

Chapter 6

Alternative Fuel and Advanced Technology Vehicles and Characteristics

Summary Statistics from Tables in this Chapter

Source		
Table 6.1	Alternative fuel vehicles in use, 2010	938,642
	<i>E85</i>	618,505
	<i>LPG</i>	143,037
	<i>CNG</i>	115,863
	<i>Electric</i>	57,462
	<i>LNG</i>	3,354
	<i>M85</i>	0
Table 6.6	Number of alternative fuel refuel sites, 2012	14,086
	<i>LPG</i>	2,670
	<i>CNG</i>	988
	<i>Electric</i>	7,197
	<i>Biodiesel</i>	630
	<i>Hydrogen</i>	56

Fuel type abbreviations are used throughout this chapter.

<i>B20</i>	=	<i>20% biodiesel, 80% petroleum diesel</i>
<i>CNG</i>	=	<i>compressed natural gas</i>
<i>E85</i>	=	<i>85% ethanol, 15% gasoline</i>
<i>E95</i>	=	<i>95% ethanol, 5% gasoline</i>
<i>H₂</i>	=	<i>hydrogen</i>
<i>LNG</i>	=	<i>liquefied natural gas</i>
<i>LPG</i>	=	<i>liquefied petroleum gas</i>
<i>M85</i>	=	<i>85% methanol, 15% gasoline</i>
<i>M100</i>	=	<i>100% methanol</i>



Alternative Fuels

The Energy Policy Act of 1992 defines alternative fuels and allows the U.S. Department of Energy (DOE) to add to the list of alternative fuels if the fuel is substantially nonpetroleum, yields substantial energy security benefits, and offers substantial environmental benefits. DOE currently recognizes the following as alternative fuels:

- methanol, ethanol, and other alcohols,
- blends of 85% or more of alcohol with gasoline,
- natural gas and liquid fuels domestically produced from natural gas,
- liquefied petroleum gas (propane),
- coal-derived liquid fuels,
- hydrogen,
- electricity,
- biodiesel (BIOO),
- fuels (other than alcohol) derived from biological materials,
- P-series.

Alternative Fuels & Advanced Vehicles Data Center

DOE established the Alternative Fuels Data Center (AFDC) in 1991 to support its work aimed at fulfilling the Alternative Motor Fuels Act directives. Since then, the AFDC has expanded its focus to include all advanced transportation fuels, vehicles, and technologies. It has been renamed the Alternative Fuels & Advanced Vehicles Data Center to reflect this broader scope. The AFDC is operated and managed by the National Renewable Energy Laboratory (NREL) in Golden, Colorado.

The purposes of the AFDC are:

- to gather and analyze information on the fuel consumption, emissions, operation, and durability of alternative fuel vehicles, and
- to provide unbiased, accurate information on alternative fuels and alternative fuel vehicles to government agencies, private industry, research institutions, and other interested organizations.

Much of the AFDC data can be obtained through their Web site: www.afdc.energy.gov. Several tables and graphs in this chapter contain statistics which were generated by the AFDC. Below are some links to specific areas of the AFDC Web site.

Alternative & Advanced Fuels – <http://www.afdc.energy.gov>

Alternative Fueling Station Locator – <http://www.afdc.energy.gov/afdc/locator/stations/>

Alternative & Advanced Vehicles – <http://www.afdc.energy.gov/afdc/vehicles/index.html>

Fleet Information – <http://www.afdc.energy.gov/afdc/fleets/index.html>

State & Federal Incentives & Laws – <http://www.afdc.energy.gov/afdc/laws/>

Data Analysis & Trends – <http://www.afdc.energy.gov/afdc/data/index.html>



There are over 938,000 alternative fuel vehicles in the United States, not including flex-fuel E85 vehicles which operate mainly on gasoline. The E85 vehicles in this table are those believed to be regularly fueled with E85.

