for neat oxygenates, these values do not represent their behavior in a final gasoline blend. ***Blending numbers*** *are therefore used for this purpose. The blending numbers vary by oxygenate type, concentration, and basestock composition. The blending numbers on this table are directly related to the basestock tested and should not be used out of context.*

Table 5.9
Basic Chemistry of Various Transportation Fuels

Chemical Formulae

Ethanol (Ethyl Alcohol) CH_3CH_2OH (or C_2H_5OH)
Methanol (Methyl Alcohol) CH_3OH
Ethane CH_3CH_3 (or C_2H_6)
Methane CH_4
Gasoline C_4H_{10} to $C_{12}H_X$

Physical Properties

	Ethanol	Methanol	Gasoline
Molecular Weight (MW)	46.07	32.04	[a]
Specific Gravity (60°F/60°F)	0.794	0.796	0.72-0.78
Density (lb/gal @ 60°F)	6.61	6.63	6.0-6.5
Boiling Point	78°C (173°F)	65°C (149°F)	27-225°C (80-437°F)
Reid Vapor Pressure (RVP)			
Neat (psi)	2.3	4.6	[a]
Blending number(psi)	12-27	93-98	8-15
Octane Number			
Neat	97	98	[a]
Blending number	111[b]	115[c]	84-93
Water solubility (volume % @ 70°F)	100%	100%	[d]
Latent heat of vaporization			
Btu/gal @ 60°F	2,378	3,340	900
Btu/lb @ 60°F	396	506	150
Heating Value (lower)			
Btu/lb	11,500	8,570	18,000-19,000
Btu/gal @ 60°F	76,000	56,800	109,000-119,000
Energy Release (Btu/ft^3)	94.7	94.5	95.2
Stoichiometric air/fuel weight	9.00	6.45	14.7

Source:
Tshiteya, Rene M. and Ezio N. Vermiglio, Properties of Alcohol Transportation Fuels, Alcohol Fuels Reference Work #1, prepared for the Biofuels Systems Division, U.S. Department of Energy, by Meridian Corporation, Alexandria, VA, July 1991, pp. 2-i, 2-8.

[a]Not applicable.
[b]For 10% ethanol blending with gasoline.
[c]For 5% methanol blending with gasoline.
[d]Negligible.

The warranties of most passenger vehicles sold in the United States cover up to the following fuel concentrations in gasoline: Ethanol, 10%; ETBE, 17%; Methanol, 3-5%; MTBE, up to 15%.

Table 5.10
Reid Vapor Pressure of Various Alcohol/Ether/Gasoline Blends

% of Gasoline	% of Alcohol/Ether	Blending Agent			
		Ethanol	ETBE[a]	Methanol	MTBE[b]
100	0	9.00	9.00	9.00	9.00
95	5	10.10	8.80	12.30	9.40
90	10	10.00	8.60	12.40	9.20
85	15	9.90	8.30	12.30	9.10
80	20	9.75	8.10	12.20	9.10
75	25	[c]	7.90	[c]	[c]
70	30	9.50	[c]	12.05	[c]
50	50	8.70	[c]	11.40	8.80
30	70	7.00	[c]	10.00	[c]
15	85	5.00[d]	[c]	7.90[d]	[c]
10	90	4.30	[c]	7.20	8.10
0	100	2.30	4.40	4.60	7.80

Source:
Tshiteya, Rene M. and Ezio N. Vermiglio, Properties of Alcohol Transportation Fuels, Alcohol Fuels Reference Work #1, prepared for the Biofuels Systems Division, U.S. Department of Energy, by Meridian Corporation, Alexandria, VA, July 1991, p. 4-i.

[a]Ethyl-tertiary-butyl ether.
[b]Methyl-tertiary-butyl ether.
[c]Data are not available.
[d]Estimated.

Table 5.11
U.S. Production of Methanol and Ethanol, 1978-93
(million gallons)

Year	Ethanol	MTBE[a]
1978	20	[b]
1979	40	[b]
1980	80	[b]
1981	85	122
1982	234	132
1983	443	134
1984	567	235
1985	793	302
1986	798	359
1987	825	[b]
1988	800	[b]
1989	750	[b]
1990	756	[b]
1991	875	[b]
1992	1,080	1,542
1993	1,156	2,081
Average annual percentage change		
1978-93	31.1%	[b]
1982-93	15.6%	28.5%

Sources:
1992-93 Ethanol and MTBE - U.S. Department of Energy, Energy Information Administration, *Petroleum Supply Monthly*, January 1994, Tables D.2 and D.3.
1978-90 Ethanol - Information Resources, Inc., Washington, DC, 1991.
1981-86 MTBE - EA-Mueller,Inc., Baltimore, MD, 1992.

[a]Methyl Tertiary Butyl.
[b]Data are not available.