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India

Biofuels Annual

2014

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Report Highlights:

Indian ethanol production in calendar year (CY) 2015 will increase to 2.1 billion liters due to higher sugarcane production in marketing year (MY) 2014/15 (October-September). Ethanol will make up 2.1 percent of India's fuel supply in CY 2014 and 2.5 percent CY 2015. Biodiesel production from multiple feedstocks a variety of feedstocks, to include crude oil, used cooking oils, and animal fats looks promising, but continues to struggle to achieve real economic viability.

Post: **Commodities:**
New Delhi

Executive Summary:

Domestic Indian ethanol production in CY 2015 will approach 2.1 billion liters, three quarters of which is for the potable spirits industry, a moderate increase over 2 billion liters produced in CY 2014. The upward forecast is due to higher sugarcane production in MY 2014/15 (October-September). The new Indian administration is considering an increase in Government of India's (GOI) ethanol blending mandate from the current level of five percent to 10 percent in CY 2015. Government-owned petroleum companies (known colloquially as oil marketing companies (OMCs)) are expected to procure 550 million liters of ethanol in CY 2014, indicating that ethanol would make up about 2.1 percent of India's fuel market. Post expects that if the mandate is increased next year, OMCs will procure upwards of 700 million liters of ethanol, which will lead to a 0.4-percent increase in ethanol's total penetration in India's fuel market.

Biodiesel production from multiple feedstocks, to include crude vegetable oil, used cooking oils, animal fats, and others shows signs of life, but more groundwork needs to be done before biodiesel is economically viable. India's earlier emphasis on jatropha-derived (*Jatropha curcus*) biodiesel has not fared well, as the production and commercial viability of jatropha have proven to be dubious. While India does not currently maintain a specific mandate for biodiesel usage, any future mandates will require a more dedicated effort to plant energy crops and/or switch to alternate sources of biodiesel to include locally available tree-borne oilseeds and a variety of other feedstocks.

Author Defined:

Overview:

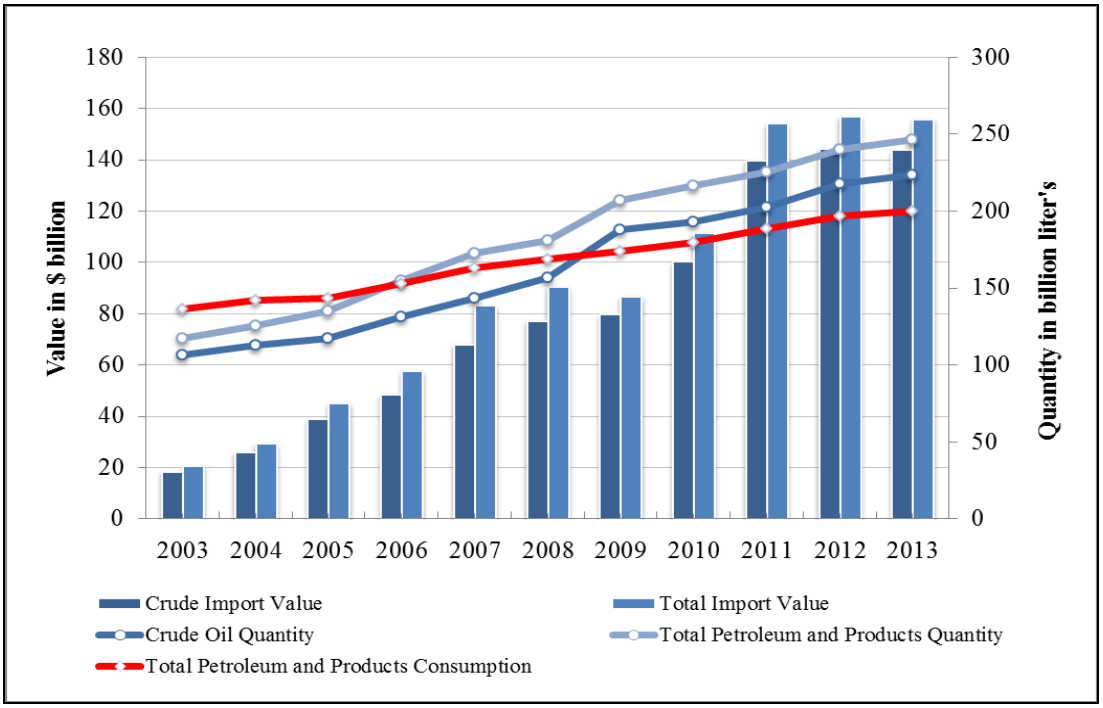
According to the World Bank's January 2014 Global Economic Prospects Report, India's economy is expected to grow by about 5.6 percent in Indian fiscal year (IFY) 2014/15 (April-March).[1] If the World Bank's forecast is accurate, it would mark a noteworthy increase over the sub-five percent levels experienced in IFY 2013/14. The report also cites that India's growth would be among the strongest among major developing economies between 2013 and 2016. India's growth drives energy consumption across all major sectors, making India the fourth largest energy consumer, following the United States, China, and Russia. Although Indian growth has slowed in recent years, India continues to benefit from strong domestic demand and international exports. Significantly, most Post contacts are optimistic that India's new Prime Minister Narendra Modi will implement better macroeconomic policies and lead a growth-oriented administration.

While India's domestic energy base is substantial, India continues to import significant amounts of energy resources. In IFY 2006/07, imports of fossil fuels grew at a rate of seven percent, which outpaced consumption growth by three percent. However, in last three fiscal years, higher petroleum

[1] World Bank's Global Economic Prospects Report 2014

prices led to demand contraction. Based on Ministry of Petroleum data, that during the last three fiscal years, the value of petroleum imports was relatively stagnant and volumes of imports grew only marginally. Post expects this was most likely due to the 35-percent depreciation of the rupee against the dollar during the corresponding period (Figure 1).