Table 6.1
Estimates of Alternative Fuel Highway Vehicles in Use^a, 1995–2010

Year	LPG	CNG	LNG	M85	M100	E85 ^b	E95	Electricity ^c	Hydrogen	Total
1995	172,806	50,218	603	18,319	386	1,527	136	2,860	0	246,855
1996	175,585	60,144	663	20,265	172	4,536	361	3,280	0	265,006
1997	175,679	68,571	813	21,040	172	9,130	347	4,453	0	280,205
1998	177,183	78,782	1,172	19,648	200	12,788	14	5,243	0	295,030
1999	178,610	91,267	1,681	18,964	198	24,604	14	6,964	0	322,302
2000	181,994	100,750	2,090	10,426	0	87,570	4	11,830	0	394,664
2001	185,053	111,851	2,576	7,827	0	100,303	0	17,847	0	425,457
2002	187,680	120,839	2,708	5,873	0	120,951	0	33,047	0	471,098
2003	190,369	114,406	2,640	0	0	179,090	0	47,485	9	533,999
2004	182,864	118,532	2,717	0	0	211,800	0	49,536	43	565,492
2005	173,795	117,699	2,748	0	0	246,363	0	51,398	119	592,122
2006	164,846	116,131	2,798	0	0	297,099	0	53,526	159	634,559
2007	158,254	114,391	2,781	0	0	364,384	0	55,730	223	695,763
2008	151,049	113,973	3,101	0	0	450,327	0	56,901	313	775,664
2009	147,030	114,270	3,176	0	0	504,297	0	57,185	357	826,315
2010	143,037	115,863	3,354	0	0	618,505	0	57,462	421	938,642
<i>Average annual percentage change</i>										
1995-2010	-1.3%	5.7%	12.1%	-100.0%	-100.0%	49.2%	-100.0%	22.1%		9.3%

Source:

U. S. Department of Energy, Energy Information Administration, *Alternatives to Traditional Transportation Fuels*, 2010, Washington, DC, May 2012, Web site www.eia.gov/renewable/afv/. 1995-2006, *Annual Energy Review*, Table 10.4. Estimated Number of Alternative-Fueled Vehicles in Use and Replacement Fuel Consumption.

^a Vehicles in Use represent accumulated acquisitions, less retirements, as of the end of each calendar year. They do not include concept and demonstration vehicles.

^b Includes only those E85 vehicles believed to be used as alternative-fuels vehicles (AFVs), primarily fleet-operated vehicles; excludes other vehicles with E85-fueling capability. In 1997, some vehicle manufacturers began including E85-fueling capability in certain model lines of vehicles. For 2007, the Energy Information Administration (EIA) estimates that the number of E85 vehicles that are capable of operating on E85, motor gasoline, or both, is about 7.1 million. Many of these AFVs are sold and used as traditional gasoline-powered vehicles.

^c Excludes HEVs.



Trolleybus, heavy rail, and light rail use nearly all alternative fuels. However, the 33.5% of buses using alternative fuels replace a lot of traditional fuel use. Rail transit vehicles have the highest average age.

Table 6.2
Alternative Fuel Transit Vehicles, 2010

Mode	Average age	Percent powered by alternative fuels	Number of vehicles
Bus	7.5	33.5%	66,239
Commuter rail	20.5	11.3%	6,927
Ferry boat	17.8	47.6%	196
Heavy rail	21.9	100.0%	11,510
Light rail	15.8	98.3%	2,104
Paratransit	3.5	8.0%	66,621
Trolleybus	8.9	100.0%	571
Vanpool	4.0	^a	12,378

Source:

American Public Transportation Association, *2012 Public Transportation Fact Book*, Washington, DC, April 2012, Appendix A. (Additional resources: www.apta.com)

Note: See Glossary for definition of modes, such as paratransit and vanpool.

^a Not available.



