IJASRM International Journal of Advanced Scientific Research and Management, Vol. 4 Issue 6, June 2019.
www.ijasrm.com
ISSN 2455-6378

India 2030 automotive energy scenario with special reference to biodiesel

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Abstract

India's economy largely depends on crude oil imports as India is the fourth largest consumer of crude oil products in the world, after the United States, China, and Japan. India for its automotive energy needs depends heavily on imported crude oil, mostly from the Middle East till date (2018). With the future rate of growth in the total number of automobiles, the crude oil imports are set to be slightly more than double by 2030. With no other option to increase the local production of crude oil, India is desperately looking for a better alternative. The alternative automotive energy should be in such a way that, it should not only save India's economy backbone but also to protect our country from environmental pollution, where already our metro cities are in the pollution danger zones. The two options of chemical potential from which India has to choose among the alternative automotive energy is the bio-diesel and Li-ion batteries. But in a bid to save the Indian economy and environment, the government of India is targeting the year 2030 by which it plans to go 100 percent electric mode in automobiles throughout the country.

While switching over to new technology the main aspects to be considered for its success is the sustainability in terms of raw materials and the economics involved in it. With the current state of infrastructure, economics, and feasibility for the common man, the possibility of going all electric within a short span of 12 years seems to be bleak. At present, the cost of Li-ion powered vehicles are really out of reach even for the middle-class population of the country, it is twice the cost of the gasoline-powered vehicle for a two-wheeler and for an electric car it is almost four to five times the cost of a gasoline-powered car. Any product in its introduction stage will have the problem of high initial cost per product, but with large scale mass production the cost will come down. In the case of Li-ion powered electric vehicle it may not be possible to have a decrease in the cost per vehicle with mass production, and the cost of the vehicle may double or triple for every five years, this is because of the limited raw material source and supplies required for the battery producers. This article tries to study the feasibility of going all electric automobile within a short span of 12 years and propose a suitable chemical potential that is the biodiesel which should be given the top priority considering the renewability, present infrastructure and the possible growth in the production and options of raw materials needed for biodiesel.

Keywords: *Environmental pollution, Alternative automotive energy, Year 2030, Electric vehicles and Biodiesel*

Introduction

India is the fourth largest consumer of petro-products among the countries of the world, and because of this reason, its economy can be significantly disrupted by the fluctuation in the price of the crude oil in the future years to come. As the crude oil reserves are getting depleted world over, the future energy demand along with the growing population of India, there will be a phenomenal rate of growth in the total number of automobiles. The crude oil imports are set to be slightly more than double by 2030. India at present for its automotive energy needs depends only on the crude oil imports, with very less option to increase the local production of crude oil, India is desperately looking for a

suitable alternative form of automotive energy. The alternative automotive energy option should be in such a way that, it should not only save India's economic backbone, it should also be sustainable by avoiding the import of raw materials, directly are indirectly from other countries. One more important consideration that should be kept in mind while shifting to another alternative form of automotive energy is that it should be in such a way that it reduces environmental pollution. Where already our metro cities are in the pollution danger zones. In a bid to save the Indian economy and environment, the government of India is targeting the year 2030 by which it plans to go all- electric automobiles in the country [2]. This article tries to study the feasibility and sustainability of this initiative and discuss the other option like biodiesel which India should consider along with the promotion of electric vehicles, before going all electric within a short span of 12 years from now.

India's current and future automotive energy demand (2015):

Crude oil imports:

India 's need for energy in the automotive sector has been steadily increasing since the 1980s, with a very long history for its dependence on crude oil. The future projections for crude oil demand leave India with the need for import of 7.2 million barrels/day of crude oil by 2040, up from 3.7 million barrels/day in 2014 (Anon.2019i), India has the highest import dependency among the other countries in the world, which will be over 90% of oil demand by 2040, up from 70% in 2014. India's growing dependence on oil and gas imports will adversely impact the current and fiscal deficits of the country. The net value of oil import which was 110 billion US dollar in 2014 will be around 300 billion US dollar by 2030.The fluctuation in crude oil price in the past 15 years is also erratic, (27 $ / barrel in 2000, 94.1 $ / barrel in 2008, 109.1$/barrel in 2012, 40.6 $ / barrel in 2016 and 65.6$ / barrel in 2018) [3] due to various international political and technical reasons makes the Indian economy very much unpredictable.

