USDA Foreign Agricultural Service
GAIN Report
Global Agricultural Information Network

Required Report - public distribution

Date: 6/20/2012

GAIN Report Number: IN2081

India

Biofuels Annual

2012

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Report Highlights:
Total ethanol supply for ethanol blending program during current fiscal year (2011/12) is anticipated to be just sufficient to meet the 2-percent blending target while production of biodiesel from jatropha in India is commercially insignificant at present. This stands in contrast to the National Biofuel Policy, which aims to replace 20 percent of petroleum fuel consumption with biofuels by end of 12th Five-Year Plan (2016/2017).

Post:
New Delhi

Executive Summary:

Total ethanol supply for ethanol blending program during current fiscal year (2011/12) is anticipated to be just sufficient to meet the 2-percent blending target while production of biodiesel from jatropha in India is commercially insignificant at present. This stands in contrast to the National Biofuel Policy approved by the Government of India on December 24, 2009. The policy encourages use of renewable energy resources as alternate fuel to supplement fossil motor fuels and had proposed a target of replacing 20 percent of fossil motor fuel consumption with biofuels (bioethanol and biodiesel) by the end of the 12th Five-Year Plan (2017).

With an outlook for strong sugarcane and sugar production for the third consecutive year [1] , the Indian government may renew its focus and strongly implement the mandatory 5-percent ethanol content in petrol, provided there is a consensus among stakeholders on the purchase price of ethanol for the Ethanol Blending Program (EBP). The government's current target of a 5-percent blend of ethanol in gasoline has been partially successful in years of surplus sugar production and below target when sugar production declined. Presently, the contracted ethanol supply for current fiscal would be just sufficient to meet 2 percent blending.

Production of biodiesel in India is commercially insignificant and will not soon be commercially deployed as a economically viable biofuel. The government's plan to blend diesel fuel with 20 percent content of biodiesel by fiscal year (April-March) 2011/12 is improbable mostly due to unavailability of high-yielding, drought-tolerant jatropha seeds to produce biodiesel.

However, generation of grid-quality power from biomass continues to play an important role as fuel for sugar and textile mills, and has significant potential in breweries, fertilizer plants, the pulp and paper industry, solvent extraction units, rice mills, and petrochemical plants. The total biomass power potential in India is estimated at 31,000 MW; of which surplus power generation through bagasse is 10,000 MW.

[1] Marketing Year Oct-Sep 2012/13

Author Defined:

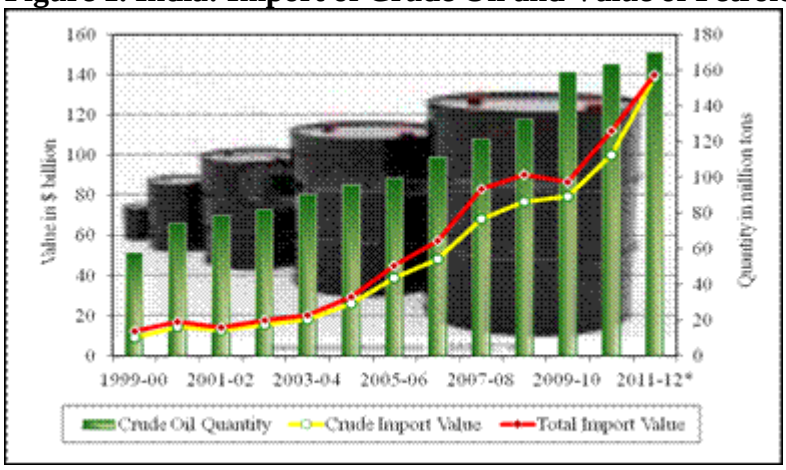
OVERVIEW

India is the world's fifth largest primary energy consumer and fourth largest petroleum consumer after United States, China and Japan. Despite the recent global economic slowdown, India's economy is expected to continue to grow at 6 to 8 percent per year in the near term. With an outlook for moderate to strong economic growth [1]: and a rising population, growing infrastructural and socio-economic development will stimulate an increase in energy consumption across all major sectors of the Indian

economy.