Table 6.3
Alternative Fuel Vehicles Available by Manufacturer, Model Year 2012

Model	Fuel	Type	Emission class
Bentley: 1-800-777-6923; www.bentleymotors.com			
Continental Supersports	E85 flex fuel	Small car	Tier 2 Bin 5
Continental GTC	E85 flex fuel	Small car	Tier 2 Bin 5
Continental Flying Spur	E85 flex fuel	Midsize	Tier 2 Bin 5
Chrysler: 1-800-999-FLEET; www.fleet.chrysler.com			
Chrysler 200S	E85 flex fuel	Sedan	Tier 2 Bin 4
Chrysler 300	E85 flex fuel	Sedan	Tier 2 Bin 5
Chrysler Town & Country	E85 flex fuel	Minivan	Tier 2 Bin 4
Dodge Avenger	E85 flex fuel	Sedan	Tier 2 Bin 4
Dodge Charger	E85 flex fuel	Sedan	Tier 2 Bin 5
Dodge Charger Police	E85 flex fuel	Sedan	N/A
Dodge Grand Caravan	E85 flex fuel	Minivan	Tier 2 Bin 4
Dodge Durango 2WD, 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
Dodge Journey	E85 flex fuel	SUV	Tier 2 Bin 4
Dodge Ram 1500	E85 flex fuel	Pickup	Tier 2 Bin 4
Jeep Grand Cherokee	E85 flex fuel	SUV	Tier 2 Bin 4
Ram 2500/3500 HD	B20	Pickup	Fed. HD 1
Ford: 1-800-34-FLEET; www.fleet.ford.com; www.fordvehicles.com			
Ford E-150, E-250, E-350	CNG/LPG capable	Van/wagon	N/A
Ford E350 FFV 2WD	E85 flex fuel	Van	Tier 2 Bin 8
Ford E-Series E-150/E-350	E85 flex fuel	Van/wagon	Tier 2 Bin 8
Ford Escape FWD, 4WD	E85 flex fuel	SUV	Tier 2 Bin 4
Ford Expedition 2WD, 4WD	E85 flex fuel	SUV	Tier 2 Bin 4
Ford F-150	E85 flex fuel	Pickup	Tier 2 Bin 4
Ford F-250/F-350	E85 flex fuel	Pickup	Tier 2 Bin 8
Ford Fusion	E85 flex fuel	Sedan	Tier 2 Bin 5
Ford Super Duty F-250/F-350	B20	Pickup	Fed. HD
Ford Super Duty F-250/F-350	CNG/LPG capable	Pickup	N/A
Ford Super Duty F-450	B20	Pickup	Fed. HD
Ford Transit Connect	CNG/LPG capable	Van	N/A
Lincoln Navigator 2WD, 4WD	E85 flex fuel	SUV	Tier 2 Bin 4
Lincoln Town Car	E85 flex fuel	Sedan	Tier 2 Bin 4
Mercury Grand Marquis	E85 flex fuel	Sedan	Tier 2 Bin 4
Mercury Mariner FWD	E85 flex fuel	SUV	Tier 2 Bin 4
Mercury Milan AWD	E85 flex fuel	Sedan	Tier 2 Bin 5
Police Interceptor FWD, 4WD	E85 flex fuel	Sedan	Tier 2 Bin 4
General Motors Corporation: 1-888-GM-AFT-4U; www.gm.com/vehicles			
Buick LaCrosse	E85 flex fuel	Sedan	N/A
Buick LaCrosse	E85 flex fuel	Sedan	N/A
Buick Regal Turbo	E85 flex fuel	Sedan	Tier 2 Bin 4
Cadillac Escalade AWD, 2WD	E85 flex fuel	SUV	Tier 2 Bin 5
Cadillac SRX 2WD, 4WD	E85 flex fuel	Sedan	N/A
Chevrolet Avalanche 1500 2WD, 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
Chevrolet Caprice Police Package	E85 flex fuel	Sedan	Tier 2 Bin 4
Chevrolet Equinox AWD, FWD	E85 flex fuel	SUV	Tier 2 Bin 4
Chevrolet Express 1500 2WD, 4WD	E85 flex fuel	Van	Tier 2 Bin 4
Chevrolet Express 2500/3500	GNG	Van	Tier 2 Bin 5
Chevrolet Express 2500/3500	B20	Van	N/A
Chevrolet HHR	E85 flex fuel	SUV	Tier 2 Bin 4
Chevrolet Impala	E85 flex fuel	Sedan	Tier 2 Bin 4
Chevrolet Impala Police Package	E85 flex fuel	Sedan	Tier 2 Bin 4
Chevrolet Malibu	E85 flex fuel	Sedan	Tier 2 Bin 4
Chevrolet Silverado 1500 2WD, 4WD	E85 flex fuel	Pickup	Tier 2 Bin 5
Chevrolet Silverado 2500/3500 HD	B20	Pickup	N/A
Chevrolet Suburban 1500	E85 flex fuel	SUV	Tier 2 Bin 5
Chevrolet Tahoe 1500 2WD, 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
Chevrolet Tahoe Police Package	E85 flex fuel	SUV	Tier 2 Bin 4

