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# ADOPTION IMPEDIMENTS TO GREEN FUEL VEHICLES: A STUDY FOR SUSTAINABLE TRANSPORTATION IN INDIA

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***Abstract:*** *Sustainable development of a country closely depends on sustainable approach towards automobile sector. In developing countries like India's economy largely depends on imported crude oil, of which, transport sector consume almost 70 per cent of diesel and 99.6 per cent of petrol. The adoption of green fuel vehicles (GFVs) has been regarded as the most efficient strategies to fight the issues like energy security, global warming, air pollutions and many others. Transport sectors have major contribution for energy related green house gas (GHG) emissions from road transport. Unburned hydrocarbon, suspended particulate matters (SPM), lead, and CO2 are the major components of GHG emissions from road transportation in the world. To reduce these harmful particles, Indian government has taken few steps to promote green fuels and encouraging all the stake holders of 'Green Fuel Vehicles'. Despite so many efforts, we are still facing huge challenges to promote wider acceptability of green fuel vehicles by the common people. The main focus of this paper is to find out the growth of different types of vehicles in India and to analyse the real adoption impediments of 'Green Fuel Vehicles' by road transportation in India.*

***Key words:*** *Adoption, Impediment, Green Fuel Vehicle, Sustainable, GHG*

## 1. INTRODUCTION

Indian transport sector growing in a faster speed is a cause and an effect of India's rapid urbanization and economic development. The USA, Japan, UK, China and many others opting for green fuel sources for transport sector to strengthen sustainable growth. The usage of fuel consumption is expected to grow for increasing demand in passenger vehicles and commercial vehicles for the next few decades. These include growing dependence on imported petroleum fuels, which is one of the major causes for global warming. Alnsour (2015) shows the alternate

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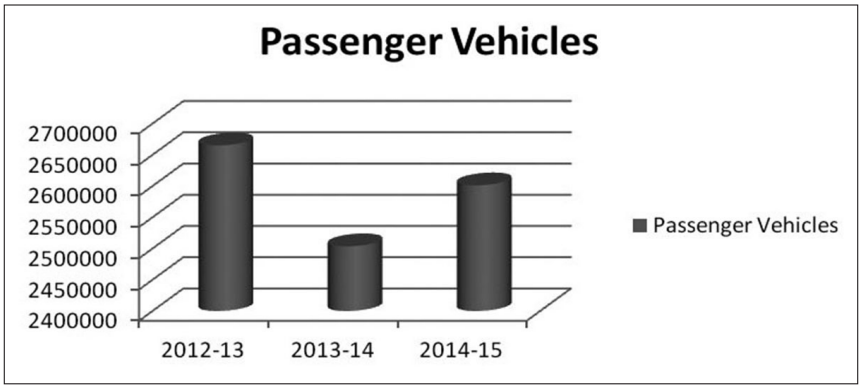
way to reduce energy consumption by the local government in Jordon, to mitigate pollution. Increasing pollutants from gasoline fueled vehicles is responsible for damages of public health. Now is the time to make new strategies for sustainable transportation, which will have direct impact on countries economic development. It is necessary to steer this growing numbers of vehicles in such a manner that will minimize the harmful particles of GHG from a burgeoning vehicles fleet. Seisler (2000) pointed out in his research work that, Chinese government moved towards a bigger natural gas vehicles market to protect coincidental issues and preserve energy. India has a tremendous opportunity to make progress on several issues related to adoption of green fuel transportation discussed in this paper. The government has formed an expert committee on Auto Fuel Vision and Policy – 2025 (MoRTH, 2014). This committee will evaluate and prepare a road map for emissions from vehicles and all types of fuel quality standards through out 2025. This expert body can also advocate policies to stop fleet of high-emitting passenger and commercial fleets, prescribe financial plans to upgrade refueling stations, publicize green fuel fleets, and spur a shift away from conventional liquid fuels toward gas (CNG, LPG, CBM) and electricity in transportation.

