



## Review

# Indian scenario of ethanol fuel and its utilization in automotive transportation sector

P. Sakthivel<sup>a,b,\*</sup>, K.A. Subramanian<sup>b</sup>, Reji Mathai<sup>a</sup>

<sup>a</sup> Research and Development Centre, Indian Oil Corporation Limited, Sector-13, Faridabad 121007, India

<sup>b</sup> Centre for Energy Studies, Indian Institute of Technology Delhi, Hauz Khas, New Delhi 110016, India



## ARTICLE INFO

## Keywords:

Ethanol  
Ethanol-gasoline blend  
Ethanol production  
Transportation  
Engine performance  
Emission

## ABSTRACT

About 85% of petroleum oil need of India is being met through imports. Indian economy is growing steadily resulting in rapid increase of vehicular population and demand for transportation fuels. Indian Government has already mandated blending of ethanol in gasoline by 10% to reduce the oil import. Bureau of Indian Standards is finalizing the specification of 20% ethanol blended gasoline for use as vehicular fuel. In this context, this review presents the current and future scenario of Indian transportation, petroleum oil and bio-fuel sectors including global progress on utilization of ethanol as an alternative transportation fuel in spark ignition vehicles. The data from various standard reference sources were compiled, analyzed and is presented. The review indicates that the gasoline demand would be around 44 billion liters by the year 2020 and India has a potential to produce ethanol to the tune of 30 billion liters per annum in addition to existing capacity. Apart from augmenting production of first generation ethanol, the second generation ligno-cellulosic ethanol and thermo-chemical conversion of carbon-rich agricultural/petroleum residues are seen as alternative options. The potential of such alternative feed stocks and ethanol conversion technologies need to be exploited to increase ethanol availability for blending. The review indicates that ethanol is most suitable fuel for spark ignition engines due to its higher octane number. Ethanol blending reduces sulphur, aromatics, olefin and benzene content in gasoline and can reduce vehicular emissions such as hydrocarbon, carbon monoxide and particulate matter.

## 1. Introduction

India is one of the fastest growing economies in the world. The gross domestic product (GDP) has grown steadily to reach 8.0% during 2015, as shown in Fig. 1 (The World Bank, 2017). Though there was a decrease in GDP growth to 7.1% in 2016, India's economy is poised to grow in the coming years as the government is taking necessary steps to improve economics of the country. The economic growth is reflected in the consumption of primary energy in transportation and non-transportation sectors. India is now the third largest country in terms of consumption of crude oil as well as total primary energy consumption in the world (BP Statistical Review of World Energy, 2017). Huge import of crude oil not only indicates energy insecurity but also costs the government exchequer heavily (Mishra, 2017). The government has taken several policy measures to reduce crude oil import such as promoting use of bio-fuels in the country. Ethanol blended petrol (EBP) program was announced during 2003 for implementation of 5% ethanol blending in gasoline (Planning Commission, 2003). A national bio-fuel policy was announced by the Government in 2008 targeting the ethanol

blending in gasoline upto 20% by the year 2017. Bio-fuel would give multiple benefits including enhancement of indigenous energy source, boosting of rural economy and strengthening of sustainable energy and environment system (MNRE, 2008). In this context, this paper presents the current and future scenario of transport vehicles, petroleum fuel consumption and ethanol production potential in India. The paper also covers review of progress made by various researchers globally on utilization of ethanol in automotive engines.

## 2. Petroleum fuel scenario in India

### 2.1. Consumption of gasoline and diesel

India imported crude oil of 214 million metric tonnes (MMT) during financial year 2016–17 at an increase of 5.4% compared to previous year (MoPNG, 2017a). The domestic production of crude oil in 2016–17 was 36 MMT at a decrease of 2.5% compared to previous year. This indicates that India met about 85% of its oil requirements through imports. The consumption of major fuels (diesel and gasoline) for

\* Corresponding author at: Research and Development Centre, Indian Oil Corporation Limited, Sector-13, Faridabad 121007, India.

E-mail addresses: [sakthivelp@indianoil.in](mailto:sakthivelp@indianoil.in) (P. Sakthivel), [subra@ces.iitd.ac.in](mailto:subra@ces.iitd.ac.in) (K.A. Subramanian), [mathair@indianoil.in](mailto:mathair@indianoil.in) (R. Mathai).