Continued on next page.



Table 6.3 (continued)
Alternative Fuel Vehicles Available by Manufacturer, Model Year 2011

Model	Fuel	Type	Emission class
General Motors Corporation (continued)			
GMC Sierra 1500 2WD, 4WD	E85 flex fuel	Pickup	Tier 2 Bin 5
GMC Sierra 2500/3500 HD	B20	Pickup	N/A
GMC Savana 1500 2WD, 4WD	E85 flex fuel	Van	Tier 2 Bin 4
GMC Savana 2500/3500	B20	Van	N/A
GMC Terrain FWD, AWD	E85 flex fuel	SUV	Tier 2 Bin 4
GMC Yukon 1500 2WD, 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
GMC Yukon Denali 2WD, 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
Honda: 1-888-CC-HONDA; www.honda.com			
Civic NGV	CNG Dedicated	Sedan	LEV II , AT-PZEV, Tier 2 Bin 2
Mazda: 1-800-866-1998; www.mazdausa.com			
Tribute 2WD FFV	E85 flex fuel	SUV	Tier 2 Bin 4
Mercedes-Benz USA: 1-800-FOR-MERCEDES; www.mbusa.com			
C300 4Matic	E85 flex fuel	Sedan	LEV II, LEV, Tier 2 Bin 5
Nissan: 1-800-NISSAN-1; www.nissanusa.com			
Armada 4WD	E85 flex fuel	SUV	LEV II, LEV, Tier 2 Bin 5
Titan	E85 flex fuel	Pickup	LEV II, LEV, Tier 2 Bin 5
Tesla Motors: 1-650-681-5000; www.teslamotors.com			
Roadster 2.5	Electric	Two-seater	ZEV, Tier 2 Bin 1
Toyota: 1-800-331-4331; www.toyota.com			
Sequoia 4WD	E85 flex fuel	SUV	Tier 2 Bin 5
Tundra 4WD	E85 flex fuel	Pickup	Tier 2 Bin 5
Vehicle Production Group: 1-877-MV1-FORU (1-877-681-3678); www.vpgautos.com			
VPG	CNG dedicated	SPV	LEV II SULEV
Volkswagen: 1-800-DRIVEVW; www.volkswagen.com			
Routan	E85 flex fuel	SUV	Tier 2 Bin 4

Source:

U.S. Department of Energy, National Alternative Fuels Data Center, Web site,
www.afdc.energy.gov/afdc/vehicles/index.html, March 2012. (Additional resources:
www.eere.energy.gov/afdc/)

Note: LEV=low emission vehicle. ILEV=inherently low emission vehicle. ULEV=ultra low emission vehicle. ZEV=zero emission vehicle. TLEV=transitional low emission vehicle. SULEV=super ultra low emission vehicle. See Chapter 12 for details on emissions.



The hybrid share of all light vehicles peaked in 2009 with 2.8% of the market. Plug-in vehicles certified for highway use began selling in 2010.