## 2. GROWTH OF INDIAN TRANSPORT INDUSTRY:

Road transport is vital to the economic development and social integration of the country. The new government of India has taken various projects for infrastructure development and road connectivity with many states. Economic slowdown declining the growth of transport sector, but we can surely say that this sector will add more and more new vehicles in coming days. India is the home ground for the largest motor cycle producer and 5$^{th}$ biggest profitable vehicles operator. Indian auto industry is manufacturing 76 lacks of two wheelers, 13 lacks private fleets, 4 lacks saleable vectors, and about 3 lacks tractors per year. Indian transport sector has reached a turnover of US $ 28 billion. Indian transport sector consumed 99.6 per cent of petrol and 70 per cent of diesel, where two-wheelers top petrol consumption with 61.42 per cent of petrol followed by cars with 34.33 per cent and three-wheelers with 2.34 per cent (PPAC, 2014). It was also revealed that due to poor road connectivity and lack of alternative sources of communication in the states of Odisha, Bihar and Rajasthan, two wheelers consumes exceeds 70 per cent of petrol. Commercial vehicles consume 13.15 per cent, utility vehicles 8.94 per cent and 3-wheelers consume 6.39 per cent of total diesel sold in the country (PPAC, 2014).

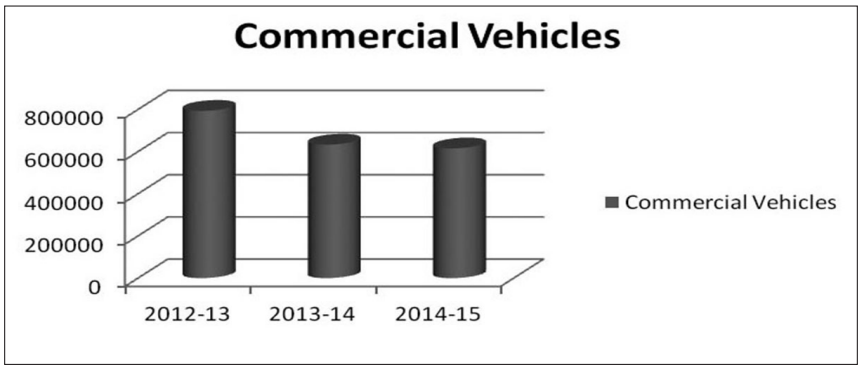
These bellow figures show that how the Indian passenger vehicles sector is changing with the change economic environment. Automobile manufacturers are facing weak demand across the globe.