Figure 1. India: Import of Crude Oil, Petroleum Products and Total Consumption



Source: Petroleum Planning and Analysis Cell, Government of India (GOI)
Note: Time scale is Indian fiscal year

Energy Consumption Basket and End Usage

Currently, coal and oil constitute 66 percent of India's total primary energy consumption basket. Natural gas maintains a seven-percent share of the basket, and renewables such as wind, geothermal, solar, hydroelectricity, and waste account for 25 percent of India's total energy. Nuclear accounts for a one-percent share.

Vehicular transportation accounts for most of India's energy usage. The total number of registered motor vehicles in India as of March 31, 2011, was 142 million, with motorbikes and scooters accounting for 72 percent, personal vehicles and taxis accounting for 14 percent, and buses and trucks making up the final14 percent.[2] Continued economic growth, increased urbanization, rising consumer spending, and improving road infrastructure should push new vehicle registration to 190 million vehicles by the end of IFY 2014/15.

According to the Ministry of Road Transport and Highways, the transportation sector accounts for 6.4 percent of India's gross domestic product (GDP), with road transportation accounting for 4.5 percent.

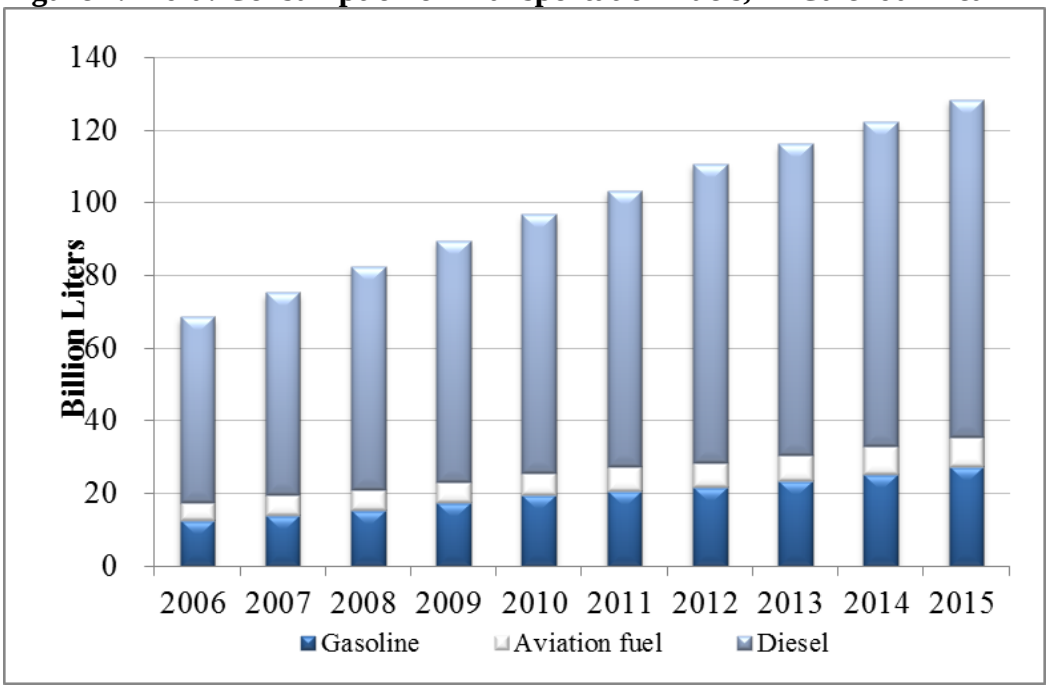
[2] http://morth.nic.in/writereaddata/linkimages/English%20Part%202-3806608617.pdf

Road infrastructure is used to transport over 60 percent of goods and upwards of 88 percent of total passenger traffic. Ease of availability, adaptability to individual needs, and economic efficiencies are the main factors favoring road transportation. Road transportation also acts as a feeder service to rail, ship, and air transportation. The number of motor vehicles on Indian roads is growing at a rate of about nine percent annually. Ninety percent of Indian freight and 60 percent of Indian passenger traffic were transported by road at the beginning of IFY 2010/11.

As vehicle ownership expands, the demand for gasoline and petroleum products will concurrently rise. Currently, diesel accounts for an estimated 73 percent of fuel demand, followed by gasoline at 20 percent, and aviation fuel at seven percent (Figure 2). The combined demand for diesel and gasoline is expected to grow by more than five percent annually over coming years. Further, Post estimates that by end of this decade, the average demand for transport fuels will rise from an estimated 117 billion liters, from 167 billion liters in CY 2013 to195 million liters and would grow reach by CY 2023 (Table 1).

The Ministry of Environment and Forestry notes that transportation growth and increasing consumption of petroleum has a negative effect on India's air quality. Because India is the fourth (energy data) largest global contributor to carbon emissions, the GOI is targeting Euro 3 and Euro 4 vehicle emission standards.[3] In its effort to achieve Euro 3 and Euro 4 standards, the Union Cabinet approved the National Biofuel Policy on December 24, 2009 (PIB press release).

Figure 2. India: Consumption of Transportation Fuels, In Calendar Year



Source: Petroleum Planning and Analysis Cell, Government of India (GOI)
*: Estimated for IFY 2014

Table 1. India: Fuel Use Projections (Billion Liters)

[3] http://morth.nic.in/index2.asp?slid=58&sublinkid=29&lang=1

Calendar Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Gasoline Total	28	30	32	35	37	40	43	47	50
Diesel Total	94	97	101	106	110	115	119	124	129
On-road	56	58	61	63	66	69	72	74	78
Agriculture	11	12	12	13	13	14	14	15	16
Construction /mining	4	4	4	4	4	5	5	5	5
Shipping/rail	5	5	5	5	5	6	6	6	6
Industry	10	11	11	12	12	13	13	14	14
Heating *	7	8	8	8	9	9	10	10	10
Jet Fuel Total	8	9	10	10	11	12	13	14	15
Total Fuel Markets	130	136	143	151	159	167	176	185	195

Source: Industry and trade sources

*: Heating / power generation

Proportion of diesel consumption through 2023 are indicative only.