Table 6.4
Hybrid and Plug-in Vehicle Sales, 1999-2011

Calendar year	Hybrid vehicle sales (thousands)	Plug-in vehicle sales (thousands)	All light vehicle sales (thousands)	Hybrid share of all light vehicles	Plug-in share of all light vehicles
1999	0.0	0.0	16,894	0.0%	0.0%
2000	9.4	0.0	17,350	0.1%	0.0%
2001	20.3	0.0	17,122	0.1%	0.0%
2002	36.0	0.0	16,816	0.2%	0.0%
2003	47.6	0.0	16,639	0.3%	0.0%
2004	84.2	0.0	16,867	0.5%	0.0%
2005	205.9	0.0	16,948	1.2%	0.0%
2006	251.9	0.0	16,504	1.5%	0.0%
2007	351.1	0.0	16,089	2.2%	0.0%
2008	315.8	0.0	13,195	2.4%	0.0%
2009	290.3	0.0	10,402	2.8%	0.0%
2010	274.6	0.3	11,555	2.4%	0.0%
2011	266.5	17.8	12,734	2.1%	0.1%

Sources:

Hybrid and Electric Vehicle Sales – Compiled by the Transportation Research Center at Argonne National Laboratory, 2012.

All Light Vehicle Sales – Table 3.11.

Note: Plug-in vehicle sales include only those vehicles certified for highway use. Small electric carts and neighborhood electric vehicles are excluded.



