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“Ethanol production from agri crops will make farmers and India truly Atmanirbhar”

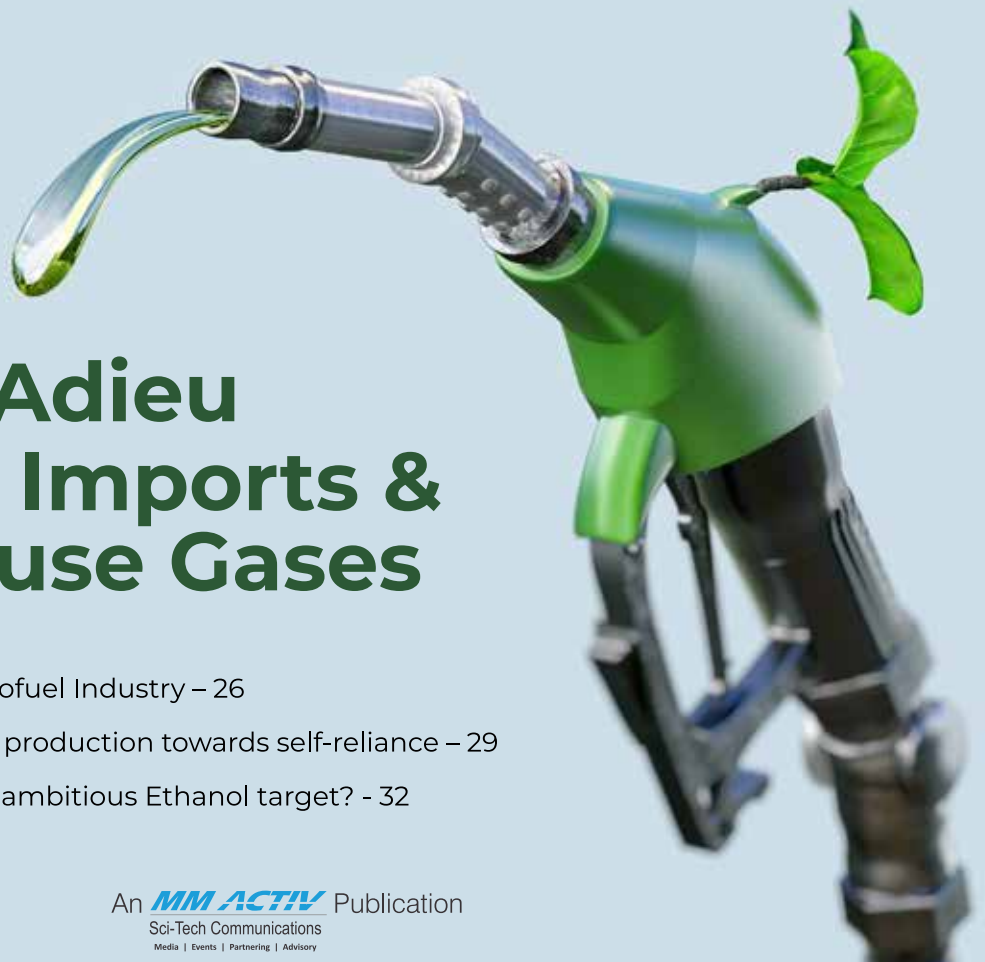
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Nitin Gadkari,

Union Minister, Road Transport & Highways

*To increase the production of fuel-grade ethanol, the government is planning to encourage distilleries to produce ethanol from maize and rice stocks available in state-held granaries run by the Food Corporation of India (FCI). Nitin Gadkari, Union Minister, Road Transport & Highways shared his views with AgroSpectrum on how the production of biofuels can bolster the growth of the agriculture industry.*

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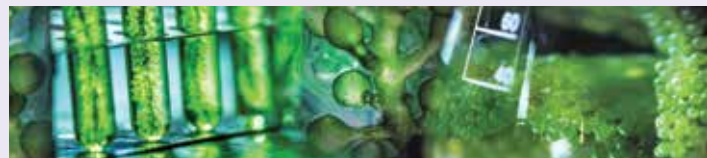
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 COVER STORY

# Bidding Adieu to Crude Imports and

# GREENHOUSE Gases

*As the country is on the path to recovery from the economic brunt of the pandemic, cutting expenditures that affect the national coffers seems like a logical move. India's annual crude oil imports have been increasing year on year, while the global petroleum prices have become too prohibitive. Fortunately, India has an advantage in its abundant agricultural produce and surplus raw materials that can be used to manufacture ethanol, a viable renewable energy source. The Indian government has set in motion various schemes and regulations that will make biofuels, a crucial component to meet the country's increasing energy needs. The oft-repeated Atmanirbhar Bharat vision seems to be at play here, empowering not just the farmers, but also India's future towards self-reliance in terms of energy demands.*





**T**he Department of Biotechnology has been promoting R&D for biofuel technology development by recognising the need for clean and renewable energy for transportation. The Government of India had, in June 2018, announced a new policy on biofuels and an indicative target of 20 per cent blending of ethanol in petrol and 5 per cent blending of biodiesel in diesel by 2030.