Scope

The GOI seeks to use biofuels as a means to provide a higher degree of national energy security by supplementing conventional energy resources, reducing dependence on imported fossil fuels, and meeting the energy needs of India's vast (and growing) population. The GOI promotes production and blending of ethanol derived from sugar molasses, and biodiesel derived from inedible and waste oils for blending with diesel.

India's production of biodiesel from jatropha seeds is commercially negligible and economically unviable. Farmers have not planted jatropha because it is difficult to market, yields are poor, and seed quality is inconsistent. As a result, most of the biodiesel units operating in India have turned to alternative feedstocks such as edible oil waste (unusable oil fractions), animal fats, and other inedible oils. This hodgepodge of oils accounts for about 28 percent of biodiesel producers' existing capacity and enables them to continue operations throughout the year. In the last few years, stakeholders from the private sector and the government have identified tree-borne oilseeds such as pongamia (*Pongamia pinnata*), neem (*Azadirachta indica*), kusum (*Achleichera oleosa*), and mahua (*Madhuca longifolia*) as alternatives to jatropha for biodiesel production, although thus far only experimentally. Long-term availability, feasibility, and sustainability of tree-borne oilseeds remain to be determined.

Additionally, biomass plays an increasingly important role as an energy source for sugar mills (captive use), textiles mills, and pulp and paper mills. Biomass also has potential for other significant industries, to include breweries, fertilizer plants, solvent extraction units, rice mills, and petrochemical plants. The total estimated biomass power potential in India is estimated at 31,000 megawatts (MW) of which the surplus power generation through bagasse cogeneration is estimated at 7,500-10,000 MW.

POLICY AND PROGRAM: INDIA'S BIOFUEL POLICY

The GOI approved India's National Biofuel Policy on December 24, 2009. The policy encourages use of renewable fuel as an alternative to petroleum and proposes to supplement India's fuel supply with a 20 percent biofuel (bioethanol and biodiesel) mandate by end of 12th Five-Year Plan (2017).

In a bid to renew its focus and implement the Ethanol Blending Program (EBP), on November 22, 2012, the Cabinet Committee of Economic Affairs (CCEA) recommended a five-percent ethanol blending mandate (CCEA had previously set the blending target). It also recommended that the procurement price of ethanol would be decided by between the OMCs and private sector suppliers of ethanol. The GOI's current target of five-percent blending of ethanol in gasoline has been partially successful in years of surplus sugar production and unfilled when sugar production declines. Presently, the contracted ethanol supply for calendar year 2014 is sufficient to meet 2.7-percent blending target.

Salient Features of India's Biofuel Policy

- Derive biofuels from non-food feedstocks grown on degraded soils or wastelands which are not otherwise suited to agriculture, thus avoiding a possible conflict of fuel versus food.

- Strengthen India's energy security by encouraging use of renewable energy resources to supplement motor transport fuels. An indicative 20-percent target for blending of biofuel for both biodiesel and bioethanol is proposed by end of 12th Five-Year Plan (IFY 2012/13 through fiscal 2016/17).

- Minimum support price (MSP) mechanisms for inedible oilseeds to provide fair prices to oilseed growers (subject to periodic revision).

- OMCs should purchase ethanol at a minimum purchase price (MPP) based on the actual cost of production and import price of ethanol. In the case of biodiesel, the MPP should be linked to the prevailing retail diesel price.

- If necessary, GOI proposes to consider creating a National Biofuel Fund for providing financial incentives, including subsidies and grants, for new and second generation feed stocks, advanced technologies and conversion processes, and production units based on new and second generation feedstock.

- Thrust for innovation, (multi-institutional, indigenous and time bound) research and development on biofuel feedstock (*utilization of indigenous biomass feedstock included*) production including second generation biofuels.

- Meet the energy needs of India's vast rural population by stimulating rural development and creating employment opportunities and addressing global concerns about containment of carbon emissions through use of environment friendly biofuels.

- Bring biofuels under the ambit of "Declared Goods" by the GOI so as to ensure their unrestricted

interstate and intrastate movement. Except for a concessional excise duty of 16 percent on bioethanol, no other central taxes and duties are proposed to be levied on biodiesel and bioethanol.

- Biofuel technologies and projects would be allowed 100-percent foreign ownership through automatic approval to attract foreign direct investment (FDI), provided the biofuel is for domestic use only, and not for export. Plantations of inedible oil bearing plants would not be open for FDI participation.

- Setting up of National Biofuel Steering Committee (NBSC) under Prime Minister to provide policy guidelines.

For more information, please note the following the link: biofuel policy.

Institutional Mechanism

The National Biofuel Policy proposed to set up a National Biofuel Coordination Committee (NBCC) headed by the Prime Minister. The NBCC provides policy guidance on the different aspects of biofuel development, promotion, and utilization. It also serves as the principle GOI coordinator for the array of different GOI agencies and ministries with more minor roles in determining India's biofuel policy. The committee meets periodically to review the progress and monitor the biofuel program. NBSC mandates that various state governments must work closely with respective research institutions, forestry departments, and universities for developing and promoting biofuel programs in their respective states. However, to date, few states have actually drafted any policies and/or set up institutions for promoting biofuel in their states.[4] Several ministries have been allocated specific roles and responsibilities as to deal with different aspects of biofuel development and promotion, to include the following:

