Alternative Fuels Data Center – Fuel Properties Comparison

	Gasoline/E10	Low Sulfur Diesel	Biodiesel	Propane (LPG)	Compressed Natural Gas (CNG)	Liquefied Natural Gas (LNG)	Ethanol/E100	Methanol	Hydrogen	Electricity
Chemical Structure [1]	C_4 to C_{12} and Ethanol ≤ 10%	C_8 to C_{25}	Methyl esters of C_{12} to C_{22} fatty acids	C_3H_8 (majority) and C_4H_{10} (minority)	CH_4 (majority), C_2H_6 and inert gases	CH_4 same as CNG with inert gasses <0.5% (r)	CH_3CH_2OH	CH_3OH	H_2	N/A
Fuel Material (feedstocks)	Crude Oil	Crude Oil	Fats and oils from sources such as soy beans, waste cooking oil, animal fats, and rapeseed	A by-product of petroleum refining or natural gas processing	Underground reserves and renewable biogas	Underground reserves and renewable biogas	Corn, grains, or agricultural waste (cellulose)	Natural gas, coal, or, woody biomass	Natural gas, methanol, and electrolysis of water	Coal, nuclear, natural gas, hydroelectric, and small percentages of wind and solar
Gasoline Gallon Equivalent [4]	97% - 100%	1 gallon of diesel has 113% of the energy of one gallon of gasoline.	B100 has 103% of the energy in one gallon of gasoline or 93% of the energy of one gallon of diesel. B20 has 109% of the energy of one gallon of gasoline or 99% of the energy of one gallon of diesel.	1 gallon of propane has 73% of the energy of one gallon of gasoline.	5.66 pounds or 123.57 cu ft. of CNG has 100% of the energy of one gallon of gasoline. [2][5](q) 6.38 pounds or 139.30 cu ft. of CNG has 100% of the energy content of one gallon of diesel [2][5](q)	5.38 pounds of LNG has 100% of one gallon of gasoline and 6.06 pounds of LNG has 100% of the energy of one gallon of diesel (r)	1 gallon of E85 has 73% to 83% of the energy of one gallon of gasoline (variation due to ethanol content in E85). 1 gallon of E10 has 96.7% if the energy of one gallon of gasoline. [3]	1 gallon of methanol has 49% of the energy of one gallon of gasoline.	1 kg or 2.198 lbs. of H_2 has 100% of the energy of one gallon of gasoline.	33.70 kWh has 100% of the energy of one gallon of gasoline.
Energy Content (Lower heating value)	112,114 - 116,090 Btu/gal (g)	128,488 Btu/gal (g)	119,550 Btu/gal for B100 (g)	84,250 Btu/gal (g)	20,160 Btu/lb [2](q)	21,240 Btu/lb (r)	76,330 Btu/gal for E100 (g)	57,250 Btu/gal (g)	51,585 Btu/lb (g)	3,414 Btu/kWh

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Energy Content (Higher heating value)	120,388 - 124,340 Btu/gal (g)	138,490 Btu/gal (g)	127,960 Btu/gal for B100 (g)	91,420 Btu/gal (g)	22,453Btu/lb [1](g)	23,726 Btu/lb (g)	84,530 Btu/gal for E100 (g)	65,200 Btu/gal (g)	61,013 Btu/lb (g)	3,414 Btu/kWh
Physical State	Liquid	Liquid	Liquid	Pressurized Liquid	Compressed Gas	Cryogenic Liquid	Liquid	Liquid	Compressed Gas or Liquid	Electricity
Cetane Number	N/A	40-55 (a)	48-65 (a)	N/A	N/A	N/A	0-54 (b)	N/A	N/A	N/A
Pump Octane Number	84-93 (c)	N/A	N/A	105 (f)	120+ (d)	120+ (d)	110 (e)	112 (e)	130+ (f)	N/A
Flash Point	-45 °F (o)	165 °F (o)	212 to 338 °F (a)	-100 to -150 °F (o)	-300 °F (o)	-306 °F (p)	55 °F (o)	52 °F (o)	N/A	N/A
Autoignition Temperature	495 °F (o)	~600 °F (o)	~300 °F (a)	850 to 950 °F (o)	1,004 °F (o)	1,004 °F (p)	793 °F (o)	897 °F (o)	1,050 to 1,080 °F (o)	N/A
Maintenance Issues			Hoses and seals may be affected by higher-percent blend. Lubricity is improved over that of conventional diesel fuel.		High-pressure tanks require periodic inspection and certification.	LNG is stored in cryogenic tanks with a specific hold time before the pressure build is relieved, the vehicle should be operated on a schedule to maintain a lower pressure in the tank.	Special lubricants may be required. Practices are very similar, if not identical, to those for conventionally fueled operations.	Special lubricants must be used as directed by the supplier and M-85-compatible replacement parts must be used.	When hydrogen is used in fuel cell applications, maintenance should be very minimal. High-pressure tanks require periodic inspection and certification.	It is likely that the battery will need replacement before the vehicle is retired.

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Energy Security Impacts	Manufactured using oil, of which nearly 1/2 is imported (n).	Manufactured using oil, of which nearly 1/2 is imported (n).	Biodiesel is domestically produced, renewable, and reduces petroleum use 95% throughout its lifecycle (i).	Approximately half of the LPG in the U.S. is derived from oil, but no oil is imported specifically for LPG production.	CNG is domestically produced from natural gas and renewable biogas. The United States has vast natural gas reserves.	LNG is domestically produced from natural gas and renewable biogas.	Ethanol is produced domestically. E85 reduces lifecycle petroleum use by 70% and E10 reduces petroleum use by 6.3% (l).	Methanol is domestically produced, sometimes from renewable resources.	Hydrogen is produced domestically and can be produced from renewable sources.	Electricity is generated mainly through coal fired power plants. Coal is the United States' most plentiful and price-stable fossil energy resource.

Notes

[1] Standard Chemical Formulas represent idealized fuels. Some table values are expressed in ranges to represent typical fuel variations that are encountered in the field
[2] The type of meter or dispensing equipment being used to fuel vehicles must be taken into consideration. For fast-fill stations that dispense CNG with Coriolis flow meters, which measure fuel mass and report fuel dispensed on a "gallon of gasoline-equivalent" (GGE) basis, the lbs./GGE factor should be used. For time-fill stations or other applications that use traditional residential and commercial gas meters that measure/register in units of cubic feet, the CF/GGE factor should be used.
[3] E85 is a high-level gasoline-ethanol blend containing 51% to 83% ethanol, depending on geography and season. Ethanol content is lower in winter months in cold climates to ensure a vehicle starts. Based on composition, E85's lower heating value varies from 83,950 to 95,450 Btu/gal. This equates to 73% to 83% the heat content of gasoline.
[4] GGE table values reflect BTU range for common gasoline baseline references (E0, E10, and indolene certification fuel)
[5] See Compressed Natural Gas Gasoline & Diesel Gallon Equivalency Methodology at http://afdc.energy.gov/fuels/equivalency_methodology.html

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