# Review Of Alternative Fuels For Internal Combustion Engines

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***Abstract-*** *This review paper covers potential alternative fuels for automotive engine application for both the spark ignition (SI) and compression ignition (CI) engines. It also includes applications for the alternative fuels in advanced combustion research applications. The representative alternative fuels in SI engines includes compressed natural gas (CNG), hydrogen (H2) liquefied petroleum gas (LPG), and alcohol fuels (methanol and ethanol); While for the CI engines includes biodiesel, Di-methyl ether (DME), and jet propellent-8 (JP-8). And the Present report summarizes current sources of the fuels, specifications and standards used in vehicle applications. From this start point a survey on published possible future alternative bio-based fuels is summarized and data on the fuels are presented in relation to parameters and properties described in current fuel standards. Gaps in fuel data and two proposed research areas in connection to fuel properties are presented*

*1. Study on the fuel system interaction with alternative fuels. Fuels considered should includes both proposed fuels as neat fuels and as the various types of blends.*

- *Filtering of neat/blends fuels*
- *Injection pump operation/control*
- *Injector operation/control*
- *Fuel solution stability and chemical stability within injection systems including high*
- *Pressures, Temperatures and return flow.*
- *Fuel deposits formation in tank, filters, pump and injectors. This also includes deposits*
- *Influence on spray/combustion.*

*2. Study on the transport system implications from types of the alternative fuels. This includes the Power train as well as the vehicle configuration.*

***Keywords***- CSTR-PID-ZN-Fuzzy-MRAM-MATLAB.

## I. INTRODUCTION

### 1.1. Back Ground

Internal combustion engines (ICEs) are machines that convert the heat produced from combustion into mechanical work. The main subjects of this paper are reciprocating engines, such as spark-ignition (SI) and compression-ignition (CI) engines. They have been widely adopted as power sources for passenger and commercial vehicles, electricity power generation, and in other industrial fields, due to their high power density and high efficiency. The combustion process is one of the most important energy conversion methods where the chemical energy of fuel is directly converted into heat. Therefore, it is possible to say that human activities are greatly driven by and rely on fossil fuel energy.

Liquid fuels are over the past 100 years evolved as the fuels of choice for transport because of their high energy density and in the ease of transport, storage and handling. Conventional fuels are complex mixtures that typically contain more than hundred chemical components whose composition has changed and evolved over time and in connection to engine development. The development has been done in correlation and in order to meet the engine development demand on power, efficiency and drivability.

Over the last decades ever more stringent emissions legislations has been added to the demands on the fuel and engine combination. When discussing alternatives to current fossil based fuels for propulsion and power generation fuel properties are important criteria from point of view to take into consideration, since the combustion behaviour relates to the main purpose of the heat machine, i.e., to convert chemical power to mechanical power.

### 1.2. Definition of alternative fuels and their importance

The definition of alternative fuels may vary depending on the context. The current study defines alternative fuels of those other than conventional gasoline and diesel fuels, covering a wide variety in terms of the final forms and manufacturing sources. For example, ethanol fuel is considered an alternative for SI engines, regardless of its original source from either conventional crude oil or any renewable biomass. The alternative fuels defined by the Energy Policy Act (EPAct) also cover a vast amount of the

non-conventional fuels, including alcohols, such as ethanol (including blends with gasoline over 85%); natural gas and liquefied fuels domestically derived from natural gas; liquefied petroleum gas (LPG); coal-derived liquid fuels (CTL); hydrogen (H 2) biodiesel (B100); fuels, other than alcohol, derived from biological materials; and fuel that is substantially non-petroleum that yields substantial energy security and environmental benefits.

The significance of using alternative fuels can be attributed to the following aspects

(1) Pursuing energy sustainability through the extended usage of those alternative fuels derived from the renewable energy sources and mitigating the concerns of limited fossil fuel energy
(2) Improving engine efficiency and engine-out emissions with the aid of superior physical or chemical properties of the alternative fuels compared to those of conventional fuels
(3) Relieving the unbalanced usage of the conventional petroleum-based fossil fuels.

### 1.3. Considerations for alternative fuels

Some of the common critical considerations for the alternative fuels for both CI and SI engines are summarized.

They are

- Physical properties(spray or mixture formation for combustion, and engine operability over a wide range of temperatures)
- Compatibility (including approval by engine and vehicle manufacturers and costs)
- Manufacturing cost and infrastructures

### 1.4. Current status of production, impact and future vision

Figure1.4.1 Summarizes all the available pathways for producing the liquid and some gaseous fuels from either fossil sources or biomass. The majority of the transportation fuels today derive from the refining of crude petroleum oil with well-established technologies, Though the production from un-conventional feed stocks, such as oil sands, oil shale and shale gas, and keeps increasing. Synthetic liquid fuels, which have a properties similar to those of petroleum-derived products, can be produced from the gasification and FischerTropsch (FT) process of any hydrocarbon or coal feedstock.