Ministry	Role
New and Renewable Energy	Policymaking and overall coordination concerning biofuels. Undertakes Research and Development (R&D) on various applications of biofuels
Petroleum and Natural Gas	Responsible for marketing biofuels as well as develops and implements pricing and procurement policy
Agriculture	R&D of biofuel feedstock through Indian Council for Agricultural Research and Indian Agricultural Research Institute (sweet sorghum, jatropha, *Pongamia*, and inedible oilseeds). Undertakes jatropha plantation in non-forest land.
Rural Development	Plantation of jatropha on wastelands. Integrates biodiesel program with rural development schemes (such as Mahatma Gandhi National Rural Employment Guarantee Scheme). Coordinates R&D with other departments/agencies
Science and Technology	Supports research on biofuel crops through bio-technology
Road Transport and Highway	Plantation along highway rights-of-way and use biofuel blended fuel. Works with automobile manufacturers association in India for engine modification,

[4] http://www.pcra-biofuels.org/whois.htm

	emission norms
Railways	Undertakes plantation of jatropha over wastelands along rail rights-of-way and trials of biodiesel blended fuel on railroad locomotives.
Environment and Forest	Ensures plantation of jatropha and tree borne oilseeds in forest wastelands; gets Central Pollution Control Board to monitor health and environmental effects.

ETHANOL POLICY

Most Indian ethanol is produced from sugarcane molasses (although a minor amount is processed from grain) for blending with gasoline. Ethanol and alcohol production in India depends largely on availability of sugar molasses (a byproduct of sugar production). Since sugarcane production in India is cyclical, ethanol production also varies accordingly and optimum sugar supply levels do not always correspond with demand. At times, lower availability of sugar molasses, and subsequent higher molasses prices, affect production costs of ethanol, thereby disrupting ethanol supplies for the blending at pre-negotiated, fixed ethanol prices.

Developments in EBP

Date	Action	Comments
January, 2003	Ministry of Petroleum and Natural Gas (MoPNG) made five-percent ethanol blending (Gazette on EBP) in gasoline mandatory across 9 States and 5 Union Territories	Partially implemented due to unavailability of ethanol (due to low sugarcane production in 2003/04 and 2004/05)
September, 2006	Resurgence in sugarcane production in 2005/06 and 2006/07 led GOI mandate five-percent blending of ethanol in gasoline across 20 states and 4 Union Territories (excludes Northeast, Jammu & Kashmir and Andaman & Nicobar) subject to commercial viability	OMC contracted for 1.4 billion liters of ethanol for EBP at INR 21.50/liter from Nov 2006 to Nov 2009. Only 540 million liters of ethanol supplied till April 2009 due to short supply of sugar molasses. GOI deferred implementation due to short supply of sugarcane in 2007/08
September, 2008	Union Cabinet approved the National Biofuel Policy. Five-percent blending mandatory across all states in the country.	GOI deferred the plan again due to short supply of sugarcane and sugar molasses in 2008/09.
October, 2008	Third phase of implementing EBP envisaged blending ratio to be increased to 10 percent.	Since there was no official notification released, oil marketing companies have not started 10-percent ethanol blending.
November 2009	Government held meeting to decide blending target for EBP	Status-quo remains, targets five-percent EBP

August 2010	Government fixed an ad-hoc provisional procurement price of INR 27 per liter of ethanol by OMC for EBP program. Decision was taken to constitute expert committee under Chairmanship of Dr. Choudhary, Member of Planning Commission, to recommend a formula for pricing ethanol.	Expert Committee in March 2011 had recommended that ethanol be priced 20-percent lower than gasoline price. No consensus yet on pricing policy of ethanol. In any event when ethanol supply runs short, government proposed to reduce import duty on alcohol and molasses. OMC caveated the proposal that alcohol or molasses could not be imported for EBP; it has to be exclusively sourced from domestic produced molasses.
CY 2011	OMC unable to procure contracted ethanol supplies from sugar mills and ethanol manufacturers. The Ministry of Petroleum and Natural Gas, GOI has not been able to implement compulsory blending of five-percent ethanol in gasoline.	Most of the domestic ethanol producers or suppliers were disqualified to supply ethanol. Non-finalization of ethanol pricing formula and procedural delays by various state governments delayed the procurement for EBP. Industry sources estimate that 365 million liters of ethanol was supplied against the contracted 570 million liters. During same period, a major share of molasses production was diverted as cattle feed to Europe.
CY 2012	OMC targets to procure 1 billion liters of ethanol for fiscal 2011/12.	After deducting the ethanol requirement for EBP in non-implementing states (such as Tamil Nadu, West Bengal, Odisha, Jharkhand, Chhattisgarh & Madhya Pradesh), the present requirement worked out to 720 million liters, of which suppliers had offered to supply 610 million liters. With lesser supply in few states, the contracted supply was subsequently drawn down to 430 million liters and further down to 305 million liters during Calendar Year 2012. Surplus molasses was exported as cattle feed to Europe.
CY 2013	In a bid to renew its focus and strongly implement the EBP, the Cabinet	The union government under the Motor Spirits Act on January 2

