FIRST AND SECOND GENERATION BIOFUELS

Transportation fuel is a biofuel-relevant market that has a critical implication on the nation's economy given the huge strain placed by the crude oil import bill (6,000 billion rupees). The Government of India initiated mandated biofuel blending programs from 2003 under the National Biofuels Mission. These programs specify blending of biofuels (5%, 10%, 20%) with fossil fuels in a time bound and phased manner across India. The 'National Policy on Biofuels' was released in 2009. Feed stocks identified are molasses for production of ethanol and tree-borne non-edible oil seed crops like Jatropha and Pongamia for production of biodiesel from marginal lands. However, the biofuel blending program has achieved only moderate success in India, mainly because of feedstock limitation. Current cost of production and pricing structure combined with the uncertainty of molasses availability favors diversion of ethanol to potable purpose than blending with petrol. To increase biofuel production that has larger scope, lignocellulosic liquid fuels from agri-residue and biodiesel from extensive Jatropha/Pongamia cultivation form wastelands are being pursued. Wastelands are also envisaged for biomass production for lignocellulosic fuel conversion. This requires relevant policy framework as well. These technologies have been estimated to take varying times (2017-2027) to be commercially ready and follow different rates of development across the four levels. Ethanol has been taken as a representative fuel from lignocellulosic biomass. The present transportation fuel consumption of India is 92 million tons/year.

As of now, only sugarcane molasses is used in India for bioethanol production. Considering that sugarcane is a water intensive crop, no substantial increase in its cultivation is considered (present: 4-5 Mha). However as the consumption of sugar in India is expected to increase in future, sugarbeet cultivation is envisaged and its molasses is projected to contribute to ethanol production. Sweet sorghum is also considered as a feedstock for bioethanol. Fuel ethanol production from sugar crop plantations approaches saturation limit by 2027.

Level 1

Sugarcane cultivation area is kept constant at 4.5 Mha. Sugarbeet and sweet sorghum cultivation areas are projected to increase gradually to 10,000 ha (by 2047) and 1,000 ha (saturates by 2032). Total first generation ethanol from sugar crops reaches 0.34 mtoe saturating by 2027. As for Jatropha/Pongamia biodiesel, cultivation wasteland is projected to increase to 0.5 Mha (by 2047); oil yield to 0.5 ton/ha and biodiesel production to 0.2 mtoe/year. Lignocellulosic liquid fuels from agri-residue begin to be commercially ready from 2027. The energy yield of the conversion process increases gradually from the present 20% to 35% by 2047. The fuel production reaches 2 mtoe/year by 2047. Total first and second generation biofuel production reaches 2.5 mtoe/year by 2047.

Level 2

Sugarcane cultivation area is kept constant at 5 Mha. Sugarbeet and sweet sorghum cultivation areas are projected to increase gradually to 15,000 ha (by 2047) and 2,000 ha (saturates by 2032). Total first generation ethanol from sugar crops reaches 0.6 mtoe saturating by 2027. As for Jatropha/Pongamia biodiesel, cultivation wasteland is projected to increase to 2 Mha (by 2047); oil yield to 1 ton/ha and biodiesel production to 1.8 mtoe/year. Lignocellulosic liquid fuels from agri-residue and wasteland biomass begin to be commercially ready from 2022. The energy yield of the conversion process increases to 43% by 2047. The fuel production reaches 5.7 mtoe/year (wasteland: 1 Mha; 0.5 mtoe/year) by 2047. Total first and second generation biofuel production reaches 8.1 mtoe/year by 2047.

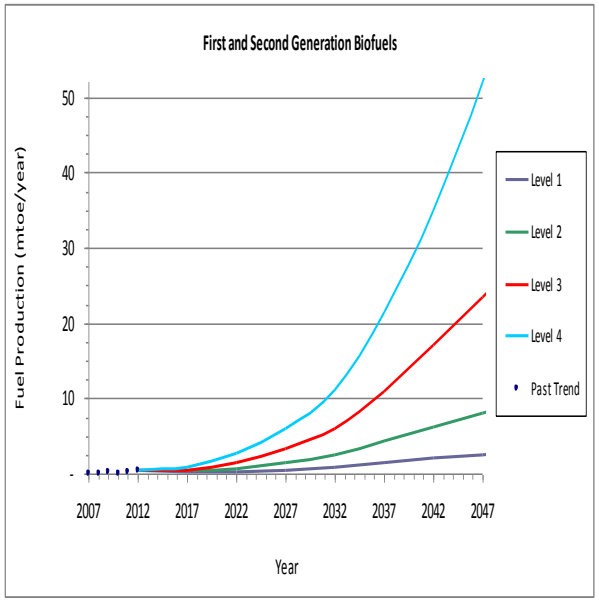
Level 3

Sugarcane cultivation area is kept constant at 5.2 Mha. Sugarbeet and sweet sorghum cultivation areas are projected to increase gradually to 20,000 ha (by 2047) and 5,000 ha (saturates by 2032). Total first generation ethanol from sugar crops reaches 0.9 mtoe saturating by 2027. As for Jatropha/Pongamia biodiesel, cultivation wasteland is projected to increase to 3.5 Mha (by 2047); oil yield to 1.5 ton/ha and biodiesel production to 4.9 mtoe/year. Lignocellulosic liquid fuels from agri-residue residue and wasteland biomass begin to be commercially ready from 2020. The energy yield of the conversion process increases to 52% by 2047.

The fuel production reaches 18 mtoe/year (wasteland: 2.5 Mha; 3 mtoe/year) by 2047. Total first and second generation biofuel production reaches 23 mtoe/year by 2047.

Level 4

Sugarcane cultivation area is kept constant at 5.5 Mha. Sugarbeet and sweet sorghum cultivation areas are projected to increase gradually to 25,000 ha (by 2047) and 10,000 ha (saturates by 2032). Total first generation ethanol from sugar crops reaches 1.26 mtoe saturating by 2027. As for Jatropha/Pongamia biodiesel, cultivation wasteland is projected to increase to 5 Mha (by 2047); oil yield to 2 ton/ha and biodiesel production to 9 mtoe/year. Lignocellulosic liquid fuels from agri-residue and wasteland biomass begin to be commercially ready from 2017. The energy yield of the conversion process increases to 60% by 2047. The fuel production reaches 42 mtoe/year (wasteland: 4 Mha; 9 mtoe/year) by 2047. Total first and second generation biofuel production reaches 52 mtoe/year by 2047.



Projection of First and Second Generation Biofuels

Note: Please see detailed documentation for referencs