**Figure 1.**



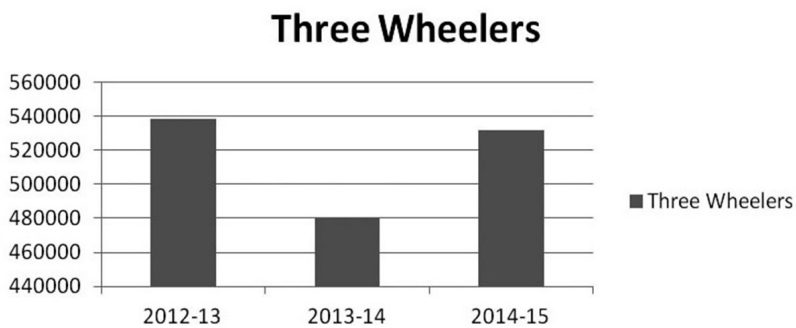

Source: SIAM, Domestic sales data

**Figure 2.**



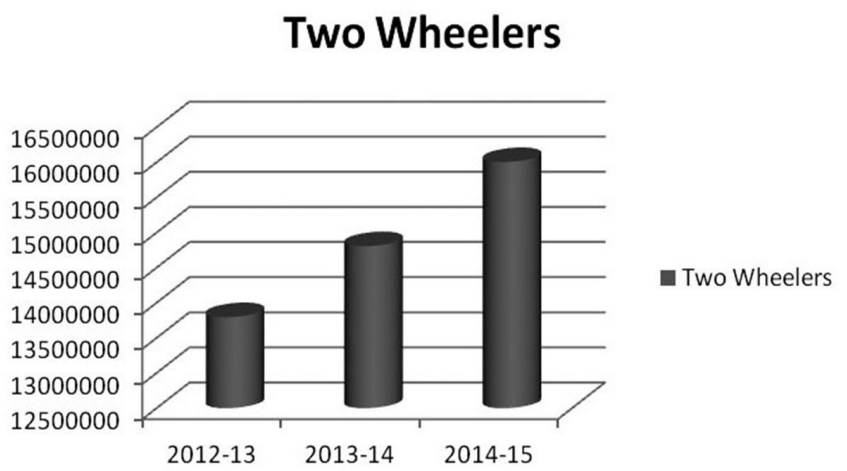

**Source:** SIAM, Domestic sales data

**Figure 3.**




Source: SIAM, Domestic sales data

**Figure 4.**




**Source:** SIAM, Domestic sales data

The latest report revealed by Siam (Society of Indian Automotive Manufacturers) data that, passenger vehicle segment and two-wheelers segment is growing in a continued manner. In the financial year 2012-13 Indian automobile manufacturers had sold 26, 65,015 units of passenger vehicles (Fig. 1), when they had sold only 26, 01,111 units of car in 2014-15 financial year. In the year 2014-15 commercial vehicles' sales growth was negative to 6, 14,961 units when it was 7, 93,211 units in 2012-13 financial year (Fig. 2). According to SIAM domestic sales report only two wheelers segment shows continuous growth from 1, 37, 97,185 units to 1,48,06,778 units to 1,60,04,581 units for the financial year 2012-13, 2013-14 and 2014-15 respectively (Fig. 4). This continuous demand is encouraging electric vehicle (EVs) manufacturers in two wheelers segment.

## 3. GREEN FUELS IN VEHICLES FLEET

The 'Green fuel' means environment friendly fuel. It is also popular in the name of Alternative fuel, Bio-fuel, clean fuel, Eco-fuel around the world. It is a fuel which creates less pollution into the air when it burns in the internal combustion (IC) engine. Previous research (Gwilliam, 2000; Matic, 2005; Janssen et al., 2006), revealed that cost benefit advantage of green fuels is most attracting factor for consumers preference for CNG, LPG or electric vehicles. Many corporate and researchers are working on different types of 'green fuels' which can be use as transport fuel. There are many sources from where we can make green fuels easily available into the market. It can also be made from waste vegetables oil (WVO) or cooking oil. Hydrogen fuel is emerging another source of green fuel as a transport fuel around the world. The Indian government has already setup a road map for

Hydrogen Economy by 2030. The finance minister of India said in the 2014 budget that, the Indian government is working on to double its existing gas pipeline infrastructure of 15,000 km. to provide a clean energy source to the consumers (ET, 2014).

## 4. TYPES OF ADOPTION IMPEDIMENTS

National Research Council (2004) suggested that the conjunction of refueling stations, uninterrupted fuel supply and GFV's are require for the adoption of green fleets. Many researchers described it as a 'chicken and egg' problem. Yeh (2007) identified that the payback periods are subject to many factors including differences of fuel prices, fuel efficiencies, price difference between the new technology and conventional technology of vehicles, and annual distances traveled. Other factors not included in the payback period analysis such as performance and utility also affect consumer's decisions making to purchase of GFV's (Yeh, 2007). Drebee et al (2012) had shown that household characteristic has an impact on consumer's choices in vehicle adoption process. Several researches suggest that, most of the GFV users want money back with in a very short span of period below 3 years for their investment in green fuel vehicles (Greene et al., 2005; Santini and Vyas, 2005). Various types of strategies and plans have been effectively implemented through stakeholder's model to encourage the adoption of GFVs in different categories of vehicles. Various kind of economical aspects, including the price of GFV's as compared to conventional fuel fleets, purchasing cost of green fuels as compared with normal diesel and gasoline and commercial viability of green fuel refueling stations can impact on consumer's preference and investor's decisions making process. This research also shows that alternative refueling stations won't be a major constrain for consumer adoption of AFVs, if available frequently as compare to conventional refueling stations (Yeh, 2007).