A number of the familiar alternative fuels, such as ethanol (bio-ethanol) and advanced biodiesel, which show a moderate compatibility with existing ICE vehicles, are in moderate-scale production and full fill moderately-low GHG emissions. The advancement of production technology from conventional methods (or 1st generation biofuels) to advanced methods (2nd generation biofuels) has enhanced the efficiency of theproduction, and promote utilization of inedible bio-feed stocks

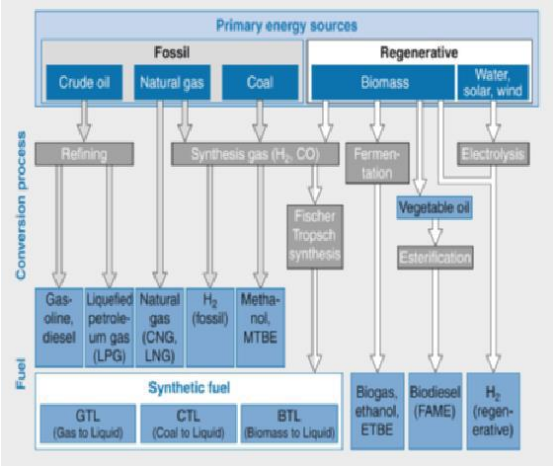


**Fig:**1.4.1Manufacturing paths of fossil and regenerative fuels

## II. ALTERNATIVE FUELS FOR SI ENGINES

In conventional SI engines, the air–fuel mixture is inducted into the cylinder, and compressed to the Top dead center (TDC), ready to be ignited .Combustion is initiated by an electric discharge by the spark plug. The distinctive characteristic of the combustion phenomena in SI engines is of the flame propagation of a premixed air–fuel mixture. Auto-ignition may occur in SI engines, referred to as 'knock'; however, it is an undesirable abnormal combustion phenomenon. Knock can be multi-point spontaneous auto-ignition throughout the entire premixed air–fuel mixture in the end gas region, accompanying extremely rapid heat release and damage to the engine (end gas is the unburned gas inside the cylinder, which is ahead of the propagating flame, ready to be burned. Knock can be caused by the fuel properties as well as by engine design parameters. There are of several requirements for the fuels for SI engines, including the prevention of knock. The following are some of the requirements for gasoline fuels, as well as for alternative fuels for SI applications

- Flammability related to lean limit and combustion stability
- Laminar burning velocity
- LHV (of air–fuel mixture)

- Volatility; boiling curve; vapour pressure
- Octane number

**2.1. Compressed Natural Gas (CNG)**

Natural gas is a alternative fuel that burns clean and is already widely a viable to people in many of the countries through utilities that provide natural gas to homes and businesses

**Positive***:* Cars and trucks with specially designed engines produce the fewer harmful emissions than gasoline or diesel.

**Negative***:* Natural gas production creates methane, a greenhouse gas that is 21 times worst for the global warming than CO2.

**2.2. Electricity**

Electricity can be used in the transportation alternative fuel for battery-powered electric and fuel-cell vehicles. Battery powered electric vehicles store power in batteries that are recharged by plugging in the vehicle into a standard electrical source. Fuel-cell vehicles run on electricity that is to produce through an electrochemical reaction that occurs when hydrogen and oxygen are combined.

**Positive:** Electricity for the transportation is highly efficient, and we already have an extensive electricity network. In the case of fuel cells, if they produce electricity without combustion or pollution.

**Negative:** Much electricity is generated today from the coal or natural gas, leaving a bad carbon footprint. (Nonetheless, electric vehicles are still the greenest option around when it comes to cars.)

**2.3. LPG**

Propane is also called as the liquefied petroleum gas or LPG .Is a product of natural gas processing and crude oil refining. Already widely used as a fuel for cooking and heating, propane is also a popular alternative fuel for

**Positive***:* Propane produces fewer emissions than gasoline, and there is also an highly developed infrastructure for propane transport, storage and distribution.

**Negative***:* Natural gas production creates methane, an greenhouse gas that is 21 times worse for global warming than CO

Low injection pressure or change of spark plug location might be required for the stable stratified combustion of LPG

**2.4. Alcohol fuels—Methanol and Ethanol**

An alcohol-based alternative fuel made by the fermenting and distilling crops such as corn, barley or wheat. It can be blended with the gasoline to increase octane levels and improve emissions quality.

**Positive***: Materials are Renewable.*

**Negative***:* Ethanol subsidies have a negative impact on food prices and availability.

**Methanol**

Methanol is also known as wood alcohol, can be used as an alternative fuel in flexible fuel vehicles that are designed to run on M85, a blend of the 85 percent methanol and 15 percent gasoline, but automakers are no longer manufacturing methanol-powered vehicles.

**Positive***:* Methanol could be become an important alternative fuel in the future as a source of the hydrogen needed to power fuel-cell vehicle.

**Negative***:* Automakers are no longer manufacturing methanol-powered vehicles.

## III. ALTERNATIVE FUELS FOR CI ENGINE

**3.1 Fuel requirements for SI engines**

Diesel fuels are the conventional fuels for the CI engines. The distinct difference of the combustion in CI compared to SI engines is that of the fuel is directly injected into the cylinder, and auto-ignites due to the high ambient temperature toward the end of the compression stroke. Therefore, the auto-ignition ability for the fuel is crucial for its use in CI engines. Several important criteria exist to measure the quality of the diesel fuels, as well as alternative fuels applied to CI engines.

- Cetane number
- Boiling point • Narrow density and viscosity spread • Low aromatic compounds

**3.2 Bio-Diesel**

Biodiesel is a alternative fuel based on vegetable oils or animal fats, even those recycled after biodiesel in its pure

form, and biodiesel can also be blended with the petrol, diesel and used in the unmodified engines restaurants have used them for cooking. In Vehicles engines can be converted into burn.

**Positive*:*** Biodiesel is safe, biodegradable, reduces air pollutants associated with vehicle emissions, such as the particulate matter, carbon monoxide and hydrocarbons.

**Negative*:*** Limited production and distribution infrastructure.

## IV. CONCLUSION

The major portion (up to 90%) of the propulsion for transportation will still relay on the internal combustion engine (ICE), even up to 2040. Indeed, the global demand for transportation fuels is expected to grow continuously at between 1.2% and 1.4% per annum. Discussions on the current state and the future of transportation fuel are important. An early discussion on future options for alternative fuels already took place during the 1980s. These attempts were made not only to seek alternative solutions to energy security and sustainability, but also to seek benefits that alternative fuels can provide to engine efficiency improvement and emission reduction

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