In the recent past, starting in Indian fiscal year (IFY) 2009/10, imports of gasoline and petroleum products has outgrown total domestic consumption by more than 14 percent. While India's domestic energy base is substantial, the country continues to rely on imports for a considerable amount of its energy use [2] , consequently escalating India's oil import expenditure to over $135 billion in IFY 2011/12, up 22 percent over the previous year (figure 1). Concurrently, petroleum consumption (Figure 2) in India has also grown in tandem to 148 million tons.

Figure 1. India: Import of Crude Oil and Value of Petroleum



Source: Petroleum Planning and Analysis Cell, Government of India (GOI)
*: estimate

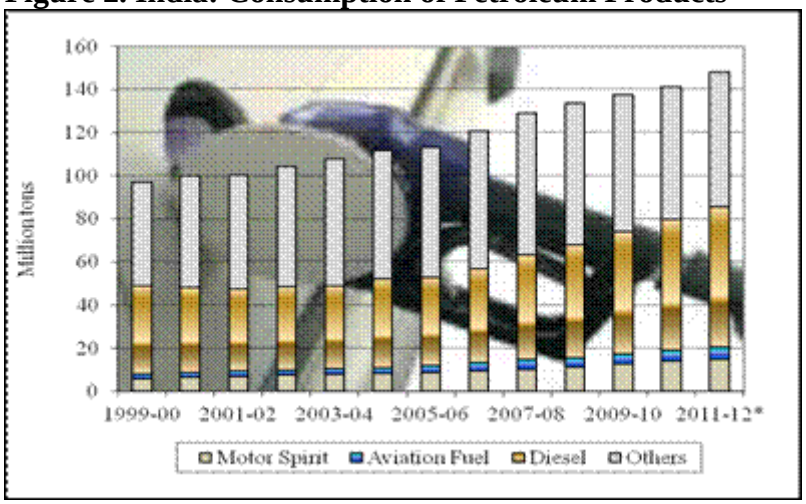
It is estimated that the proportionate consumption of petroleum products in India is as follows (petroleum consumption):

- Transport (Petrol, Diesel, CNG, Aviation Fuel) : 51 percent
- Industry (Petrol, Diesel, Fuel Oil, Naphtha, Natural Gas): 14 percent
- Commercial and Others: 13 percent
- Domestic (LPG and Kerosene): 18 percent
- Agriculture (Diesel): 4 percent

Thus, in terms of end usage, energy demand across the transport sector is greatest. Roads, being one of the dominant infrastructures for transport, carry an estimated 85 to 90 percent of the country's passenger traffic and 65 percent of its freight. Traffic on roads is growing at a rate of 7 to 10 percent per year; while the vehicle growth is of the order of 8 to 10 percent per year.

Easy availability, adaptability to individual needs and cost saving are some of the factors which favor road transport. Total registered motor vehicles in India in fiscal year 2005/06 numbered approximately 90 million [3] and are forecast to exceed 140 million by the end of fiscal 2011/12. Economic growth, increasing urbanization, a rise in consumer spending levels and improved road infrastructure have stimulated new vehicle registrations (particularly four-wheel as opposed to two-wheel vehicles). As vehicle ownership expands, petroleum demand in the transport sector is expected to grow in tandem. Diesel and gasoline account for more than 95 percent of the requirement for transportation fuel, and demand is expected to grow at 6 to 8 percent over the coming years.

Figure 2. India: Consumption of Petroleum Products



Source: Petroleum Planning and Analysis Cell, Government of India (GOI)
*: Estimate

Given that India is the fourth largest global contributor to carbon emissions, the GOI transport policy has targeted EURO-III and IV vehicle emission norms [4] for vehicles, which in turn would require adoption of clean and green fuel. The government is seriously concerned about economic, environmental, [5] energy security while looking to alternate fuels to meet energy demand through safe, clean, and convenient forms of energy at least cost in a technically efficient, economically viable and environmentally sustainable manner. To meet these objectives, the Union Cabinet approved the National Policy on Biofuels on December 24, 2009 (PIB press release). Endowed with significant potential for generating energy through renewable resources, the Government of India (GOI) is promoting production and use of i) ethanol derived from sugar molasses/juice for blending with gasoline and ii) biodiesel derived from inedible oils and oil waste for blending with diesel.