After the country took a massive financial hit due to the outbreak of COVID-19, the government bodies have been actively endorsing biofuel and its usage as it will help the country to cut down on its crude oil imports. In 2019, India imported around 226 million metric tonnes (MMT) of crude oil and this volume keeps rising every year. By mixing a small portion of biofuel with other processed fuels will help the government to provide a renewable source of energy to its citizens and that too at a very low price.

In 2015, Prime Minister Narendra Modi had stated that India needs to bring down its oil import dependence from 77 per cent in 2013-14, to 67 per cent by 2022, when India will celebrate its 75th year of independence. Now, stretching further on this concept of using green energy, the central government is planning to direct oil companies to sell up to 20 per cent ethanol blended petrol from April 1, 2023.

According to reports, India imports 83 per cent crude oil for its domestic use after processing. Similarly, 50 per cent of its natural requirement is fulfilled by imports. The government has set a target to reduce this import dependence by 10 per cent in the next two years.

As per the report by NITI Aayog 2021, India's net import of petroleum was 185 Million Metric Tonnes (MMT) at a cost of \$55 billion in 2020-21. Most of the petroleum products are used in transportation. Hence, a successful E20 programme can save the country \$4 billion per annum, which is around Rs 30,000 crore. Besides, ethanol is a less polluting fuel, and offers equivalent efficiency at lower cost than petrol. Availability of large arable land, rising production of food grains and sugarcane leading to surpluses, availability of technology to produce ethanol from plant based sources, and feasibility of making vehicles compliant to ethanol blended petrol make E20 not only a national imperative, but also an important strategic requirement.

## Relying on biofuels inevitable

Biofuels obtained from organic matter or waste are one of the most valuable renewable energy sources that can help reduce carbon emissions. Bio-diesel, bio-ethanol and biogas are the three most commonly used biofuels. Apart from being a renewable source of energy, biofuels help in reducing the air pollution of the globe. As per the Renewable Fuels Association, an association for America's ethanol industry, the usage of biofuels has helped in reducing more than 230 million metric tonnes of carbon emissions since 2007.

Adopting biofuels as an alternative source of energy can significantly improve farmers' income, generate employment opportunities, reduce imports, augment waste to wealth creation, etc. Therefore, the government, through several programmes, promotes the production and usage of biofuels.

In order to further encourage the production and the usage of biofuels, the Government of India has launched various schemes and policies such as National Policy on Biofuels, 2018, Pradhan Mantri JIVAN Yojana, Biogas Power Generation and Thermal Energy Application Programme (BPGTP), New National Biogas and Organic Manure Programme (NNBOMP), Sustainable Alternative Towards Affordable Transportation (SATAT) etc.

Elaborating on the government's schemes and policies, Atul Mulay, President, Bioenergy, Praj Industries, said, "Government has already taken various strategic interventions to boost the ethanol production and consumption in the country. Government has recently released a five year roadmap, advancing the E20 target by five years to FY 2025. This has created ethanol capacity building opportunities."

## Ethanol production

In India, ethanol is produced through various sources and depending on the raw materials used for their production, their outputs are categorised in 1G, 2G and 3G, where 'G' stands for 'generation'. The source of 1G – the first generation of biofuels – include edible sources like molasses, sugar-containing materials like sugarcane, sugar beet and sorghum, starch-containing materials like corn, cassava and rotten potatoes, and edible oil seeds. 2G biofuels use non-edible sources like non-edible oilseeds (e.g. *Jatropha curcas*), used cooking oil, agriculture

residue such as rice straw, cotton stalk, corn cobs, saw dust, bagasse, etc. 3G biofuels are drawn from industrial waste, municipal solid waste, etc. 2G and 3G biofuels are recognised as being more advanced.