Table 6.5
Electric Drive Vehicles Available by Manufacturer, Model Year 2012

Model	Battery type ^a	Type	Emission class
BMW: 1-800-831-1117; www.bmwusa.com			
ActiveHybrid 5	NiMH	Sedan	N/A
ActiveHybrid 7	NiMH	Sedan	Tier 2 Bin 5
ActiveHybrid 7L	NiMH	Sedan	Tier 2 Bin 5
Ford: 1-800-34-FLEET; www.fleet.ford.com; www.fordvehicles.com			
Ford Escape Hybrid	NiMH	SUV	LEVII, SULEV, Tier 2 Bin 3
Ford Focus-Electric	Li-ion	Sedan	ZEV, Tier 2 Bin 1
Ford Fusion Hybrid	NiMH	Sedan	PZEV, Tier 2 Bin 3
Ford Transit Connect	Li-ion	Van	ZEV, Tier 2 Bin 1
Lincoln MKZ FWD	NiMH	Sedan	LEVII, SULEV, Tier 2 Bin 3
Mercury Mariner Hybrid	NiMH	SUV	LEVII, SULEV, Tier 2 Bin 3
Mercury Milan FWD Hybrid	NiMH	Sedan	LEVII, SULEV, Tier 2 Bin 3
General Motors: 1-888-GM-AFT-4U; www.gm.com/vehicles			
Buick LaCrosse Hybrid	Li-ion	Sedan	N/A
Buick Regal Hybrid	Li-ion	Sedan	Tier 2 Bin 4
Cadillac Escalade Hybrid 2WD, 4WD	NiMH	SUV	Tier 2 Bin 5
Chevrolet Silverado 1500 Hybrid 2WD	NiMH	Pickup	Tier 2 Bin 5
Chevrolet Tahoe 1500 Hybrid 2WD, 4WD	NiMH	SUV	Tier 2 Bin 5
Chevrolet Volt	PHEV	Sedan	SULEV
GMC Sierra 1500 Hybrid 2WD, 4WD	NiMH	Pickup	Tier 2 Bin 5
GMC Yukon 1500 Hybrid 2WD, 4WD	NiMH	SUV	Tier 2 Bin 5
Honda: 1-888-CC-HONDA; www.honda.com			
Civic Hybrid	Li-ion	Small car	LEV II, AT-PZEV, Tier 2 Bin 2
CR-Z	NiMH	Small car	LEV II, AT-PZEV, Tier 2 Bin 2
FCX	Hydrogen fuel cell	Sedan	CARB ZEV, Tier 2 Bin 1
Fit EV	Li-ion	Small car	CARB ZEV, Tier 2 Bin 1
Insight	NiMH	Compact car	LEV II, AT-PZEV, Tier 2 Bin 2
Hyundai: 1-800-633-5151; www.hyundaiusa.com			
Sonata Hybrid	Li-Polymer	Sedan	LEV II, SULEV, Tier 2 Bin 2
Infiniti: 1-800-662-6200; www.infinitiusa.com			
M35h Hybrid	NiMH	Sedan	LEV II, ULEV, Tier 2 Bin 5
Kia: 1-800-333-4KIA (1-800-333-4542); www.kia.com			
Optima	Li-poly	Sedan	LEV II, SULEV
Lexus: 1-800-255-3987; www.lexus.com			
Lexus CT 200h	NiMH	Compact car	LEV II, SULEV, Tier 2 Bin 3
Lexus GS 450h	NiMH	Small car	LEVII, SULEV, Tier 2 Bin 3
Lexus HS 250h	NiMH	Small car	LEVII, SULEV, Tier 2 Bin 3
Lexus LS 600h L	NiMH	Sedan	LEV II, SULEV, Tier 2 Bin 3
Lexus RX 450h AWD	NiMH	SUV	LEVII, SULEV, Tier 2 Bin 3
Mercedes-Benz USA: 1-800-FOR-MERCEDES; www.mbusa.com			
S400 Hybrid	Li-ion	Sedan	LEVII, SULEV, Tier 2 Bin 4
F-cell	Hydrogen fuel cell	Sedan	CARB ZEV, Tier 2 Bin 1
Mitsubishi: 1-888-MITSU2012 (1-888-648-7820); www.mitsubishicars.com			
MiEV	Li-ion	Subcompact	CARB ZEV, Tier 2 Bin 1
Nissan: 1-800-NISSAN-1; www.nissanusa.com			
Altima Hybrid	NiMH	Sedan	LEV II, SULEV, Tier 2 Bin 5
Leaf	Li-ion	Sedan	CARB ZEV, Tier 2 Bin 1
Porsche: 1-800-PORSCHE (1-800-767-7243); www.porsche.com/usa/			
Cayenne S Hybrid	NiMH	SUV	LEV II, ULEV, Tier 2 Bin 5
Panamera S Hybrid	NiMH	Sedan	LEVII, ULEV, Tier 2 Bin 5
Toyota: 1-800-331-4331; www.toyota.com			
Camry Hybrid	NiMH	Sedan	LEVII, AT-PZEV, Tier 2 Bin 3
Highlander AWD Hybrid	NiMH	SUV	LEVII, SULEV, Tier 2 Bin 3
Prius Hybrid	NiMH	Sedan	LEVII, AT-PZEV, Tier 2 Bin 3
Prius Plug-In Hybrid	Li-ion	Sedan	LEVII, AT-PZEV, Tier 2 Bin 3
Prius V	NiMH	Station wagon	LEVII, AT-PZEV, Tier 2 Bin 3
RAV4 EV	Li-ion	Small SUV	CARB ZEV, Tier 2 Bin 1

Continued on next page.



Table 6.5 (continued)
Electric Drive Vehicles Available by Manufacturer, Model Year 2012

Model	Battery type ^a	Type	Emission class
Volkswagen: 1-800-DRIVE VW; www.volkswagen.com			
Touareg Hybrid	NiMH	SUV	Tier 2 Bin 5
Wheego Electric Cars: 1-678-904-4795; www.wheego.net			
Wheego Life	Li-Iron-ion	Compact	CARB ZEV, Tier 2 Bin 1

Source:

U.S. Department of Energy, National Alternative Fuels Data Center, Web site,
www.afdc.energy.gov/afdc/vehicles/index.html, March 2012 (Additional resources:
www.eere.energy.gov/afdc/)

Note: LEV = low emission vehicle; ILEV = inherently low emission vehicle; ULEV = ultra-low emission vehicle; ZEV = zero emission vehicle; TLEV = transitional low emission vehicle; SULEV = super ultra-low emission vehicle; AT-PZEV = advanced technology - partial zero emissions vehicle. See Chapter 12 for details on emissions.