POLICY AND PROGRAM: 'INDIA'S BIOFUEL POLICY'

SALIENT FEATURES OF INDIA'S BIOFUEL POLICY

- National Biofuel Steering Committee (NBSC) under the Prime Minister to set policy.
- Strengthen India's energy security by encouraging use of renewable energy resources to supplement transport fuels. An indicative 20-percent target for blending of biofuel for both biodiesel and bioethanol.

- Meet the energy needs of India's vast rural population, stimulating rural development and creating employment opportunities.
- Address global concerns about net reduction of carbon emissions through use of environmentally friendly biofuels.

- Derive biofuel from inedible feedstock grown on degraded soils or wastelands unsuited to food or feed production, thus avoiding a possible conflict of fuel- versus food security.

- Facilitate optimal development and utilization of indigenous biomass feedstock for production of biofuels. The policy also envisages development of next-generation, more efficient biofuel conversion technologies based on new feedstock's.

- Minimum Support Price (MSP) mechanism to ensure a fair price for biodiesel oilseed growers. Implementation of the proposal would be considered carefully after consultation with stakeholders, central and state governments, Biofuel Steering Committee, and a final decision by the National Biofuel Coordination Committee.

- The state-owned Indian oil marketing companies propose to purchase bioethanol at a Minimum Purchase Price (MPP) based on the actual cost of production and import price of bioethanol. In the case of biodiesel, the MPP should be linked to the prevailing retail diesel price.

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

- Bring biofuels under the ambit of "Declared Goods" by the Government so as to ensure their unrestricted movement between states. [6]

- Except for a concessional excise tax 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 equity through an automatic approval route to attract foreign direct investment (FDI), provided the biofuel is for domestic use only, and not for export. Planting of inedible oil bearing plants would not be open to FDI participation.

For more information, please follow the link to biofuel policy.

Institutional mechanism

The National Biofuel Policy proposes to set up a National Biofuel Coordination Committee (NBCC) headed by the Prime Minister. Given the roles of different agencies and ministries in the biofuel program, NBCC's role of providing high-level coordination, policy guidance and review of biofuel development, promotion and utilization becomes more imperative. The committee would meet periodically to review progress of and to monitor the biofuel program. The policy also mandates a Biofuel Steering Committee headed by a Cabinet Secretary to oversee implementation of its policies on a regular basis.

Various state governments will work closely with their respective research institutions, forestry department, and universities for development and promotion of biofuel programs. Few states (http://www.pcra-biofuels.org/whois.htm) have drafted policies and set up institutions for promoting biofuel in their states. In order to deal with different aspects of biofuel development and promotion in the country, several ministries have been allocated specific roles and responsibilities:

Ministry of…	Role
New and Renewable Energy Sources	Policymaking and overall coordination concerning biofuels. Undertake Research and Development (R&D) of various applications of biofuels
Petroleum and Natural Gas	Marketing biofuels as well as development and implementation of pricing and procurement policy
Agriculture	R&D of biofuel feedstock through ICAR and IARI (sweet sorghum, jatropha, pongamia oil tree (*Millettia pinnata*), and inedible oilseeds). Undertake jatropha plantation on non-forest land.
Rural Development	Plantation of jatropha on wastelands. Integrate biodiesel program with rural development schemes (such as Mahatma Gandhi National Rural Employment Guarantee Scheme). Coordinate R&D with other agencies.
Science and Technology	Support research on biofuel crops through biotechnology
Road Transport and Highway	Plantation along highways and use of biofuel blended fuel. Work with automobile manufacturers' association in India for engine modification, emission norms, etc.
Railways	Undertake plantation of jatropha on wastelands, along rail rights of way, and conduct trials of biodiesel blended fuel in locomotives.
Environment and Forests	Ensure implementation of jatropha and tree borne oilseed plantations in forest wastelands; Central Pollution Control Board to monitor health and environmental effects.