	Committee of Economic Affairs (CCEA) on November 22, 2012, recommended five-percent mandatory blending of ethanol with gasoline. Henceforth, the procurement price of ethanol shall be decided by between the OMC and suppliers of ethanol (CCEA recommendation). OMC floated a joint e-tender in first week of January for procuring 1.05 billion liters of ethanol to be supplied during April 2013 through March 31, 2014. With the validity of the offer for the domestic tender expiring on May 27, 2013, the offer was further extended on request by two months through July 26, 2013. Per one of the CCEA recommendations, in case of any shortfall in domestic availability, the OMCs and chemical companies were free to import ethanol for EBP. Since OMCs were falling short by more than 820.3 million liters of ethanol, they floated a global tender in third week of January to augment remaining supplies. The tender floated in January 2013 for 1.05 billion liters of ethanol supply through March 14 has now been extended to November 2014.	notified that few states such as Uttar Pradesh, Delhi, Haryana, Punjab, Karnataka and Goa can even achieve up to 10-percent ethanol blending target, but the overall average for the country as whole should reach five percent by end of June 30, 2013. The interim (ad-hoc) price of INR 27 per liter would no longer hold as price would now be decided by market forces. Indian ethanol suppliers (sugar manufacturers) offered to supply 551 million liters. Price quoted by suppliers ranged from INR 38 to INR 54 per liter (*delivered at OMC Depot*). The price quoted by few bidders was perceived to be on the higher side. OMCs received 5 offers from both Indian and international suppliers, of which one was rejected. (This was the first time the government had allowed foreign suppliers to offer ethanol for domestic EBP. Suppliers offered around 620 million liters of ethanol. However, the price quoted (INR 69 to 92 per liter of ethanol, C&F depot) was perceived to be high and therefore the global tender was rejected. Of the total ethanol offered by suppliers, the quantity accepted for lifting by OMCs was 382 million liters. However, by end of CY 2013 the only 182 million liters was lifted. Remaining 200 million liters will be carried forward to CY 2014.
CY 2014	OMCs floated another tender in July 2013 for procuring 1.33 billion liters of ethanol for supply during December	The quantity offered by sugar mills/ethanol manufacturers was 618 million liters. The quantity accepted

	2013 through November 2014. In January 2014, OMCs floated an EOI for procuring additional ethanol. GOI is contemplating to raise EBP program from 5 to 10 percent in near future. There is a proposal to revise the formula to fix the benchmark price for ethanol procurement. The proposed formula would be based on the average of the refinery transfer price (RTP) or cost of petrol to the oil marketing companies for the previous financial year instead of the lowest RTP, which stands at INR 44 a liter. The revised formula is expected to be a win-win opportunity for both the stakeholders.	by OMC for lifting was 252 million liters. Quantity offered by sugar mills was 53 million liters and the whole volume was accepted to be lifted by OMCs. Total quantity accepted by OMC is thus 252 + 53 million liters = 305 million liters. Adding 200 million liters as carry forward from CY 2013, total quantity that shall be lifted in CY 2014 will be 505 million liters through November 2014. Assuming that OMC shall come out with another tender soon for ethanol procurement for CY 2015, Post anticipates that OMC shall procure another 50 million liters in December 2014. The cumulative volumes will now be 555 million liters (252+53+50). Presently, the EBP is presently being implemented in a total of 13 states with blending level of about 2.1 percent (and is expected to touch 2.5 percent blending by end of CY 2015). Post expects to see some momentum when the new pricing formula is put in place and 'implemented'. We have noticed in past that India has the capacity to fulfill its ethanol blending mandate provided there is an equal incentive for both the producers (sugar millers) and blenders (oil marketing companies). Major distilleries were reported to have exported ethanol as well as molasses (as cattle feed) as way to infuse cash flows in otherwise surplus sugar season when sugar mills are finding difficult to break-even. Currently, the OMCs are offering a ceiling price of INR 44 per liter ($0.74), delivered at various depots. Given the current ex-mill prices of

		molasses based products (rectified spirit, extra neutral alcohol and fuel ethanol ($.67 per liter)) that range from INR 33-46 per liter, the offered price by OMC is still attractive for some suppliers or sugar mills although average retail price of gasoline is still on a higher side. A benchmark price somewhere in the middle could still be negotiated between buyer and seller and looks feasible as well. Further, it is estimated that by end of CY 2017, India would require more than 6.3 billion liters (Table 1) of ethanol to meet its ambitious target of 20-percent EBP. Given the current pace of development, a target to meet 5% blending of ethanol (1.6 billion liters) with gasoline looks plausible.

Means to expand domestic ethanol supply

- If mills are given the flexibility to market cane juice, whether to crystallize most of it into sugar or ferment it into alcohol, they will produce more of whichever fetches higher revenues.[5] Coupled with a robust EBP, the cyclical swings in sugar production could also be addressed. Additionally, diverting B-Heavy molasses could produce additional ethanol when required.

- Current research and development activities are focused more on second-generation bio-diesel production from locally available ligno-cellulosic material or agricultural and forest residues; which has its own set of challenges and opportunities. Both the private and public sectors claim to be successful in customizing technology (low-cost) to generate power (on pilot scale) from bio-mass resources, particularly ligno-cellulosic material. Scaling up of such projects is yet to be seen, while industry observers are optimistic.

- Public and private institutions can also promote use of alternate crops such as sweet sorghum, sugar beet, sweet potatoes, pearl millet and broken rice to supplement domestic ethanol production, though the efforts to produce ethanol from these feed stocks are only experimental or at pilot stage.

- The GOI is offering subsidized loans through sugarcane development funds to sugar mills for setting up of ethanol production units. The loan would cover a maximum of 40 percent of the project cost.

[5] Excerpts from *Hindu Business Line* column "Dithering on ethanol", March 14, 2014.

Impediments

Procedural hurdles such as non-issuance of export permits for interstate transport of ethanol, delay in issuing no-objection certificates (NOC), plus higher taxes and levies across different state lines have impeded the EBP. Rules and regulations, including the high excise duty (central excise duty of INR 772.50 per ton on molasses versus 12.36% ad valorem on industrial alcohol), interstate charges, and so on applicable to control alcohol for potable industry use are equally applicable for ethanol blending with gasoline, thereby severely constraining its availability and utilization for EBP.

BIODIESEL POLICY

The GOI had launched the National Biodiesel Mission (NBM) identifying jatropha as the most suitable inedible oilseed for biodiesel production. The Planning Commission of India had set an ambitious target of planting 11.2 to 13.4 million hectares to jatropha by the end of 11th Five Year Plan (2011/12). The central government and several state governments provide fiscal incentives for supporting planting of jatropha and other inedible oilseeds. Several public institutions, government departments, state biofuel boards, state agricultural universities and cooperative sectors are also supporting the biofuel mission in various capacities.