^a NiMH = Nickel-Metal Hydride; PbA = Lead-Acid; Mild hybrid = A vehicle that shuts down the engine when coasting, breaking or stopped while continuing to power accessories. There is however, no electric drivetrain like that found on a full hybrid vehicle.



This list includes public and private refuel sites; therefore, not all of these sites are available to the public.

Table 6.6
Number of Alternative Refuel Sites by State and Fuel Type, 2012

State	B20 sites	CNG sites	E85 sites	Electric sites	Hydrogen sites	LNG sites	LPG sites	Totals by State ^a
Alabama	7	11	20	4	0	1	106	149
Alaska	0	1	0	0	0	0	8	9
Arizona	14	30	34	43	1	1	67	190
Arkansas	5	6	20	31	0	0	46	108
California	49	228	59	1,718	23	35	227	2,339
Colorado	14	28	81	100	1	0	58	282
Connecticut	3	14	1	93	2	1	14	128
Delaware	1	1	1	0	0	0	3	6
Dist. of Columbia	2	2	3	72	0	0	0	79
Florida	15	18	65	475	0	0	71	644
Georgia	25	20	53	81	0	0	55	234
Hawaii	8	0	1	59	1	0	3	72
Idaho	7	8	9	19	0	0	28	71
Illinois	8	28	216	245	1	0	70	568
Indiana	3	10	154	40	0	0	182	389
Iowa	4	0	172	41	0	0	21	238
Kansas	7	5	39	20	0	0	37	108
Kentucky	4	1	32	0	0	0	41	78
Louisiana	2	14	2	20	0	1	22	61
Maine	3	1	0	3	0	0	8	15
Maryland	7	6	24	262	0	0	18	317
Massachusetts	7	20	5	163	1	0	21	217
Michigan	13	17	121	480	4	0	64	699
Minnesota	5	3	362	84	0	0	38	492
Mississippi	3	2	2	6	0	0	40	53
Missouri	4	10	104	67	1	0	59	245
Montana	6	2	1	0	0	0	46	55
Nebraska	2	6	69	0	0	0	19	96
Nevada	5	9	23	28	2	1	41	109
New Hampshire	3	4	0	33	0	0	11	51
New Jersey	4	24	4	84	0	0	10	126
New Mexico	6	10	10	6	0	0	50	82
New York	25	108	81	367	9	0	36	626
North Carolina	144	23	31	211	0	0	63	472
North Dakota	2	2	75	0	1	0	18	98
Ohio	21	15	88	70	1	1	68	264
Oklahoma	6	69	16	4	0	0	56	151
Oregon	23	12	8	415	0	0	31	489
Pennsylvania	8	33	34	45	2	0	70	192
Rhode Island	2	5	0	11	0	0	6	24
South Carolina	30	5	102	86	2	0	27	252
South Dakota	1	0	100	0	0	0	17	118
Tennessee	44	6	44	195	0	0	75	364
Texas	13	34	60	570	1	5	480	1,163
Utah	5	81	4	30	0	1	29	150
Vermont	1	3	0	14	1	0	4	23
Virginia	12	11	15	128	1	0	58	225
Washington	32	15	20	674	0	0	67	808
West Virginia	0	1	3	7	1	0	9	21
Wisconsin	2	18	124	93	0	0	50	287
Wyoming	13	8	6	0	0	0	22	49
Totals by Fuel:	630	988	2,498	7,197	56	47	2,670	14,086

Source:

U.S. Department of Energy, Alternative Fuels Data Center Web site,
www.afdc.energy.gov/afdc/fuels/stations_counts.html, February 2012.

^a Totals by State is the total number of fuel types available at stations. Stations are counted once for each type of fuel available.



Clean Cities is a locally-based government/industry partnership, coordinated by the U.S. Department of Energy to expand the use of alternatives to gasoline and diesel fuel. By combining the decision-making with voluntary action by partners, the "grass-roots" approach of Clean Cities departs from traditional "top-down" Federal programs.