ETHANOL POLICY

Ethanol is produced in India from sugarcane molasses for blending with gasoline. Beginning January 2003, the GOI mandated a 5-percent ethanol blend in gasoline through its ambitious Ethanol Blending Program (EBP). 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 with sugar and sugarcane production and therefore does not assure optimum supply levels needed to meet the demand at any given time. Lower sugar molasses availability and consequent higher molasses prices affect the cost of production of ethanol, thereby disrupting the supply of ethanol for the blending program at pre-negotiated fixed ethanol prices.

Developments in EBP

Period	Action	Comments

January, 2003	Ministry of Petroleum and Natural Gas (MoPNG) made 5-percent ethanol blending (Gazette on EBP) in gasoline (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 to mandate 5-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 Rs 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 nationwide.	GOI deferred the plan again due to short supplies of sugarcane and sugar molasses in 2008/09.
October, 2008	Third phase of implementing EBP; blend 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 meets to decide blending target for EBP	*Status quo ante* remains, targets 5 percent EBP
August 2010	Government fixed an ad-hoc provisional procurement price of Rs 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. No consensus yet on pricing policy of ethanol. When ethanol supply runs short, government proposes to reduce import duty on alcohol and molasses. OMC caveats the proposal that alcohol or molasses could not be imported for EBP; it has to be exclusively sourced from domestic produced molasses.
Indian Fiscal Year [7] (April-March) 2010/11	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 5 percent ethanol in gasoline.	Most domestic ethanol producers or suppliers were disqualified from supplying ethanol. Failure to set ethanol pricing formula and procedural delays by various state governments delayed 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.
Fiscal Year 2011/12	OMC targets procurement of 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 and Madhya Pradesh), the present requirement worked out to 720 million liters, of which suppliers had offered to supply 610 million liters. With lower supplies in a few states, the contracted supply was further drawn down to 430 million liters. Molasses continues to be exported as cattle feed to Europe.
Current Status	By 2017, the GOI mandates replacing 20 percent of petroleum-based motor fuel with biofuels.	Given the surplus sugar situation in the current and forecast years (2012/13), net ethanol availability after accounting for domestic consumption seems sufficient to meet blending targets (5 & 10 percent) for EBP. The contracted supply for current fiscal year is just sufficient to meet 2 percent blending target. However, given the constraints, achieving a higher target (20 percent) looks unattainable.

Expanding the ethanol supply:

Currently, the government does not allow use of imported ethanol for the EBP program, as the focus is on developing domestic capacity.

- Presently, ethanol is manufactured directly from sugar molasses, but given the projection for higher sugarcane production in India for 2011/12 and 2012/13 [8] (upswing in production cycle), use of sugarcane juice (on an experimental basis) for ethanol production seems to be a viable option especially under conditions of a sugarcane glut.

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

- Given the limited scope for bringing additional area under water-intensive sugarcane cultivation, fluctuations in supply and pricing of ethanol could be stabilized through use of alternate crops. Public and private institutions could promote use of alternate crops such as sweet sorghum, sugar beets, and sweet potatoes to supplement domestic ethanol production, though the efforts to

produce ethanol from these feed stocks are at an experimental stage.

- Development of low-cost technology to utilize lignocellulosic material such as agricultural and forest residues to produce bioethanol.

Impediments

Procedural hurdles such as non-issuance of export permits for interstate transport of ethanol, delays in issuing no-objection-certificates (NOC), higher taxes and levies across different states have impacted the EBP. Rules and regulations, including a high excise tax of Rs 750 per ton on molasses, which works out to 25- to 30 percent ad valorem, whereas on industrial alcohol the central excise duty is 12.36 percent ad valorem, and interstate (octroi) taxes applicable to potable alcohol for industrial use are equally applicable to ethanol for blending with gasoline, thereby severely constraining its availability and utilization for EBP.