India's automotive industry past and the present (2015):

The first car ran on the Indian road was in the year 1897, till 1940s car was only imported that too in small numbers. In 1942 the first automotive industry in India was started by HINDUSTAN MOTORS followed by the PREMIER in 1944. After independence, between 1947 to 1970 passenger cars were produced by Hindustan motors, premier automobiles, and standard motors. Utility and Light Commercial Vehicles were produced by BAJAJ TEMPO, MAHINDRA & MAHINDRA and STANDARD MOTORS. Medium and Heavy Commercial Vehicles were manufactured by VEHICLE FACTORY JABALPUR, TATA Motors, Ashok Leyland and Simpson & Co. Scooters, Mopeds, and Motorcycles were produced by Bajaj Auto, Royal Enfield, Escorts group and Ideal java [4]. However, the growth was very slow till the 1970s.

After 1970 and till 1983 there was some potential growth in commercial vehicle segments, cars were meant for the elite, and the two-wheeler segment saw some growth in urban areas among the middle class. Only after 1992 Suzuki, Toyota and Hyundai of South Korea were allowed into the Indian automotive industry. Now India is the fourth largest automobile manufacturer in the world, producing a record 25.3 million motor vehicles in 2016-17. The total number of registered motor vehicles in India was 210 million as on 31.03.2015 [4] With this ever-increasing number of vehicles on Indian roads, the fossil fuel demand is at 213 million tones for the year 2017-18 [5], which amounts to USD 70.196 billion or Rs.4.7 lakh crore. According to a report by World Energy Outlook [1], the passenger car ownership in India will grow from less than 20 vehicles per 1,000 inhabitants in 2015 to 175 cars per 1,000 people in 2040, which will result in fuel consumption of eight times as that of in 2015.

Environmental concerns:

The current state of pollution in India is very much alarming. Air pollution in most Indian cities has crossed critical levels. The particulate matters (2.5 micrometers and 10 micrometers) and dangerous carcinogenic substances from the emission of automobiles have reached very alarming levels, taking a heavy toll on the health of the densely populated Indian cities. Out of the 20 world's most polluted cities, 13 cities are in India, and Delhi tops the list of more polluted [14] cities with 150 micrograms of 2.5 PM. The use of fossil fuels both petrol and diesel has severely threatened the economics and environment of India. The worldwide contribution of greenhouse gas of 20% is from vehicles using the fossil fuels, having a tremendous impact on climate change [24], even though late this is the right time to think for a suitable alternative and act.

Automotive energy options:

The current total alternative to the use of fossil fuel is very less, for the past hundred years due to the dependence of fossil fuels for

automobiles by India, the present infrastructure is not conducive for an immediate complete shift of technology to electric vehicles. The other options to decrease fossil fuel usage are, going for electric hybrid vehicles and biodiesel which can use the present infrastructure with ease.

Biodiesel for India- is it a good option:

Considering the climatic conditions and the availability of vast area of land in India, there is a strong possibility to look into the option of generating biodiesel and use it as alternate form energy for the diesel-guzzling automobiles, which is around 30 % of the total requirement of India. The government of India estimates that approximately 13.4 million hectares of barren land available to grow non-edible oil bearing trees, which can give a yield of about 15 million tons of oil each year [14]. India has over 300 different varieties [16] of species of trees which can produce non-edible oil from its seeds. Out of the 75 species studied, 37 species were found to be suitable for biodiesel development which could satisfy the ASTM fuel standards [20]. With all these advantages India formulated its first national policy on biofuel in 2009. The salient feature of this national policy on biodiesel is that India should adopt to biodiesel blending of 5 % by 2012, 10 % by 2017 and 20 % after 2017 [15] But the blending of biodiesel by 2017 stands only at 0.5% [21] this is because, even though India has all its advantages in-favor of biodiesel target, the biodiesel policy 2009 has its limitations which led to the shortfall in reaching the target. Due to the failure of the national policy of biodiesel 2009, the government of India may have switched over to the plan of going 100% electric by 2030. With the current infrastructure, population and economics it will be challenging to reach 30 to 40 % electric by 2030, considering the global penetration of electric vehicles of just 1 % in 2016.

Failure of national policy on biofuels-2009 and the emergence of biofuel policy-2018:

The critical factors to be considered for the failure of biofuel policy-2009, which had the target of blending of 20% biodiesel after 2017 are as follows:

1. The strategy and approach are only to produce biodiesel using the feedstock from the seeds of non-edible oil grown in the wasteland and degraded forest and non-forest land.
2. plantation of only new crops for producing non-edible oil bearing seeds by the cultivators and farmers were encouraged for the production of biodiesel, which can take more than seven years to give a sustainable output of oilseeds provided there is sufficient rainfall or water availability.
3. India's national mission on biodiesel encouraged the cultivators to focus on particular types of crop species such as Jatropha curcas[17] irrespective of geographical conditions. This crop can sustain draught, but it gives yield only when it receives proper irrigation.
4. The use of feedstock such as used cooking oil for the production of biodiesel in a decentralized manner has not been considered keeping in mind the food or fuel conflict.