“The supply chain for 1G ethanol production from sugar is well established. Different sugar mills have their own ethanol production capacity. Recently, the government has permitted use of starchy feedstock (surplus and damaged grains) for ethanol production. Starchy feedstock from Food Corporation of India (FCI) will be made available to ensure uninterrupted supply,” said Mulay. Echoing similar sentiments, Dr Anjan Ray, Director Council of Scientific and Industrial Research-Indian Institute of Petroleum (CSIR-IIP) said, “The new biofuel policy has opened up new avenues of using 1G, as well as 2G and also mixed feedstock. While 1G-bioethanol technologies are well established, and the 2G-bioethanol processes are moving towards maturity, the Indian energy sector now has to roll out production by focusing on economically viable and scalable technologies using waste-based feeds as far as possible and also by enhancing productivity and utilisation of 1G crops other than sugarcane.”

Some of the leading players in India ethanol market are Praj Industries, India Glycols, Bajaj Hindusthan Sugar, Shree Renuka Sugars Ltd., Triveni Engineering & Industries Ltd., Balrampur Chini Mills Ltd., Mawana Sugars Ltd., HPCL Biofuels Limited, Jeypore Sugar Company Ltd., Simbhaoli Sugars Ltd., BSM Sugar and E.I.D Parry India Ltd.

## Compressed Biogas

Waste / Biomass sources such as agricultural residue, cattle dung, sugarcane press mud, municipal solid waste and sewage treatment plant waste etc. produce biogas through the process of anaerobic decomposition. The biogas is purified to remove hydrogen sulfide (H<sub>2</sub>S), carbon dioxide (CO<sub>2</sub>), water vapour and compressed as Compressed Bio Gas (CBG), which has methane (CH<sub>4</sub>) content of more than 90 per cent.

In order to expand the scope of CBG in India, the then Petroleum Minister Dharmendra Pradhan stated that the country is well poised to receive a whopping investment of Rs 2 trillion to set up 5,000 CBG units across the country. On that note, the Ministry of Petroleum and Natural Gas signed memorandum of understandings

## Ethanol blended petrol compatible vehicles

Currently, produced two-wheeler and passenger vehicles in the country are designed optimally for E5, with rubber and plastic components compatible with E10 fuel; their engine can be calibrated for E10 for better performance. As the ethanol blended petrol (EBP) rolls out in the country, vehicles need to be produced with rubberised parts, plastic components and elastomers compatible with E20 and engines optimally designed for use of E20 fuel.

The Society of Indian Automobile Manufacturers (SIAM) has assured that once a road-map for making E10 and E20 available in the country is notified by the Ministry of Petroleum and Natural Gas (MoPNG), they would gear up to supply compatible vehicles in line with the roadmap. It is possible to roll out E20 material compliant vehicles by April 2022 and E20 Engine compatible vehicles by April 2023. However, considering the supply of Ethanol Blended Fuel, it is recommended that E20 material compliant and E10 engine tuned vehicles may be rolled out all across the country from April 2023.

These vehicles can tolerate 10 per cent to 20 per cent of ethanol blended gasoline and also give optimal performance with E10 fuel. Vehicles with E20 tuned engines can be rolled out all across the country from April 2025. These vehicles would run on E20 only and will provide high performance.

(MoUs) with energy companies like JBM Group, Adani Gas, Torrent Gas and Petronet LNG for setting up the CBG plants. The ministry, likewise, inked MoUs with technology providers in CBG sectors like Indian Oil, Praj Industries, CEID Consultants, and Bharat Biogas Energy. Through these arrangements, the government under the SATAT is aiming to complete its target of 5000 CBG plants by 2023-24 with a production target of 15 MMT.

Further, Pradhan said that the Government is in the process of including CBG under Priority Sector Lending. This move will provide ease in the financing of CBG plants. He added that Central

### Supply and demand of ethanol

- Last year, 1.91 billion litres of ethanol was blended with petrol, achieving just 5.5 per cent blending
- This year, so far oil companies have signed up contracts for 1.4 billion litres and contracts of additional 310 million litres are in the pipeline.
- There is demand of 5.11 billion litres from oil companies
- Since there is around 21 per cent dip in production, the target of ethanol blending could reach 4.5 per cent only.

**Source: Ministry of Consumer Affairs, Food and Public Distribution**

Financial Assistance or Subsidy for setting up CBG plants has been extended to 2020-21 to promote new projects. As per the Ministry of Petroleum and Natural Gas, CBG projects are viable and have an attractive rate of return for new entrepreneurs. A new package for MSME shall also assist to fund CBG Plants across India. The ministry is also exploring global funds to fund CBG projects.