Figure 6.1. Clean Cities Coalitions



Source:

U.S. Department of Energy, Alternative Fuel Data Center, March 2012. (Additional resources: www.eere.energy.gov/cleancities/progs/coalition_locations.php)



Vehicle Technologies Program

www.eere.energy.gov/vehiclesandfuels

The Vehicle Technologies Program is administered by the Department of Energy's Office of Energy Efficiency and Renewable Energy. The mission of this program is to develop more energy efficient and environmentally friendly highway transportation technologies that enable America to use less petroleum. The long-term aim is to develop "leap frog" technologies that will provide Americans with greater freedom of mobility and energy security, with lower costs and lower impacts on the environment. For additional information about the Vehicle Technologies Program, visit the Web site listed above.

Hydrogen Analysis Resource Center

hydrogen.pnl.gov/

The Hydrogen Analysis Resource Center was developed to provide reliable data and information for hydrogen-related analytical activities. The Center's Web site includes:

- Hydrogen Data Book – contains a wide range of factual information on hydrogen and fuel cells. hydrogen.pnl.gov/cocoon/morf/hydrogen/article/103.
- Hydrogen Glossary – contains acronyms and terms used commonly in the Hydrogen Analysis Resource Center.
- Related Sites – provides links to other sites with data relevant to hydrogen and fuel cell analysis.
- Guidelines and Assumptions for DOE Hydrogen Program Analysis - contains guidelines for conducting analysis (under development) and assumptions.
- Calculator Tools – provides tools to perform conversions of hydrogen and other calculations relevant to hydrogen and fuel cells.
- Analysis Tools – provides links to models and other tools relevant to hydrogen and fuel cells, such as H2A, GREET, PSAT, VISION, MOVES, and other transportation and energy models.



Table 6.7
Properties of Conventional and Alternative Fuels

Property	Gasoline	No. 2 diesel	Methanol	Ethanol
Chemical formula	C ₄ to C ₁₂	C ₈ to C ₂₅	CH ₃ OH	C ₂ H ₅ OH
Physical state	Liquid	Liquid	Liquid	Liquid
Molecular weight	100–105	~200	32.04	46.07
Composition (weight %)				
Carbon	85–88	87	37.5	52.2
Hydrogen	12–15	13	12.6	13.1
Oxygen	0	0	49.9	34.7
Main fuel source(s)	Crude oil	Crude oil	Natural gas, coal, or woody biomass	Corn, grains, or agricultural waste
Specific gravity (60° F/ 60° F)	0.72–0.78	0.85	0.796	0.794
Density (lb/gal @ 60° F)	6.0–6.5	7.079	6.63	6.61
Boiling temperature (F°)	80–437	356–644	149	172
Freezing point (F°)	-40	-40–30	-143.5	-173.2
Autoignition temperature (F°)	495	~600	867	793
Reid vapor pressure (psi)	8–15	<0.2	4.6	2.3

Property	Propane	CNG	Hydrogen
Chemical formula	C ₃ H ₈	CH ₄	H ₂
Physical state	Compressed gas	Compressed gas	Compressed gas or liquid
Molecular weight	44.1	16.04	2.02
Composition (weight %)			
Carbon	82	75	0
Hydrogen	18	25	100
Oxygen	n/a	n/a	0
Main fuel source	Underground reserves	Underground reserves	Natural gas, methanol, and other energy sources
Specific gravity (60° F/ 60° F)	0.508	0.424	0.07
Density (lb/gal @ 60° F)	4.22	1.07	n/a
Boiling temperature (F°)	-44	-263.2 to -126.4	-423
Freezing point (F°)	-305.8	-296	-435
Autoignition temperature (F°)	842	900-1,170	932
Reid vapor pressure (psi)	208	2,400	n/a

Source:

Alternative Fuels Data Center, “Properties of Fuel,” www.eere.energy.gov/afdc/pdfs/fueltable.pdf and “Fuel Comparison,” www.eere.energy.gov/afdc/fuels/properties.html, March 2012.

Note: n/a = not applicable.