Even though the oil marketing companies provide the minimum purchase price for biodiesel, it was linked to the prevailing retail diesel price [11].Since the retail diesel price fluctuates with the international crude price and the yield of seeds also varies with the availability of water and rainfall, almost 85% of the farmers discontinued [17] their plantation of Jatropha Curcas.

Merits of national biofuel policy-2018:

The failure of national policy on biofuel-2009 led to the emergence of the new national policy on biodiesel-2018. The goal of the policy with regard to the blending percentage of biodiesel is fixed at 5 % by 2030, which is very much less than the national biofuel policy-2009 and seems to be pessimistic. The definition of biodiesel according to national policy on biodiesel 2019 is that "a methyl or ethyl ester of fatty acids produced from non-edible vegetable oils, acid oils, used cooking oil or animal fat and bio-oil.[11]" The feedstock now includes used cooking oil, which is a good move since India produce 9.2 million tons [22] of used cooking oil per year and if all the used cooking oil is converted into biodiesel India can satisfy its entire diesel demand by 2030.

Is india's plan to go all-electric by 2030 over ambitious:

The entry of electric vehicle in India at commercial level started with the entry of two-wheelers after 2005 from China. When the fuel price was high during 2012, there was some interest seen in the use of two-wheeler electric bikes, but do the technical flaws (usage of lead acid battery) and the running range of only 30 to 40 km for a single charge and top speed of only 35km/hr made this alternate automotive technology less attractive. Also, an attempt by a company called REVA [6] which made small electric four wheeler car failed to create any buzz in the industries and public.

At present (2018) with a tremendous improvement in battery technology, there is an option for the reentry of electric vehicles on Indian roads.

But taking into other consideration with the other aspects like infrastructure for charging, the initial cost of ownership and the global penetration of electric vehicle sales of 1 % as on 2016 [26] the dream of going 100 % all electric in India by 2030 cannot be made a reality.

Assuming that there will be an electric vehicle penetration share of 40 to 50%. India has to look into other alternatives such as biodiesel along with electric vehicles to get itself sustainable by 2030.

What are the challenges?

Infrastructure:

India with the history of only getting adapted to the fossil fuel like petrol and diesel, the infrastructure for the fuel distribution throughout the nation has been established keeping in mind the requirements of internal combustion engines. For shifting towards electric mobility, for both two wheelers and four wheelers the infrastructure needed are quite complex, for so much number of petrol and diesel vehicles already on the road with lot of parking problems [7], the most essential infrastructure needed for extending the range is the establishment of charging station in metros, cities, and towns. To achieve this government and the electric vehicle manufacturers should sort out a strategic plan for establishing many more charging stations so that the Indian government national electric mobility plan of getting seven million electric vehicles on the Indian road by 2020 is possible.

The electric vehicle technology, past and present in India (2018):

The lesson learned from the launch of first-generation electric vehicles and the experience of using the lead-acid battery for automobile mobility, which gave a low range [19] of distance coverage (35 km for two-wheelers and 70 km for cars in a single charge). Also, there was a significant decrease in overall battery capacity within a year of usage and charging of vehicles only at home which resulted in losing confidence in electric vehicles during 2008-2012.

At present (2018) the Li-ion battery technology is so much evolved that the range of electric vehicle can be extended to 120 km per charge for a two-wheeler and 350 km to 450 km for a car. Since the Li-ion batteries are light and have more power density, this extended range is possible. Also, its reliability in performance makes the Li-ion powered electric vehicle more attractive. But the advantage of a gasoline-powered vehicle, which can cover a range of thousands of kilometer just by refueling the tank in a few minutes, can be matched only if we have enough number of charging station and improving the quick charge technology.

Economics and feasibility of owning an electric vehicle for common man:

India should not compare itself with the countries like the Netherlands, Norway, and France, whose ambition of selling only electric vehicles in the future because the population of these countries is less and their economy are strong. At present, the cost [26] of Li-ion powered vehicles in India are really out of reach even for the middle-class population of the country, it is twice the cost of the gasoline-powered vehicle for a two-wheeler and for an electric car it is almost four to five times the cost of a gasoline-powered car. Any product in its introduction stage will have the problem of high initial cost per product, but with large scale mass production the cost will come down.

In the case of Li-ion powered electric vehicle it may not be possible to have a decrease in the cost per vehicle with mass production, and the cost of the vehicle may double or triple for every five years, this is because of the limited raw material source and supplies required for the battery producers. Since the electric vehicle market around the world is at the brink of explosive growth, the raw material reserves mainly lithium, cobalt, and nickel could deplete before we see 300 million electric vehicles on the road say a report [7].