### Reducing stubble burning menace

Stubble burning is a very big issue especially in Delhi NCR region as the entire zone gets covered with haze of air pollution causing serious health issues to living beings. The root cause of this hazardous issue is farmers have their backs against the wall with no other option to burn massive biomass as they need to prepare the field for the next crop. These farmers have limited storage space and with almost no offtake available, they prefer burning the stubble.

Last year, the Government of Punjab gave its nod to Indian Oil Corporation Ltd. (IOCL) to install a CBG plant at the site of closed cooperative sugar mills at Rakhra in Patiala. This newly developed plant will use paddy straw to produce biogas hence it will drastically reduce the stable burning in the region.

On a similar note, Praj Industries is all set to install CBG project at Badaun in Uttar Pradesh. This set up will use RenGas technology developed using proprietary microbes to produce CBG from rice straw. This project which has received a green signal from Hindustan Petroleum Corporation (HPCL) will have the capacity to process 35000



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focusing on economically viable and scalable technologies using waste-based feeds as far as possible and also by enhancing productivity and utilisation of 1G crops other than sugarcane."

**Dr Anjan Ray**, Director, Council of Scientific and Industrial Research-Indian Institute of Petroleum



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**Atul Mulay**, President, Bioenergy, Praj Industries

MT of rice straw as feedstock to generate 5250 MT of CBG annually.

To overcome the menace, Col Rohit Dev (Retd), Chief Operating Officer, Punjab Renewable Energy Systems Private Limited (PRESPL) has suggested, "A People Public Private Partnership (PPPP) Model could be evolved to foster mitigation of the stubble burning and use of biomass in Bio-Energy Projects; with first, for Bio-CNG, being under the aegis of the PMO, and to be implemented for next season, next year and secondly for Bio-Ethanol (2G) in Bhatinda, Punjab of HPCL / Barghar, Orissa of BPCL by year 2022. This model can be replicated for all small, medium and large industrial applications later".

He further added that such installations will enhance rural development with double income for farmers, financial inclusion, more jobs etc. It is the best way to establish 'Anna Daata to Oorja Daata' for the farmer community. Also lead the climate change initiative and work towards Sustainable Development Goals (SDGs) agreed upon during the Paris Agreement, through the Biomass-based Bio-Energy Sector by getting green fuels and reducing dependency on fossil fuels and also, reducing carbon, sulfur oxide and nitrogen

### Edge over CNG

Compressed Biogas is considered to have an edge over Compressed Natural Gas which is rapidly gaining popularity especially in the automobile sector. However, though both are methane-based gases, CBG offers better calorific value and can thus be used as green fuel in automotive, industrial and commercial sectors.

To explore further on this domain, oil marketing companies have invited Expressions of Interest (EoI) from potential entrepreneurs to set up CBG production plants and offer CBG in the market for use in automotive fuels. Apart from adding another affordable renewable fuel option to the country, it will also help the farmers to enhance their income in many ways.

oxides emissions. India being a huge market for biofuels, will attract tremendous Foreign Direct Investment (FDI) and establishment of projects and manufacturing units of varied kinds in India and that will give impetus to Make in India, more employment, better market share of production of biofuels in the world, growth boost to economy etc.

Moved by the potential of India's CBG sector, a German company called Verbio AG is gearing up to set up its CBG plant at Bhutal Kalan village in Punjab's Sangrur district. As per the company, it will be using paddy stubble as raw material which will be collected within the 15 km radius of the plant. Claus Sauter, CEO, Verbio, stated, "On the one hand, the Indian Government is promoting the expansion of gas mobility as a cheap alternative to expensive fossil fuels in the country. On the other hand, it urgently needs and wants to contain the problem of massive air pollution caused by the large-scale burning of waste straw in the fields. Our straw biomethane technology is so far the only concrete answer to both challenges."

The company uses an advanced technology

**Uttar Pradesh is dominating the ethanol production domain in India with 58 crore litres of ethanol produced by 54 distilleries established across the state.**



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which enables the raw materials to ferment in big fermenters with a capacity of 8,000 to 10,000 cubic metres. The biomass is left in the fermenters with the addition of bacteria for about 30 days. During fermentation, raw biogas is produced comprising about 60 per cent methane. It also contains carbon dioxide, sulphur and inorganic elements, which are removed in the next steps in first a desulphurisation plant and then a CO<sub>2</sub> capture plant. The inorganic components are also removed. The resulting biomethane with a purity of 99 per cent is then fed into the natural gas grid. Ammonium sulphate solution, straw humus, phosphate and potassium are also produced and can be used as organic fertilizer. The company further states that four big bales of straw (two tonnes of straw) transformed into biomethane provide enough biofuel to run a mid-class CNG car for a whole year (ca. 11,500 km).

