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### Expert call: Progressing on ethanol journey but delays possible

- India is progressing on the 15bn target of ethanol production, but delivery target could be delayed by a couple of years beyond ESY25
- Ethanol project progress is slow with 2.6bn litres of capacity granted consent to establish by Mar'23
- 2G ethanol projects are far from establishing viability and need highvalue added byproducts to support viability

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We interacted with Deepak Desai, Chief Consultant of Ethanol India, to understand India's progress on its ethanol journey and the feasibility of targets. Key takeaways:

India is progressing on expanding inputs for ethanol: India has ramped up ethanol blending in petrol to 4.1bn litres in ESY22 from just 0.3-0.4bn litres two decades ago. Sugar use for ethanol has increased to 4.5mn tonnes (mt) of sugar in ESY23 from total production of 40.2-41.0mt. While use of B-heavy molasses has increased to 59.96% of total inputs in ESY23 YTD, use of C molasses has come down to 3%. Contribution of grain has also improved with damaged food grains and maize accounting for 9.5% and surplus rice from FCI improving to 8.6%.

**ESY25** target for ethanol production is steep: India has advanced its 20% ethanol blending target to ESY26 and is looking to ramp up availability of ethanol for blending to 5.4bn litres in ESY23 and 9.9bn litres in ESY25. This together with traditional use requires ethanol production of 15bn litres by ESY25.

**Ethanol projects progress is slow:** While consent to establish has so far been granted to 2.6bn litres of capacity, consent to operate has been granted to 0.26bn litres. India needs more than 5bn litres of capacity to deliver on its target of 15bn litres. Looking at the current progress of projects, achievement of the target could be delayed by a couple of years.

**2G** ethanol commercial projects under implementation: Under Phase 1 of the JI-VAN scheme, OMCs are implementing four commercial projects to assess economic feasibility. While IOCL is in the advanced stage of commissioning, plants of BPCL, HPCL and NRL are due for implementation over the next couple of years.

**2G** ethanol still far from establishing viability: Deriving significant value from byproducts is key for 2G ethanol projects to establish economic feasibility to offset high capital intensity and higher conversion cost (i.e. higher power and steam usage). While availability of biomass is adequate, support of the agriculture ministry would be essential to develop organised procurement.





# 1G ethanol progressing towards a steep target

## India is moving to expand inputs for ethanol

India has increased ethanol production to 4.5bn litres in Ethanol Supply Year (ESY) 2021-22 (ending Nov'22) from 2.5bn litres two decades ago. This has helped ethanol blending to increase to 10% in ESY22.

- Blending in fuel has become most prominent usage for ethanol. Ethanol blending in petrol has increased to 4.1bn litres in ESY22 from just 0.3-0.4bn litres two decades ago. Earlier when production was lower, ethanol was prioritised for potable alcohol (1.0bn liters) and industrial alcohol (0.8bn litres) applications. India has been able to bring about this major change by offering a higher price for ethanol at ~Rs 65/l for ESY22-23 from Rs 17.5/l two decades ago.
- Sugar mills are diverting more sugar for ethanol production. With improved availability of sugar and higher realisation for ethanol, sugar mills have been focusing on higher production of the fuel. This has resulted in 2.0-2.5% additional diversion of uncrystallised sugar totalling ~6% of sugar produced for ethanol manufacture, translating to ~3.4mt of sugar usage in ESY22 and ~4.5mt in ESY23 out of total sugar production of 40.2-41.0mt. Desai estimates that 35-36mt of the sweetener is likely to suffice for meeting domestic sugar consumption requirements in India.
- Sugar mills are diverting a higher proportion of B-heavy molasses for ethanol production. In ESY23 YTD, while B-heavy molasses accounted for 59.96% of all inputs for ethanol production, C-heavy molasses have sharply come down to 3%, as per Desai's estimates. Effective ethanol production is higher from B-heavy molasses (at ~330-340litres/tonne of molasses) than C-heavy molasses (yield of 270l/t) due to higher sugar content.
- Contribution of grain for ethanol production has started inching up. Contribution of damaged foodgrains and maize has improved to 9.5% whereas usage of surplus rice from FCI has improved to 8.6%.
- Feedstock mix in last ESY: During ESY22, feedstock contribution to ethanol production was as follows C-heavy molasses 2.5%, B-heavy molasses 61.1%, SCI/sugar/syrup 19.7%, damaged food grains and maize 5.5%, and surplus rice from FCI 11.2%, as per the BPCL Ethanol Booklet published in Mar'23.

### India's ESY25 target for ethanol production is steep

- Ethanol blending target for ESY25 at 15bn litres. To meet the target of 20% ethanol blending in petrol by ESY26, India would need to ramp-up ethanol available for blending to 5.4bn litres in ESY23, 7.0bn litres in ESY24, 9.9bn litres in ESY25 and 10.2bn litres in ESY26, as per Niti Aayog. This together with other traditional usage requires total ethanol production of 15bn litres by ESY25.
- Ethanol targets for ESY23. Ethanol production is targeted at 9.75bn litres in ESY23. This would comprise of 3.5bn litres of grain-based production and 6.25bn litres of molasses-based production. For ESY23, 5.4bn litres of ethanol is likely to



be required for blending with petrol and the rest would be used in traditional applications.