## 5. CHALLENGES OF GREEN FUEL VEHICLES (GFV'S):

Few years ago the Planning Commission of India has suggested and recommended 5 percent ethanol blend fuel for the financial year 2007-12 and 10 percent for 2012-17 financial years. The oil marketing companies (OMC's) were failed to meet the projected target. Due to some wrong existing policies, OMC's was unable to procure from green fuel manufacturers and failed to blend with normal petrol and diesel. Various significant steps have been taken by the Indian government to curb the harmful particles from its growing transportation sector. When the smart city projects were transforming urban India, then the demand of well connected transportation network would increase emission problems. Indian government has taken major steps to tackle-down its burgeoning deterioration of air quality. This includes tightening emission standards of conventional fuel quality and launching

cleanest sources of fuels. New policies promoting eco-fuels like electricity, CNG/ LPG, ethanol and bio-diesel run vehicles for sustainable urban planning and transportation.

The biggest challenges in front of the Indian government is to build up separate infrastructures for green fuel vehicles especially in over populated cities like Kolkata, Delhi, Mumbai and Chennai. If the Indian government would like to implement the world's most advance emission norms and use cleanest fuels, still overall emissions from vehicles would continue to increase as long as private fleets remained the most preferable transportation option for the common public. The state governments are facing lot of difficulties in environmental and safety point of view to set up refueling stations for green fuels as well as recharging point for electric vehicles. Recently Indian government has de-regularized the price of petrol and diesel, which will encourage green fuel vehicles adoption. Current policies regarding subsidy in green fuel vehicles (especially on electric vehicles) reduce the price of vehicles and encourage its adoption. India will have to emulate on all these environmental and economic issues as it develops sustainable transportation policy for the next generations.

Government initiatives such as green fuel procurement preferences, requirements to set targets for green fuel consumption, vehicles performance and safety, adoption targets for green fuel fleets, direct investments in service networks and refueling stations (Yeh, 2007). Incentive based instruments model targeting all the stake holders including vehicle manufacturers, fuel suppliers, R&D firms, government funded agencies and consumers to encourage the adoption of green fuel vehicles.

## 6. REFUELING STATIONS OF GREEN FUELS ACROSS INDIA:

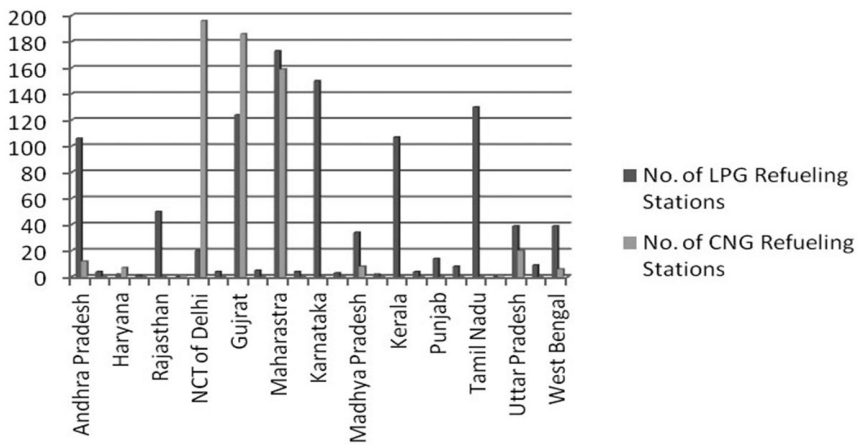
Continued growth in demand for conventional gasoline based transport system faces a numbers of long term challenges like global warming, deterioration of urban air quality, energy preservation and imported high priced petroleum fuel sources (Melaina and Bremson, 2008). Much needed approach is to establish easy availability of refueling stations is one of the many inputs required to support the adoption process of AFV technology (Norberg-Bohm, 2002; Popper and Wagner, 2002). Refueling stations of LPG and CNG are not densely located across the India, it can be accessible only few parts of India.