Experts agree that only a synergetic effort by the government, farmers and companies involved in the production of ethanol will help transform the country economically and safeguard the environment for the future generations. **AS**

**Nitin Konde**



"The advancing of E20 target to FY 2025 has created tremendous ethanol capacity building opportunity"



**ATUL MULAY,**  
President, Bioenergy,  
Praj Industries



*Praj Industries is India's most successful company in the field of biofuel and other bio-based technologies that was started as an enterprise under the name of Praj Counsel Tech, three decades ago. Founded in 1983 by Dr Pramod Chaudhari and made public in 1994, Praj Industries has an influence on five continents. Mainly focussed on providing and developing 2nd generation ethanol technology, Praj Industries is India's leading manufacturer in engineering processes and projects. As a global process solutions company, it is driven by innovation and integration capabilities, offering solutions to add significant value to bio-energy facilities, brewery plants, water and wastewater treatment systems, critical process equipment and systems, compressed biogas plants, HiPurity solutions and bio-products. Over the past 35 years, Praj has focused on environment, energy and agri- process led applications. The company has been a trusted partner for process engineering, plant and critical equipment and systems with over 750 references across 75 countries. Atul Mulay, President, Bioenergy, Praj Industries, shared his views on the status of ethanol production in India with AgroSpectrum. Edited excerpts;*

**How is Praj contributing in attaining the government's vision of 20 per cent ethanol blending in petrol (E20) by 2025?**

As a flag bearer of the ethanol industry, Praj works on multiple fronts such as technology, ecosystem development, policy advocacy etc.

to help fulfil the government's vision of 20 per cent blending in petrol. End to end technology solutions for production ethanol offered by Praj inspire project developers and investors' confidence for capacity building.

In line with government policy of expanded range of feedstock to boost ethanol production,



Praj has developed technologies to process variety of feedstock such as sugary (C molasses, B heavy molasses and sugarcane juice), starchy (damaged/ surplus grains) and lignocellulose (agriculture residues such as wheat straw, rice straw etc.) to make ethanol projects technologically viable.

To improve commercial feasibility of ethanol plants, Praj Matrix, our R&D centre continuously works towards improving the process efficiencies and reducing energy and water footprints. We have been working closely with government agencies at state and national level to help formulate and rollout progressive biofuel policies.

By actively participating in the leading industry forums such as Confederation of Indian Industry (CII), Maharashtra Chamber of Commerce, Industry & Agriculture (MACCIA) etc., Praj has been furthering the causes of the biofuel industry by taking up important industry issues at appropriate government agencies for expeditious resolutions.

Being a global player, Praj is privy to ethanol industry's global best practices which it shares with stakeholders from time to time with the objective of overall improvement of industry standards. Praj recognises that success of E20 blending programme is contingent upon wholehearted participation of automakers. To ensure cooperation of the auto industry, Praj works closely with Automotive Research Association of India (ARAI), Pune, and OEMS for application development of advanced biofuels.

Currently ethanol blending in petrol is close to 10 per cent. To achieve the government's target of 20 per cent by 2025, a significant capacity addition in the range of 1000 Crore Litres of ethanol is envisaged. Praj is highly optimistic about achieving this target with an integrated approach and close collaboration amongst the industry stakeholders.

**Recently, Praj Industries bagged an order to set up India's largest capacity syrup-based ethanol plant from Godavari Biorefineries Ltd (GBL) in Karnataka using 'SHIFT' technology. How SHIFT technology will minimise energy and water footprint, while maximising value for customers?**

Using Praj's proprietary SHIFT technology, we are able to significantly improve the

throughput of ethanol plants and at the same time minimise water and energy footprints. In normal cases alcohol concentration after fermentation is usually 12 per cent; however our SHIFT technology takes the concentration to 15 per cent. Due to this, steam consumption during the distillation process is lower. For the syrup dilution process, instead of using fresh water, up to 50 per cent recycled spent wash is used. This results in lower spent wash generation resulting in lower energy requirement (almost 40 per cent lower) for its concentration. Thus SHIFT technology contributes to overall enhancement of techno commercial feasibility.