Developments in NBM:

Date	Action	Comments
April, 2003	**Demonstration phase 2003 to 2007:** Ministry of Rural Development appointed as nodal ministry to cover 400,000 hectares under jatropha cultivation. This phase also proposed nursery development, establishment of seed procurement and establishment centers, installation of trans-esterification plant, blending and marketing of biodiesel	Public and private sector, state government, research institutions (Indian and foreign) involved in the program achieved varying degrees of success.
October, 2005	MoPNG announced biodiesel purchase policy in which Oil Marketing Companies (OMC) would purchase biodiesel across 20 procurement centers across the country to blend with high speed diesel w.e.f January 2006. Purchase price set at INR 26.5 per liter	Cost of biodiesel production higher (20 to 50 percent) than purchase price. No sale of biodiesel.
2008	**Self-Sustaining Execution phase 2008 to 2012:** Targeted to produce sufficient biodiesel for 20-percent blending by end of 11th (2008-12) five year plan	Lack of large scale plantation, conventional low yielding jatropha cultivars, seed collection and extraction infrastructure, buy-back arrangement, capacity and confidence building measures among farmers impeded the progress of this phase.
2010	An estimated 0.5 million hectares has	Assuming 80-percent biodiesel

	been covered under jatropha cultivation of which two third plant populations is believed to be new plantation and would take two to three years to mature	requirement is met though jatropha oilseeds, the biodiesel thus obtained will just meet 0.01 percent of total biodiesel required for five-percent blending by 2010/11.
Fiscal 2011/12	No additional wastelands have been brought under jatropha cultivation except for few captive plantations managed by OMCs.	The government may have to offer fiscal incentives (coupled with carbon credits) to growers to adopt better agronomic practices during first 2-3 years of plantation development besides marketing and price support mechanism to encourage jatropha plantation.
Fiscal 2011/12	The production of biodiesel from jatropha seeds remained commercially insignificant.	According to the Ministry of Petroleum and Natural Gas, GOI, no biodiesel has been procured by oil marketing companies for blending with diesel in last three to four years.
Fiscal 2012/13	Biodiesel production from multiple feed-stocks (crude oil, used cooking oils, animal fats etc.) was economically viable option left with the producers.	Most of the plants utilizing this technology were able to make commercial sales in last few years despite running at slightly over quarter of their installed capacities (480 million liters estimated). Industry sources claim that small to medium scale industries are the major buyers of biodiesel (methyl ester) who blend it with conventional diesel. Industry sources claimed that the average purchase price of biodiesel in India (particularly in Andhra Pradesh that produces bulk of biodiesel through multiple feed stock utilization) then was around INR 45-48 per liter (includes freight) and seem viable for blending as regular diesel was selling at a price premium of 18-20 percent over biodiesel (methyl ester).
Present status	Industries engagement with tree-borne oilseeds as alternate to jatropha for biodiesel production gets due attention.	Seed yield from jatropha plantation (on pilot scale) were observed to be significantly lower than stipulated. Consequently, cost of production of biodiesel from jatropha seed is too high providing little incentive for producers to go full throttle. Evidently, in last few

		years, few stakeholders (from private and government sector) were engaged in identifying tree-borne oilseeds (neem, pongamia, mahua and kusum) as alternate to jatropha for bio-diesel production, but on an experimental basis. However, availability, feasibility and sustainability of tree-borne oilseeds still need to be validated. Biodiesel producers claim to realize INR 38-40 from sale of a liter of biodiesel (excludes transportation cost). Hopes are high that if subsidies on diesel are gradually phased out, biodiesel producers may get a larger piece of the pie.

The GOI's earlier plan of producing a 20-percent mandate of biodiesel by MY 2011/12 (October/September) was based on assumptions that significant quantities of jatropha would be available. While India does not currently maintain a specific mandate for biodiesel usage, any future mandates would require a more dedicated effort to plant commercially viable energy crops and/or switch to alternate sources of biodiesel to include locally available tree-borne oilseeds and a variety of other feedstocks.

Impediments

The combination of small land holdings and ownership issues with public and/or community-owned wastelands resulted in little progress made by state governments to create large jatropha plantations. Additionally, jatropha seeds were not readily available (due to poor productivity), lack of promising varieties/cultivars, rising wage rates, and inefficient marketing channels increased the costs of production, making it economically unviable. As a result, jatropha production never achieved any level of commercial scalability and production of jatropha-based biodiesel failed. While India does not currently maintain a specific mandate for biodiesel usage, any future mandates would require a more dedicated effort to plant energy crops and/or switching to alternate sources of biodiesel to include locally available tree-borne oilseeds and a variety of other feedstocks.

ETHANOL

There upwards of 330 ethanol distilleries in India with a total combined annual production capacity of over 4 billion liters of rectified spirit (alcohol) and 1.5 billion liters of fuel ethanol. About 143 distilleries have the capacity to distill over 2 billion liters of conventional ethanol which includes an additional annual ethanol production capacity of over 400 million liters that was built up in last five years after government provided funds to sugar mills. Theoretically, the installed capacity is sufficient to meet around seven percent of blending with gasoline. India produces conventional bioethanol mostly from sugar molasses and partly from grains. Production of advanced bioethanol remains in the research

and development phase.