Nomenclature			
BIS	Bureau of indian standards	IS	Indian standard
C/H	Carbon/Hydrogen	kmph	Kilometer per hour
CAFC	Corporate average fuel consumption	MBT	Maximum brake torque
CAGR	Compound annual growth rate	MMT	Million metric tonnes
CO	Carbon monoxide	MMTPA	Million metric tonnes per annum
CO <sub>2</sub>	Carbon dioxide	MPFI	Multi point electronic fuel injection
CR	Compression ratio	NOx	Oxides of nitrogen
CY	Calendar year	NRL	Numaligarh refinery limited
E0	Neat gasoline	OMC	Oil marketing companies
E10W	10% hydrous ethanol blended gasoline	RON	Research octane number
E5	5% ethanol blended gasoline	SAE	Society of automotive engineers
ECU	Electronic control unit	SI	Spark ignition
FTP	Federal test procedure	UDC	Urban driving cycle
GDP	Gross domestic product	US	United States
HC	Hydrocarbon	US DoE	US department of energy
IMEP	Indicated mean effective pressure	WOT	Wide open throttle
IOCL	Indian oil corporation limited	NREL	National renewable energy lab
		HCCI	Homogeneous charge compression ignition engine
		VOC	Volatile organic compounds

transportation sectors is increasing steadily over the years as shown in Fig. 2. While gasoline consumption increased by 9%, the diesel consumption increased by 2% in 2016–17 compared to 2015–16.

The faster growth of gasoline consumption compared to diesel during the recent years may be due to (a) increased sale of gasoline cars and (b) reduced price gap between gasoline and diesel. The price

difference between diesel and gasoline widened after deregulation of gasoline price in June 2010. However, the gap narrowed after deregulation of diesel prices in October 2014. Use of compressed natural gas as fuel in passenger cars, buses and non-transportation applications resulted in reduced diesel consumption. The diesel to gasoline consumption ratio is decreasing over the years and a steep decline from 4.4

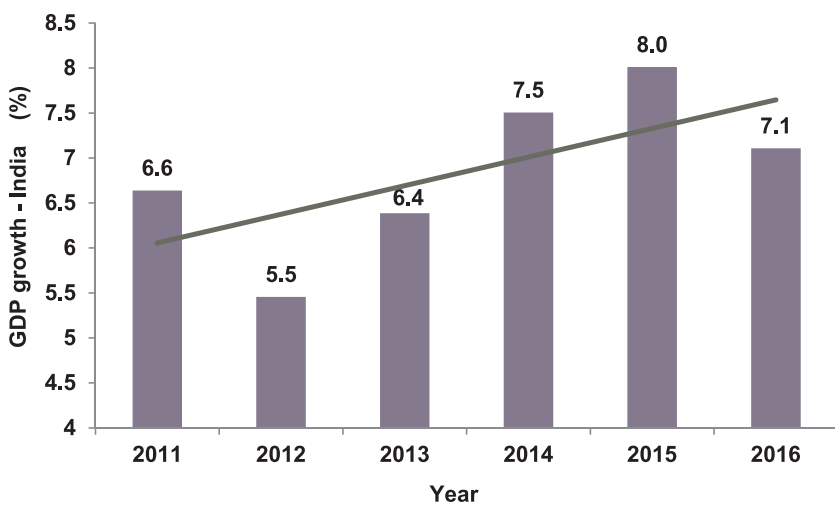


Fig 1. GDP growth of India during recent years (The World Bank, 2017).

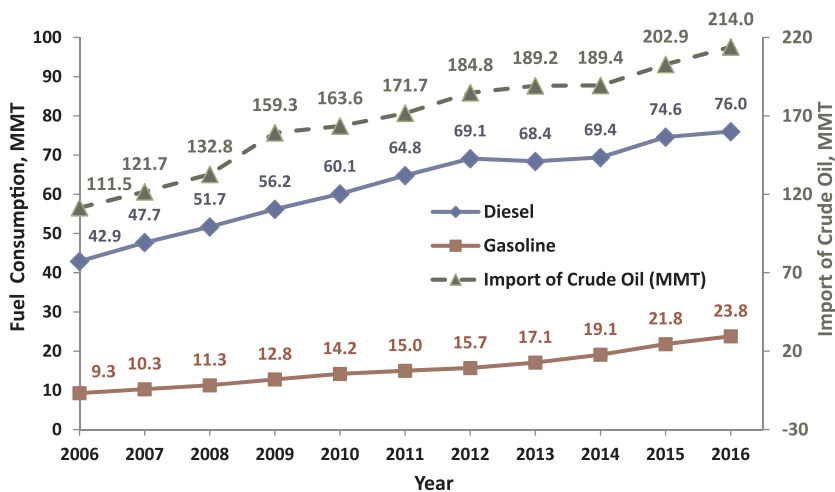


Fig. 2. Diesel and gasoline fuel consumption trend (MoPNG, 2017a).

Download English Version:

<https://daneshyari.com/en/article/7494308>

Download Persian Version:

<https://daneshyari.com/article/7494308>

[Daneshyari.com](https://daneshyari.com)