BIO-DIESEL POLICY

The GOI had launched the National Bio-diesel Mission (NBM) after identifying jatropha (*Jatropha curcas*) as the most suitable tree-borne oilseed for biodiesel production. The Planning Commission of India set an ambitious target of planting 11.2 to 13.4 million hectares of land to jatropha by the end of the 11th Five Year Plan (2011/12). The central government and several state governments provide fiscal incentives in support of planting 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

Period	Action	Comments
April, 2003	**Demonstration phase 2003 to 2007:** Ministry of Rural Development appointed as nodal ministry to plant 400,000 hectares to jatropha. 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 sectors, state governments, research institutions (Indian and foreign) involved in the program achieved varying degrees of success.

October, 2005	Ministry of Petroleum and Natural Gas (MoPNG) announced biodiesel purchase policy under which oil marketing companies (OMC) would purchase biodiesel from 20 procurement centers across the country to blend with high speed diesel as of January 2006. Purchase price set at Rs 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, use of conventional low-yielding jatropha cultivars, seed collection and extraction infrastructure, buy-back arrangement, inadequate capacity- and confidence-building measures among farmers impeded the progress of this phase.
2010	An estimated half-million hectares has been planted to jatropha, of which two thirds is believed to be new plantations needing two to three years to mature	Assuming 80 percent of the biodiesel requirement is met though jatropha oilseeds, the biodiesel thus obtained will meet just 0.01 percent of total biodiesel required for 5-percent blending by 2010/11.
Fiscal Year 2011/12	No additional 'wastelands' have been brought under jatropha cultivation	The government may have to offer fiscal incentives [9] to growers to adopt better agronomic practices during first 2-3 years of plantation development in addition to marketing and price support mechanisms to encourage biodiesel program. Status quo remains as the production of biodiesel from jatropha seeds is commercially insignificant at present.

The GOI's ambitious plan of producing sufficient biodiesel by fiscal 2011/12 to meet its mandate of 20-percent blending with diesel is looking unattainable given the unavailability of sufficient feedstock (jatropha seeds) and lack of sufficient research and development to evolve high-yielding, drought-tolerant jatropha seeds.

According to one estimate, 3.21 million tons of biodiesel would be required from 3.42 million hectares to meet 5-percent blending by Fiscal 2011/12 [10] . Considering jatropha to be a major feedstock for biodiesel with an average seed yield of 2.5 tons/hectare and 30 percent biodiesel recovery rate, 18.6 million hectares would need be brought under jatropha cultivation to meet the 20-percent blending target by 2017. The above assessment assumes a steady rise in demand (circa 6.4 percent/annum) for diesel in India. Diesel demand during the 12th Five-year plan (fiscal year 2012/13 through 2016/17) is likely to grow by 35 percent to 87.4 million tons [11] . Meeting a 5-percent blending target will require an additional 4.1 million hectares under jatropha.

Impediments

Smaller land holdings, ownership issues with government- or community-owned wastelands, very little progress made by state governments to stimulate large scale jatropha plantations, and negligible commercial production of biodiesel have impeded efforts and investments by both private- and public-sector companies.

In the face of reports that most biodiesel companies in India are working at very low capacity and some are idle, the GOI has reportedly contemplated fixing a higher price of Rs 34 per liter (compared to Rs 26.5 /liter) for purchase of biodiesel (please refer our previous GAIN report IN1058 for more information) through oil marketing companies (OMC), though industry and stakeholders had recommended an even higher price (Rs 36 per liter) to bring idle companies back to operation. The proposed price is believed to have been mutually agreed by the GOI and industry representatives. However, this proposal has yet to materialize.

ETHANOL AND BIODIESEL

Ethanol

India has 330 distilleries which can produce over 4 billion liters of rectified spirit (alcohol) per year in addition to 1.5 billion liters of fuel ethanol. Of this total, about 140 have the capacity to distill around 2 billion liters [12] of conventional ethanol per year and could meet the demand for 5-percent blending with gasoline. Currently, India produces conventional bioethanol from sugar molasses; production of advanced bioethanol is in a nascent phase (research and development).