Table 2. India: Ethanol Used as Fuel and Other Industrial Chemicals (Million Liters)

Calendar Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015 *
Beginning Stocks	483	734	1,374	1,642	1,240	1,021	627	624	689	380
Production	1,898	2,398	2,150	1,073	1,522	1,681	2,154	2,057	2,036	2099
Imports	30	15	70	320	92	39	34	34	50	100
Exports	37	23	12	14	53	119	177	234	175	50
Consumption	1,640	1,750	1,940	1,780	1,780	1,995	2,015	1,792	2,220	2280
Fuel Consumption	200	200	280	100	50	365	305	182	550	700
Ending Stocks	734	1,374	1,642	1,240	1,021	627	624	689	380	249
Production Capacity										
No. of Refineries	115	115	115	115	115	115	115	115	115	115
Nameplate Capacity	1,500	1,500	1,500	1,500	1,500	1,500	2,000	2,000	2,000	2,000
Capacity Use (%)	127	160	143	72	101	112	108	103	102	105
Feedstock Use (1,000 MT)										
Molasses	7,910	9,992	8,958	4,469	6,342	7,004	8,975	8,573	8,481	8,746
Market Penetration										
Fuel Ethanol	200	200	280	100	50	365	305	182	550	700
Gasoline	12,761	14,189	15,368	17,606	19,563	20,716	21,842	23,749	25,957	28,371
Blend Rate (%)	1.6	1.4	1.8	0.6	0.3	1.8	1.4	0.8	2.1	2.5

Source: FAS/New Delhi Estimates based on information from trade sources
*: Forecast

Production

Domestic ethanol production in CY 2015 will inch closer to 2.1 billion liters compared to 2 billion liters in CY 2014, due to an incremental rise in sugarcane production. In CY 2014, the sugar mills (ethanol manufacturers) offered 671 million liters of ethanol and OMCs have committed to procure 305 million liters. Including carry forward of 200 million liters from previous year and adding another 50 million liters likely to be supplied in December 2014 (from a possible new tender seeking ethanol supply for blending in CY 2015), the cumulative procurement by OMCs is estimated at 555 million liters indicating the total market penetration of fuel ethanol at 2.5 percent. Likewise a blend target of 2.5 percent looks achievable in CY 2015. Technically, given the installed capacity of ethanol for fuel production and market penetration for gasoline, a target of 7.5-percent blend is theoretically feasible.

Currently, the OMC are offering a ceiling price of INR 44 per liter ($0.74), delivered at various depots.

Given the current ex-mill prices of molasses-based products (rectified spirit, extra neutral alcohol and fuel ethanol ($0.67 per liter)) that range from INR 33-46 per liter, the offered price by OMC is still attractive for some sugar mills, although average retail price of gasoline is still on a higher side. A benchmark price somewhere in the middle could still be negotiated between buyers and sellers and may be a possibility going forward.

Any procedural delay in EBP particularly when profit margins of sugar mills are thin, may encourage sugar mills to divert molasses to cattle feed while diverting excess ethanol to other potential end users (e.g., potable alcohol production units) or even exports if prices are competitive. In the past, tight supply condition of sugar molasses either due to downswing in sugar production cycle or strong demand from chemical and potable businesses have not only raised ethanol's cost of production but made supply of ethanol unviable to petroleum companies at the pre-negotiated price.

Consumption

Given steady rise in supply of molasses coupled with strong and growing demand of ethanol from the chemical and potable liquor industries in conjunction with an expected rise in blending for EBP will push total ethanol consumption in CY 2014 and CY 2015 to 2.2 billion liters and 2.3 billion liters, respectively.

Trade

When the GOI started its EBP in 2003, the trade balance for ethanol was generally negative. However, by 2009, the trade balance flipped and India became a net exporter of ethanol, partly due to consistent supply of molasses for ethanol production, and rising overseas demand, particularly from African countries (Note: In India, biofuel exports are only permitted after the domestic requirement are met and approval is given by the NBCC).

Exports

Ghana, South Korea, Nigeria, Singapore, Cameroon are among major importers of Indian ethanol. Conversely, the United States, Brazil, South Africa, Bhutan, and Pakistan are major exporters of ethanol to India. Over the last four years, ethanol exports grew by $40 million to $183 million in CY 2013. However, during corresponding period, imports dropped from $68 million to $44 million. Although the GOI provides no financial assistance for exports of biofuels, current trade regulations allow for duty-free imports of feedstocks for re-export by certified export oriented units.

Imports

Lower import tariffs make imports more attractive and economically viable. Per Customs Notification No. 12/2012, the GOI on March 17, 2012, lowered the import tariff on ethanol from all countries to 7.55 percent except for imports from Brazil, which enjoy a preferential rate of six percent because of a 20-percent rebate per Customs vide notification No. 57/2009 (Table 3). Traditionally, India imports ethanol to meet shortfalls in demand during years of lower sugar production. Demand is mostly for consumption across the potable and chemical industries and not for fuel. There are no quantitative restrictions on biofuel imports.

Table 3. India: Import Duty on Biofuels (Ad Valorem Based on CIF)

ITC HS Tariff Number	Total Import duty
2207.20 Denatured Ethyl Alcohol and Spirits (including ethanol)	7.55 percent
3824.90 Chemical products not elsewhere specified (including biodiesel)	25.85 percent

Source: Central Board of Excise and Customs, GOI

Ending Stocks

Rising demand and steady consumption over in last 5-6 years had led to steep decline in stocks from over 1 million liters in CY 2010 and years since. End stocks will further decline from 380 million liters in CY 2014 to 250 million liters in CY 2015.

BIODIESEL

As noted above jatropha production has not been successful in India. Consequently, there are no commercial sales of biodiesel across the biodiesel purchase centers set up by the GOI. As a result, researchers are gradually shifted their focus and resources to study feasibility of producing bio-diesel from tree-borne oilseeds such as pongamia (*Pongamia pinnata*), neem (*Azadirachta indica*), kusum (*Schleichera oleosa*), mahua (*Madhuca longifolia*), as well as waste edible oils and multiple feedstocks.