Green fuels such as CNG and LPG were implemented in public transport system by the Chinese government through various through direct investments, incentive programs, various R&D projects and targets to promote green fuel vehicles (Yeh, 2007). One research was conducted by Matic (2005), revealed that the Beijing's civic transport authority has pledged to replace 90 percent of their

18,000 urban buses by CNG before the Olympic Games in 2008, and other Chinese cities are also following similar kind of attachments for the international events.

### 6.1 Diagram of LPG & CNG refueling stations across in India

**Figure 5.**




**Source:** MoPNG, Up to May 2014

Above diagram shows that how LPG and CNG refueling stations located across India. CNG refueling stations concentrated only in Maharastra, Gujrat and NCT Delhi with the number of 159, 186 and 196 respectively. Few parts of Andhra Pradesh, Uttar Pradesh, Madhya Pradesh and West Bengal have limited numbers of CNG refueling stations. But in case of LPG almost every state has easy availability of LPG refueling stations. The domestic sales figure of CNG cars is very poor because of low density of CNG refueling stations in eastern parts of India as compare to central and western India. Automobile majors like Maruti-Suzuki, Tata Motors, Hyundai Motors are targeting for their LPG variants in Southern and Eastern parts of India due to high concentration of LPG refueling stations.

## 7. RECOMMENDATIONS AND CONCLUSION:

India's 5 per cent ethanol blending projects has failed to take off as per recommendation by Planning Commission in 2007. The government has directed to the OMC's (oil marketing companies) that 10 per cent ethanol blending is mandatory during 2012-17 financial years. Till date oil marketing companies can able to blend up to 2 to 3 per cent of their targeted amount. Current scenario shows that 10 per cent ethanol blending with conventional fuels is near to impossible. Now governments need to focus on other widely available green fuels like CNG/LPG or CBM to build up refueling stations aggressively across the country. Yeh, (2007)

has recommended in her previous study that government need to take initiatives such as procurement, disclosure of fuel consumption, safety and performance, adoption targets for green fuel fleet, direct investments in refueling stations and service networks to market for GFVs. Government incentives, tax holidays and tax credits can boost up the adoption process of green fuel vehicles in India. Rubin and Leiby (2000) suggested in their research that economic incentives can be provide for green fuel vehicles manufacturers. With the help of new technology adoption and optimal utilization of resources, following measures should be taken to save environmental damages.

1. Central government as well as state government should take initiative to implement New Electric Mobility Mission Plan priority basis to reduce vehicle pollution (MoRTH, 2014).
2. Easy accessibility of more efficient Green Fuel vehicles and fuels, such as CNG, LPG, Ethanol, Bio-diesel across the country to reduce emissions.
3. Green fuel vehicles have the potential to reduce vehicle pollutions and increase air quality. Vehicles run by gaseous fuels or electricity has the highest capability of emission reductions. Green fuels not only reduce harmful particles but also has cost benefit advantage as compare to conventional petrol and diesel.
4. To protect environmental pollution government should build 'Green Corridor Network' (GCN) dedicated only for Green Fuel Vehicles (GFV's).
5. To encourage this Green Fuel Vehicles sector government may implement 'incentive' and 'tax benefit' schemes for the entire green fuel vehicle's stake holders.
6. Government may involve environmental activist to promote 'Green Fuel Vehicles' or 'Alternative Fuel Vehicles'.
7. 'Green Transport Network' (GTN) can be built in SMART Cities across the country to provide sustainable clean transport.

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