Table 1. India: Conventional Bioethanol Production and Distribution (million liters)

Calendar Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Beginning Stocks	483	747	1,396	1,672	1,241	1,065	756	911
Production	1,898	2,398	2,150	1,073	1,522	1,681	2,170	2,239
Imports	29	15	70	280	92	20	80	50
Total Supply	2,410	3,160	3,616	3,025	2,855	2,766	2,901	2,995
Exports	24	14	3	4	10	15	10	15
Consumption								
Industrial Use	619	650	700	700	720	700	720	740
Potable Liquor	745	800	850	880	900	850	880	910

Blended Gasoline	200	200	280	100	50	365	400	450
Other Use	75	100	110	100	110	80	85	85
Total Consumption	1639	1750	1940	1780	1780	1995	2085	2135
Ending Stocks	747	1,396	1,673	1,241	1,065	756	911	1,000
Total Distribution	2,410	3,160	3,616	3,025	2,855	2,766	3,006	3,200
Production Capacity (Conventional Fuel)								
No. of Biorefineries [13]	115	115	115	115	115	115	140	140
Capacity (billion liters')	1.5	1.5	1.5	1.5	1.5	1.5	2	2
Feedstock Use (1,000 MT)								
Feedstock A (000' tons)	7,910	9,992	8,958	4,469	6,342	7,004	9,041	9,330

Source: FAS/New Delhi Estimates based on information from trade sources
Note: Feedstock A is molasses

Production:

With an outlook for strong sugar production for a third consecutive year (viz., 2012/13, Marketing Year (MY) October-September), domestic ethanol production is likely to grow in tandem, almost reaching the high it last achieved in calendar year 2007. The Indian government may renew its focus and strongly implement the mandatory 5-percent ethanol blending in petrol, provided there is consensus among stakeholders on the purchase price of ethanol for EBP. Presently, only three-fifths of total facilities are actually supplying ethanol, severely constraining the supply of ethanol for EBP. Consequently, molasses stocks are being diverted to Europe for cattle feed. Short supplies of sugar molasses in preceding years (before MY 2010/11) had constrained ethanol production and consequent higher prices made it unviable to supply ethanol to petroleum companies at the negotiated prices. Presently, strong demand for bagasse (from paper mills, independent sugar units) and molasses (for cattle feed and potable alcohol production) continues to support profitability of sugar mills at times when profit margins run thin.

Consumption:

Improved supplies of molasses and a steady rise in demand from the chemical and potable liquor industries in the face of an expected rise in blending for EBP could raise total ethanol consumption in 2013 to 2.1 billion liters.

Trade:

Exports of ethanol [14] have grown significantly in the last three years. Taking advantage of the upswing in the sugarcane production cycle, India has exported 25.2 million liters [15] of denatured ethanol and spirits worth $21 million [16] to Ghana, South Korea, Saudi Arabia, Sierra Leone, Cameroon, Tanzania, Liberia and host of other African and neighboring countries [17]. Besides being a net exporter of ethanol, India had also imported approximately 16 million liters of ethanol and spirits mostly from

United States, UAE, Pakistan, UK, South Africa, Germany and China. Traditionally, India imports ethanol only to meet shortfalls during years of low sugar production. Demand is mostly for consumption across the potable liquor and chemical industries, not for fuel. There are no quantitative restrictions on import of biofuels; however, high duties (Table 2) sometimes make imports economically unviable. The GOI does not provide any financial assistance for exports of biofuels (biodiesel or ethanol). However, current trade regulations allow duty-free imports of feedstocks for re-export by certified export oriented units.

Table 2. India: Import duty on biofuels (percent ad valorem on CIF value)

ITC HS Tariff Number	Import duty (percent)
2207.20 Denatured Ethyl Alcohol and Spirits (including ethanol)	28.64
3824.90 Chemical Products NES (including biodiesel)	28.64

Ending Stocks:

The ending stocks for the forecast year (2013) are likely to recover to 1 billion liters, up 90 million liters over the current year's estimate.