In ESY23, India was expecting sugar-based ethanol production of 6-6.25bn litres. Against this, ethanol manufacturers offered 5.9bn litres and the government agency allotted 4.65bn litres to manufacturers. Against this, ethanol manufacturers have supplied 2.23bn litres in ESY23 year-to-date.

- New projects are making only gradual progress. While 341 projects having aggregate potential of 20.5bn litres have received environmental clearance by Mar'23, consent to establish was given to only 2.6bn litres of capacity and consent to operate was granted to only 0.26bn litres of capacity. This indicates that progress of these projects is running slow.
- India is likely to achieve its target of 15bn litres...: Even if 25% of new projects
  having aggregate potential of 20.5bn litres materialise from here, this could help
  India achieve its target of 15bn litres.
- ... however, achievement could get delayed by a couple of years. However, keeping in view current progress, there is a possibility that delivery may get stretched a couple of years beyond ESY25.
- Extension of interest subvention scheme could help industry. In Jul'18, the government notified Ethanol Interest Subvention Scheme(s) for a period of five years for new ethanol plants. Under this scheme, the government offered financial assistance in the form of interest subvention at 6% per annum or 50% of the rate of interest charged by banks/financial institutions, whichever is lower for five years including a one-year moratorium. In Jan'21, the government included grain-based distilleries under the interest subvention scheme for capacity expansion.

### 2G ethanol still far from establishing viability

- JI-VAN scheme for 2G projects: The government of India has developed the scheme Pradhan Mantri Jaiv Indhan Vatavaran Anukool Fasal Awashesh Nivaran (JI-VAN) Yojana for providing financial support to integrated bioethanol projects using lignocellulosic biomass and other renewable feedstock.
- Scheme objectives: The scheme envisages setting up 12 commercial scale second generation (2G) bioethanol projects and 10 demonstration scale 2G bioethanol projects based on non-food biomass feedstocks and other renewable feedstocks. The government has allocated financial support of Rs 19.7bn including Rs 1.5bn capital assistance for each new project. This was planned to be implemented in phases with six commercial projects and five demonstration projects planned for phase 1 over FY19 to FY23.
- 2G ethanol projects under implementation: At present, four commercial projects are under implementation to establish technology and economic feasibility. These include IOCL Panipat, Haryana (100klpd plant using rice husk), BPCL Bagrah, Odisha (100klpd using rice husk), HPCL Bhatinda, Punjab (100klpd using foodwaste), and Numaligarh Refinery Golahghat, Assam (185klpd based on bamboo).



IOCL has commissioned the Panipat project based on its own design and with Praj Industries as a turnkey contractor. BPCL and HPCL projects are being implemented using Praj's technology.

- Raw material availability is not an issue...: Availability of raw material for operating a 2G ethanol plant is not an issue as long as the plant is sized for collecting raw materials from a surrounding 250km area. Biomass requirement for operating a 100klpd or 25-30mn litre per annum ethanol plant is ~1.2mn-1.6mt. While biomass is only available during the harvesting season, this can be stored in sufficient quantity to make it available for 2G plants through the year.
- ...but organised procurement is essential. Support from the Agriculture department would be essential to develop a backend integration with farms for organised procurement (e.g. co-operative society). This could raise the cost of procurement of biomass to ~Rs 6k-8k per tonne. While OMCs (i.e. oil marketing companies setting up 2G plants) have control over fuel, they also need to develop control over farms for round-the-year procurement.
- Conversion cost is a challenge. For 2G plants, the requirement of utilities is significantly higher than that of 1G plants. 2G plants require 10-12MW of power (vs. 3MW for a 1G plant) and steam of 60t (vs. 40t for a 1G plant) for a 100klpd 2G plant. While a 2G plant saves on cost of biomass (just Rs 2.5k-4k/t in current unorganised form vs. Rs 20k/t for 1G plant), it incurs much higher conversion costs.
- Capital intensity is significantly higher. Capital cost of a 2G project is ~Rs 9bn-10bn for a 100klpd plant compared to Rs 1.1bn-1.2bn for a similar sized 1G plant.
- Byproducts are key to establish viability of 2G ethanol projects. As an example, feasibility of a maize-to-ethanol plant lies in the byproducts rather than the ethanol itself. A typical 100klpd 2G ethanol plant will require 230t of maize annually. At the current price of Rs 23/t, the cost of maize procurement itself will be the equivalent of Rs 52/l of ethanol. To allow for conversion cost and capital recovery, byproducts need to generate much higher value to support viability of the project. Funding under PM-JIVAN is only limited to Rs 1.5bn per plant and is not sufficient.

A 100klpd biomass-based ethanol plant will require 400-410tpd of biomass to produce 80-85tpd of ethanol. Besides ethanol, the plant will produce 78-79tpd of carbon dioxide, fusel oil of 0.3-0.4%, lignen of 201-212tpd and biogas of 2.5tpd. Losses are around 10-11%. It is important to derive value from these byproducts to improve feasibility of a 2G biomass-based plant. For example, deriving biochemicals with higher value could substantially improve the feasibility of a 2G plant.

- Water sustainability is another challenge; likely consumption high for 2G ethanol: A 100klpd 2G ethanol plant requires 2.28mn litres of water per day vs. 0.6mn litres for a 1G ethanol plant. *Technological* advancements to reduce water consumption by controlling evaporation loss will be useful to improve water sustainability of 2G projects.
- Agriculture-waste has the potential to produce 20-25bn litres of ethanol if commercially viable and could go a long way to improve ethanol consumption in India.



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