Conclusive remark and policy recommendation:

The wise strategy for India would be not trying for 100 % electric vehicle at any point of time in the future and combine with some other alternatives such as bio-diesel for diesel vehicles and bio-ethanol for petrol run vehicles along with Li-ion powered electric vehicles. Biodiesel is an excellent option to meet out the requirements of the current diesel demand of 30% [22]. The feedstock for the production of biodiesel can be obtained from waste vegetable oil and non-edible oils. India is the largest consumer of vegetable oils, producing around 9.2 million tons [22] of waste vegetable oil per year, the total diesel demand for India will be about 8 million tons by the year 2019 [8]. If all the used vegetable oils are collected and converted to biodiesel, then the total demand of diesel for India could be easily met. Despite having immense potential for the production of biodiesel from used vegetable oil, India is producing only 0.1% [22] of the total world production of biodiesel, the main reason for this is, that the used vegetable oil is reused for cooking at various level down the line and there is no regulation or law to ban the reuse of cooking oil. The consumption of used vegetable oil which contains a

higher amount of free fatty acids creates a lot of health problems [26]. If the government of India can create a policy and make laws to divert, all the used vegetable oils having greater than 25 % of free fatty acids to the production of biodiesel, the consumption of used vegetable oil can be eliminated. The waste is not only converted to wealth by producing biodiesel but also safeguard the health of the people and which in turn can reduce the burden of the government spending on the health sector. The collection and conversion of waste vegetable oil to biodiesel should be decentralized for its economic feasibility [13] rather than having a centralized system.

To curb the pollution problems more effectively, where the issue of pollution is severe in places like Delhi and other cities in India, allowing the registration of only electric vehicles may be permitted from 2030.

Policy recommendations:

The national policy on biofuels (both 2009 and 2018) by Government of India encourages mainly the non-food feedstock for biodiesel production to avoid any conflict with food security, and it has identified over 400 tree species producing non-edible oils. Only now in the national policy on biodiesel-2018, the use of feedstock such as used cooking oil has included, but even now the policy is not matured enough to utilize its full potential. It needs further improvement, and the recommendations are as follows

1. The government of India should bring a policy to ban the reuse of used vegetable oil containing more than 25% of free fatty acid.
2. Allow the import of used vegetable oil and fatty acid oil for biofuel production.
3. Policy for collecting used vegetable oil from bulk users such as from food industry and a mechanism in place to convert the used vegetable oil into biodiesel in a decentralized manner.
4. Policy for creating health awareness on the consumption of used vegetable oil and the benefits of converting them into biodiesel.
5. Health ministry and family welfare, Government of India should frame strict laws to restrict the consumption of used vegetable oil in the food industry. It also should frame guidelines to check the quality aspects for using the vegetable oil beyond which the oil should be discarded.
6.Research and development to find a suitable economic production process for converting non-edible oil containing a higher percentage of free fatty acids and used cooking oil into biodiesel.
7. Suggestion after in-depth analysis and investigation of the crops to be grown for the production of oil, so that it is economically feasible for the farmers to grow a particular crop in a particular geographical location.

References

[1] "775 Per Cent Jump In Passenger Car Ownership In 24 Years: Report". 2019. The EconomicTimes.https://economictimes.indiatimes.com/775-per-cent-jump-in-passenger-car-ownership-in-24-ears-report/articleshow/52958430.cms

[2] Anon.2019a. India To Sell Only Electric Vehicles By 2030: Piyush Goyal. The Hindu. Accessed December24,2018.https://www.thehindu.com/news/national/karnataka/india-to-sell-only-electric-vehicles-by-2030-piyush goyal/article19516175.ece?_escaped_fragment_=.

[3] Anon.2019b.OPEC Oil Prices 1960-2018 |Statistic. Statista. https://www.statista.com/statistics/262858/change-in- opec-crude-oil-prices-since-1960/.

[4] Anon.2019c.Automotive Industry In India .En.Wikipedia.Org.January10,2019.https://en.wikipedia.org/wiki/Automotive_industry_in_India .

[5] Anon.2019d.India'S Fuel Demand Grows 5.30% In FY18 - ET Energyworld. Etenergyworld.Com.https://energy.economictimes.indiatimes.com/news/oil-and-gas/indias-fuel-demand-grows-5-30-in- fy18/63848708.