Biodiesel

Jatropha plantation is a subject for state governments. Public-sector petroleum companies and private-sector firms have entered into memoranda of understanding with state governments to establish and promote jatropha plantation on government wastelands or to contract with small and medium farmers. However, only a few states have been able to promote actively jatropha plantation despite the government's incentives and encouraging policies.

Slow progress in jatropha planting has resulted in lower availability of jatropha seeds to be used as feedstock for biodiesel production and hence most of the biodiesel units are not operational most of the year. There are about 20 large-capacity biodiesel plants (10,000 to 200,000 metric tons per year) in India that produce biodiesel from alternative feed stocks such as edible oil waste (unusable oil fractions), animal fat and inedible oils.

Presently, commercial production and marketing of jatropha-based biodiesel in India is small, with estimates varying from 140 to 300 million liters per year. The biodiesel produced is sold to the unorganized sector (irrigation pumps, mobile towers, kilns, agricultural usage, owners of diesel generators, etc.) and to experimental projects carried out by automobile manufacturers and transport companies. However, as per industry sources, there has been no commercial sale of biodiesel to state-owned transport companies except for trials [18] .

Additionally, there has been no commercial sale of biodiesel across the biodiesel purchase centers (set up by the GOI) as the government biodiesel purchase price of Rs 26.5 (48 cents) per liter is still below the estimated biodiesel finished production cost (Rs 35 to Rs 40 per liter / 63-72 cents per liter [19]). Unavailability of feedstock supply (jatropha seeds), rising wage rates and inefficient marketing channels are a few of the major factors that have contributed to higher production costs [20] .

In order to revive and accelerate the biodiesel industry, a recent study taken up by the industry recommends that the present procurement prices of biodiesel be raised as well as to ensure an average procurement price of jatropha seeds at level such that farmers will not shift land from food crops to fuel crops.

Advanced Biofuels

Research and development activities (experimental or pilot trials by select industry groups and government research institutes) are being carried out to develop suitable technologies for production of advanced biofuels from wood biomass, agricultural and forest waste, municipal solid waste conversion, microalgae and photosynthetic organisms. Given the technological challenges, commercial production of advanced biofuel is still far in the future.

BIOMASS FOR HEAT AND POWER

Scope

The Ministry of New and Renewable Energy is implementing a biomass power program with the objective of generating grid-quality power from biomass resources through various conversion technologies along with optimizing power generation from bagasse produced in sugar mills. The benefits include its renewable nature, wide adaptability, carbon neutrality and the potential to provide largescale productive employment in rural areas. Biomass has been playing important role as fuel for sugar mills, pulp and paper mills, small and medium enterprises (SME). In particular; there is significant potential in breweries, textile mills, fertilizer plants, solvent extraction units, rice mills, and petrochemical plants.

Biomass

Biomass materials used for power generation include bagasse, rice husk, straw, cotton stalks, coconut shells, soy husk, oilseed cakes, coffee waste, jute wastes, peanut shells, and sawdust [21] . However, competition for biomass from the growing cattle and water buffalo sector may limit supplies unless biomass is grown specifically for power generation. The availability of crop residue from non-fodder crops may prove to be good alternatives for biomass power production [22] .

Availability

The availability of biomass in India is estimated at about 500 million tons per year including residues from agriculture, agricultural industries, and forest products. A survey by the Ministry of New and Renewable Energy indicated that 15-20 percent of total crop residues could be used for power generation, without altering their present uses. This implies availability of 120 to 150 million tons of surplus agro-industrial and agricultural residues per year that could be made available for power generation. Around 1525 MW of power is proposed to be harnessed from agricultural residues and plantations by end of 12th Five-Year Plan (Table 3).