**Praj Industries has partnered with Hindustan Petroleum Corporation Limited (HPCL) for setting up a Compressed Biogas (CBG) project at Badaun in Uttar Pradesh using RenGas™ technology developed using proprietary microbes to produce CBG from rice straw. How will this bolster the growth of the biofuel industry in India?**

Praj is honoured to partner with HPCL for the Badaun project that has capacity to process 35000 MT of rice straw as feedstock to generate 5250 MT of CBG annually. It will also generate high quality solid as well as liquid bio-manure for ferti-irrigation. This project has a potential to save up to 15000 MT of CO<sub>2</sub> emissions per year.

HPCL Badaun CBG project will serve as a showcase installation by demonstrating end to end functioning of the value chain. This will definitely inspire developers and investors to actively consider setting up CBG projects. This project will lay to rest any apprehensions about technology, feedstock management, energy off take etc.

India currently imports 45 per cent of natural gas which is further processed for producing compressed natural gas (CNG) that is extensively used in meeting India's energy demand. India is taking concerted efforts to improve the share of gas in its energy mix to 15 per cent by 2030, from 6 per cent currently.

CBG is a high octane renewable gaseous fuel produced by processing bio-based feedstock such as press mud, agricultural waste etc. This not only helps in energy self-sufficiency but also helps in reduction in carbon intensity especially

in the transportation and industrial sectors, thus helping conserving the environment.

In a first of its kind initiative in the world the Sustainable Alternative towards Affordable Transportation (SATAT) programme launched by the government, 500 plants are envisaged to be built over a period of five years.

### **Praj Industries has developed innovative technology to produce Bio-bitumen based on lignin (one of the co-products resulting from the 2nd generation Ethanol plants). How can it contribute to the growth of the ethanol production industry?**

Praj has always endeavoured to deploy innovative technology solutions to maximise the value of ethanol plants by developing value-added co-products from waste streams to increase project attractiveness.

Bio-bitumen based on lignin, is one such co-products resulting from the 2nd generation Ethanol plants, paper making and also from Compressed Biogas plants. Praj has now developed a proprietary process (under patenting) to convert the crude lignin into Bio-bitumen. It has potential to replace this fossil based bitumen and offer eco-friendly green bitumen. The binding and viscoelastic property of Bio-bitumen makes it useful for applications in asphalt.

Praj's Bio-bitumen samples have been approved by Netherlands-based Circular Bio based Delta, one of Europe's premier consortia for scale up in Asphalt on a Dutch test strip on the road.

### **What inputs are required for the growth of the biofuel industry in India?**

**Sustained Policy support:** The government has already taken various strategic interventions to boost the ethanol production and consumption in the country.

**Demand visibility:** The government has recently released a five year roadmap while advancing E20 target by five years to FY 2025. This has created ethanol capacity building opportunity.

**Attractive pricing:** Government has announced differential pricing for ethanol based on different feedstock to facilitate financial viability of projects.

**Feedstock availability:** The supply chain for 1G ethanol production from sugar is well established. Different sugar mills have their own ethanol production capacity. Recently the government has permitted use of starchy feedstock (surplus and damaged grains) for ethanol production. Starchy feedstock from Food Corporation of India (FCI) will be made available to ensure uninterrupted supply.

Advanced technologies for ethanol production by processing bio based feedstock in an efficient manner will facilitate project viability.

### **What are the opportunities in the biofuel sector in India? What is the future of Biofuels & 2G Ethanol technology in India?**

Opportunities in the biofuel sector are abundant in India. Transportation fuel mix is undergoing a major transition by way of mainstreaming of renewable low carbon biofuels. While biofuels usage in surface transportation has already gained momentum, its application in the aviation sector is about to take off. Also application of marine biofuels in water transportation are ushering on the horizon.

Future of 2G ethanol technology in India appears very promising as it positively impacts the interest of stakeholders across the value chain delivering differentiated value. Biofuels produced from captive resources i.e. agriculture residues, facilitates energy self-reliance as it reduces dependency on the imported crude and associated forex bill. It also provides an additional revenue stream for farmers. Carbon neutral cycles triggered by combustion of biofuels help curtail health hazards attributable to the air pollution due to burning of agriculture residues and emissions from fossil fuel combustion.

India's first batch of commercial projects based on 2G ethanol technology is under development. Praj is working on three numbers of advanced biofuel refineries in India, based on proprietary 2G enfinity™ technology. Construction and Installation activities are in full swing at all sites and we expect mechanical completion of the first project by February 2022. We expect to commission this plant in June 2022. AS

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