[6] Anon.2019e.https://economictimes.indiatimes.com/india-emerging/reva-electric-car-founder-chetan-maini-on-his-entrepreneurial-journey-electric-car-dreams/articleshow/8796342.cms.[6] Anon.2019f.Ijirset.Com.http://www.ijirset.com/upload/2017/february/50_A%20Case.pdf.

[7] Anon.2019g. 'Shortage Of Battery Ingredients Comes In The Way Of EV Switchover'.TheHindu. https://www.thehindu.com/business/Industry/shortage-of-battery-ingredients-comes-in-the-way-of-ev- switchover/article23281341.ece#!

[8] Anon.2019h.Diesel Use In India Set For RecordIn2018.IN. https://in.reuters.com/article/india-diesel/diesel-use-in-india-set-for-record-in-2018-idINKBN1H30PS.

[9] Anon.2019i. Indian Petroleum And Natural Gas Statistics-2016-17.Data.Gov.In. https://data.gov.in/catalog/indian-petroleum-and-natural-gas-statistics-2016-17.

[10] Anon.2019j https://www.moneylife.in/article/grasping-at-straws-pathetic-state-of-biofuels-in-india/54124.html.

[11] Anon.2019k.Mnre.Gov.In. https://mnre.gov.in/file-manager/UserFiles/biofuel_policy.pdf.
[12] Anon.2019l..Petroleum.Nic.In. http://petroleum.nic.in/sites/default/files/biofuel policy2018_1.pdf.
[13] Avinash, A., and A. Murugesan. 2017. Economic Analysis Of Biodiesel Production From Waste Cooking Oil. Energy Sources, Part B: Economics, Planning, And Policy 12, no. 10: 890-894.
[14] Biswas, T. and Biswas, N. (1999). Electric Vehicle: A Natural Option for India?. IETE TechnicalReview,16(3-4), pp.367-373.
[15] Chandel, Anuj K., Latika Bhatia, Vijay Kumar Garlapati, Lakshmishri Roy, and Anju Arora. "BiofuelPolicyin Indian Perspective: Socioeconomic Indicators and Sustainable Rural Development." In Sustainable Biofuels Development in India, pp. 459-488.
[16] Dadwal, S. 2009. India's Energy Security: Challenges And Opportunities. Eurasian Geography And Economics 50, no. 6: 665-681.
[17] Kant, P., and S. Wu. 2011. The Extraordinary Collapse Of Jatropha As A Global Biofuel. Environmental Science&Technology 45, no. 17: 7114-7115.
[18] Kumar, A., and S. Sharma. 2011. Potential Non-Edible Oil Resources As Biodiesel Feedstock: An Indian Perspective. Renewable And Sustainable Energy Reviews 15, no. 4: 1791-1800.
[19] Liao, F., E. Molin, and B. van Wee. 2016. Consumer Preferences For Electric Vehicles: A Literature Review. Transport Reviews 37, no. 3: 252-275.
[20] MOHIBBEAZAM, M., A. WARIS, and N. NAHAR. 2005. Prospects And Potential Of Fatty AcidMethylEstersOf Some Non-Traditional Seed Oils For Use As Biodiesel In India. Biomass And Bioenergy 29, no. 4: 293-302.
[21] Natarajan, R. 2019. Grasping At Straws: Pathetic StateOf Biofuels In India. Https://Www.Moneylife.In. https://www.moneylife.in/article/grasping-at-straws-pathetic-state-of-biofuels-in-india/54124.html.
[22] Pareek, S. 2019. This New Technology By IIT Delhi Students Can Convert Waste Cooking Oil Into Bio Diesel - The Better India. The Better India. https://www.thebetterindia.com/17584/new-technology- that-can-convert-waste-cooking-oil-into-bio-diesel-iit-delhi-innovation/.
[23] Registered Motor Vehicles In India As On 31.03. 2015". 2019. Open Government Data PlatformIndia. https://community.data.gov.in/registered-motor-vehicles-in-india-as-on-31-03-2015/.
[24] Sims, Ralph, Roberto Schaeffer, F. Creutzig, X. Cruz-Núñez, M. D'agosto, D. Dimitriu, M. J. Figueroa Meza et al. "Transport Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change ed O Edenhofer et al." Cambridge and New York: Cambridge University Press. Available at: https://www.ipcc.ch/site/assets/uploads/208/02/ipcc_wg3_ar5_chapter8.pdf.
[25] Sperling, D. (2018). Electric vehicles: Approaching the tipping point. Bulletin of the Atomic Scientists,74(1),pp.11-18.
[26] Utlu, Z. 2007. Evaluation Of Biodiesel Fuel Obtained From Waste Cooking Oil. Energy Sources, PartA:Recovery, Utilization, And Environmental Effects 29, no. 14: 1295-1304.