Bagasse power cogeneration

With modernization of new and existing sugar mills the surplus power generation through bagasse cogeneration in India's 550 sugar mills is estimated at 10,000 MW (the 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 bagasse. Total estimated biomass power potential from bagasse (biomass power) is about 31,000 MW. The GOI has initiated several programs and schemes for promoting renewable energy sources, the details of which may be accessed from www.mnre.gov.in.

Table 3. India: Biomass based Commercial Energy Achievement in Mega Watts (MW)

S.No.	Sources/ Systems	Estimated Potential	Achieved in fiscal 2010-11	Achieved through March 2011	Achieved through December 2011	Total Target by end of 12th Five-year plan (2016/17)
1	Biomass Power *(Agri-residues and plantations)*	18,000	143.50	1,025	1,118	1,525
2	Biomass Power Cogeneration *(Non-bagasse)*	NA	61.19	282.07	NA	NA
3	Biomass Power Cogeneration *(Bagasse)*	10,000 #	257	1616	2,012 *	3,216
4	Waste to Energy	2,700	7.50	72.46	NA	324
5	Biomass Gasifier	-	6.72 eq	150 eq	NA	NA
6	Family Type Biogas Plants	12 Million	73,281 units	4.5 million units	NA	5.6 million units

Source: Ministry of New and Renewable Energy, GOI

Notes:

NA: Not Available

MW: Megawatts

MW eq: Megawatt equivalent

*: Includes 1932 MW from private-sector sugar mills while additional capacity from cooperative sector likely to be commissioned by August 2012

#: updated from Indian Sugar Mills Association (ISMA)

[1] Economic Survey of India pegs growth at 7.6 percent for fiscal 2012/13 and 8.6 percent for fiscal 2013/14, while other private institutions and rating agencies expect Indian economic growth to moderate down to 6.5/7 percent and 7.5 percent in Indian fiscal 2012/13 and 2013/14 respectively.

[2] According to the International Energy Agency (IEA), hydrocarbons account for the majority of India's energy use. Together, coal and oil represent about two-thirds of total energy use. Natural gas now accounts for a seven-percent share, which is expected to grow with the discovery of new gas deposits. Combustible renewable resources and waste constitute about one fourth of Indian energy use. This share includes traditional biomass sources such as firewood and cow-dung, which are used by more than 800 million Indian households for cooking. Other renewable such as wind, geothermal, solar, and hydroelectricity represent a 2-percent share of the Indian fuel mix. Nuclear holds a one percent share.

[3] Ministry of Road Transport and Highways, GOI

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

[5] Preliminary estimate for 2010 indicates that India outpaced EU-27 and stands third after China and U.S. on CO_2 emission estimates

(India's carbon emissions are growing 3.2 percent annually)
[6] In contrast to the United States, India does not enjoy free interstate movement of goods and services.
[7] Hereinafter referred to as 'fiscal year' unless otherwise stated
[8] Marketing Year (MY) (October-September)
[9] Coupled with carbon credits
[10] A policy brief paper from the National Centre for Agricultural Economics and Policy Research (NCAP)
[11] Diesel demand in 2011-12 was estimated at 65.2 million tons (77.7 billion liters).
[12] Includes an additional annual ethanol production capacity of 400 million liters that was built up in the last four years after the Indian government provided funds to sugar mills
[13] An estimated three-fifths of total refineries are actually supplying ethanol for EBP.
[14] Export of biofuel is only permitted after supply meets the domestic requirement and the final decision is taken by the National Biofuel Coordination Committee.
[15] Global Trade Atlas
[16] First 10 months of calendar year 2011
[17] During the same period, India also exported 132,068 metric tons of chemical products including biodiesel worth $108 million to Sri Lanka, United States, Italy, Bangladesh and other Asian and European countries.
[18] A few state road transport corporations claim to run their buses on blended fuels
[19] Cost of production may be still higher, as above estimates are based on inputs from industry sources
[20] Feedstock constitutes more than 75 percent of cost of production of biodiesel
[21] Annual report 2011/12, MNRE, GOI
[22] Department of Science and Technology, GOI