Table 4. India: Biodiesel Production from Multiple Feedstock (Million Liters)

Calendar Year	2010	2011	2012	2013	2014	2015
Beginning Stocks	45	38	42	45	45	50
Production	90	102	115	120	130	135
Imports	0	0	0	0	0	0
Exports	0	0	0	0	0	0
Consumption	52	60	70	75	80	85
Ending Stocks	38	42	45	45	50	50
Production Capacity						
Number of Biorefineries	5	5	5	6	6	6
Nameplate Capacity	450	450	460	465	480	480
Capacity Use (%)	20.0	22.7	25.0	25.8	27.1	28.1
Feedstock Use (1,000 MT)*						
Used Cooking Oil	36	48	53	56	58	60
Animal Fats and Tallow's	4	5	5	6	6	7

Other Oils	33	42	47	50	52	55
Market Penetration						
Biodiesel, on-road use	26	30	35	38	40	43
Diesel, on-road use	44,843	46,907	49,065	51,324	53,686	56,157
Blend Rate (%)	0.06	0.06	0.07	0.07	0.07	0.08
Diesel, total use	74,738	78,178	81,776	85,539	89,476	93,595

Source: Industry and Post estimates
CY 2014 is projected
* Used cooking oil includes vegetable oils such as rice bran oil, palm stearine, cotton seed oil and fatty acid oils while 'Other Oils' include tree oils, palm sludge etc.

Currently, India has 5-6 large capacity production plants (10,000 to 250,000 MT per year) with the installed capacity to produce 115-130 million liters of biodiesel from multiple feedstocks such to include crude vegetable oil, used cooking oils, animal fats, and others. The biodiesel produced is sold to automobiles companies for research and development, and public entities which run buses on blended fuels. Small amounts of biodiesel is also sold to unorganized consumers such as cellular communication companies, brick kilns producers, progressive farmers, and to other institutions that run diesel generators as source of power back-up.

ADVANCED BIOFUELS

The Indian biofuel industry, both private and public sector, claim to be successful in developing and customizing technology for converting ligno-cellulosic materials in form of wood biomass, agricultural (corn cob, bagasse, straw and stover) waste and forest waste. Trials are underway to process municipal solid waste, micro-algae and photosynthetic organisms into advanced biofuels. However, given the technological challenges, commercial production and economic viability remains unclear.

Biomass for Heat and Power

Scope

Biomass, non-fossilized and biodegradable organic material originating from plants, animals and micro-organisms, has the potential to produce grid-quality power through various conversion techniques. Benefits include renewability, adaptability, carbon neutrality, and the potential to generate employment in rural areas. According to the Ministry of New and Renewable Energy, the potential could be further enhanced if dedicated plantation in forest and degraded land are linked to biomass power.[6] Additionally, biomass has been playing an important role as fuel for sugar mills, rice mills, textiles mills, pulp and paper mills, and other small and medium enterprises.

Biomass Material

Bagasse, rice husks, straw, cotton stalks, coconut shells, soy husks, de-oiled cakes, coffee waste, jute waste, peanut shells, and sawdust are used as raw material for power generation.[7] The crop residues

[7] Annual report 2011/12, MNRE, GOI

from non-fodder crops, e.g., cotton, oilseeds, chilies and bamboo residues may also be considered as good alternatives for biomass power production. s

Availability

Biomass availability in India is estimated at about 500 million tons per year covering residues from agriculture, processing industries, and forestry (however, some research studies estimate biomass availability to be higher than 500 million tons). This estimate is based on a survey by the Indian Ministry of New and Renewable Energy, which indicates that 15 to 20 percent of total crop residues could be used for power generation, without altering the primary crops' present uses. Concurrently, between 120 and 150 million tons of surplus agro industrial and agricultural residues per year could be made available with potential to generate 18,000 MW.

Bagasse Power Cogeneration

With modernization of new and existing sugar mills, surplus power generation through bagasse cogeneration in India's 550 sugar mills is estimated at 10,000 MW (target for 12th Five-year plan is to achieve 32 percent of total potential) if these mills were to adopt technically and economically optimal levels of cogeneration for extracting power from the bagasse they produce. The optimum cogeneration capacity installed in Indian sugar mills is one of the highest among major sugar producing countries. The total estimated biomass power potential (biomass power) is about 31,000 MW. (Note: Some think tank organizations estimate that bagasse-based power generation could be 7,000 MW. Considering the preceding estimate, total biomass power potential scales down to 27,000 to 28,000 MW.)

The GOI has initiated several programs and schemes for promoting renewable energy sources. Seventeen Indian states have policies for development of biomass power. Biomass power projects attract fiscal incentives such as accelerated depreciation, concessional customs duties, and income tax exemptions. An emphasis will be put on development of fuel value-chain business models while encouraging the operating period of bagasse cogeneration projects from 180-220 to 300-plus days. Further details may be accessed from mnre.gov.in

Table 5. India's Biomass-Based Commercial Energy Achievement

Sector	Target in 2013/14	Cumulative Achievements as of March 31, 2014	Total target by end of 12th five year plan	Estimated Potential
A. Grid Interactive Power (Capacities in MW)				
Biomass power and gasification	105	1365.2	1525	18,000
Bagasse cogeneration	300	2648.4	3216	10,000^
Waste to power	20	106.6	324	2,700
B. Off-Grid /Captive Power (Capacities in MWEQ)				
Waste to energy	10	132.7	NA	NA
Biomass (non-bagasse)	80	531.8	NA	NA

Cogeneration				
Biomass Gasifiers				
i)Rural	1	17.5	NA	NA
ii)Industrial	9	147.2	NA	NA
Biogas based energy system	2	3.77	NA	NA
C. Other Renewable Energy System				
Family Biogas Plants (in 00,000')	1.1	47.4	5600	12,000

Source: Ministry of New and Renewable Energy, GOI Notes:
NA: Not Available
MW: Megawatts
MW eq: Megawatts equivalent
^: Per MNRE report, bagasse based cogeneration in India is estimated at 5000 MW in contrast to another think tank estimating its potential at 10,000 MW
#: updated from Indian Sugar Mills Association (ISMA)
Source: Physical achievements MNRE