

**Alternative Fuel Comparison Chart**

<b>Fuel Type</b>	<b>Source</b>	<b>Emissions</b>	<b>Maintenance/ Refueling</b>	<b>Safety</b>	<b>Common use</b>	<b>Fuel Costs</b>
Compressed Natural Gas	drawn from gas wells or crude oil production	reduced emissions of CO, NO and lower toxic and carcinogenic pollutants	requires more frequent refueling than gasoline	narrow flammability range, leaks indoors may form flammable mixture	light, medium and heavy duty vehicles	costs 15 - 40% less than gasoline
Biodiesel	liquid produced from renewable sources such as vegetable oil, animal fats, and used oil and fats.	depending on blend, reduces emissions of CO, PM, HC, SO <sub>2</sub> ; increases NO <sub>2</sub> and no change in emissions of methane	deposits may form on tank walls and cause fuel filter clogs; may degrade certain rubber compounds over time	biodegradable, non-toxic, less flammable than diesel	light, medium and heavy duty vehicles	costs 30 - 40 cents more than gasoline
Electric Vehicles	on-board rechargeable batteries power electric motor	no pollution if not a hybrid vehicle	no required oil changes or tune-ups; lengthy process for recharging battery	batteries contain toxic components, must meet same standards as conventional vehicles, safer than vehicle with a gas tank	light, medium and heavy duty vehicles	average monthly electricity cost, \$15
Ethanol (E85)	from corn and other crops, wood or paper wastes	reduced emissions of CO, PM, NO <sub>x</sub> , SO <sub>x</sub> and VOCs	special lubricants required, but fewer oil changes	less flammable than gasoline, non-toxic	light, medium and heavy duty vehicles	more expensive than gasoline; prices comparable to gasoline when sold in the Midwest
Fischer-Tropsch	technology that converts coal, natural gas, and low-value refinery products into a high-value, clean burning fuel, a cleaner substitute for diesel fuel	reduces NO, HC, CO emissions; no PM emissions	no significant differences versus petrodiesel fuels, based on current research	no reported safety issues	light, medium and heavy duty vehicles in Africa, South America	according to the California Energy Commission, costs can be 10 % more than diesel fuel
Fuel Cells	uses chemical energy rather than combustion to generate electrical power by combining hydrogen from fuel with oxygen from the air	can achieve zero emissions	being researched but anticipating increased engine efficiency	some of the fuel cells can add too much weight which can make the vehicle hard to stop	no vehicles available for sale	no vehicles are currently available
Liquefied Natural Gas	underground reserves	produces half the PM of diesel vehicles; reduces NO and VOC, and CO <sub>2</sub> emissions as well as toxic and carcinogenic pollutants; increase in methane emissions	longer life of engine, no need for periodic inspections	personnel must be trained because of the fuel's below freezing temperatures	used in heavy-duty fleet operations	usually less than the cost of gasoline per mile
Methanol	produced from natural gas, and/or renewable sources such as wood or waste paper	lower NO and VOC emissions; potentially greater formaldehyde emissions; no PM emissions	requires special lubricants	burns invisible and hard to detect; personnel must be trained to operate and maintain vehicles	race vehicles and others	costs less than gasoline; however, vehicle needs more methanol to travel the same distance as a gasoline powered vehicle
Propane (Liquefied Petroleum Gas)	by-product of petroleum refining and natural gas production	potentially lower, toxic CO <sub>2</sub> , CO, NMHC emissions	less corrosion and less engine wear	low flammability but likely to ignite because it becomes a gas so quickly	light and medium duty vehicles	comparable to gasoline; however, vehicle needs more propane to travel the same distance as a gas powered vehicle
Hydrogen	produced from steam reformation of natural gas, or electrolysis of water	few or no emissions (water vapor and a small amount of NO <sub>x</sub> )	more data needed from current experiments	more data needed from current experiments	light and medium duty vehicles	more data needed from current experiments

**Abbreviations**

CO = carbon monoxide	HC = hydrocarbons	NO = nitrogen oxide	NO <sub>x</sub> = nitrogen oxides	SO <sub>2</sub> = sulfur dioxide	VOC = volatile organic compounds
CO <sub>2</sub> = carbon dioxide	NMHC = non-methane hydrocarbons	NO <sub>2</sub> = nitrogen dioxide	PM = particulate matter	SO <sub>x</sub> = sulfur oxides	