Future ready 2G ethanol plants
for a sustainable world

Our technology solution brings infinite possibilities to the environment and energy challenges confronting mankind, apart from making use of nature’s endless resources. That’s why we are proudly call it... ‘enfinity’
For a sustainable world

Transportation fuels account for more than 15% of the GHG emission worldwide. While there are various options to reduce the impact of transportation fuels on the environment, renewable fuels present a far more imminent solution. Ethanol blended gasoline as a cleaner transport fuel has been implemented in various countries for more than five decades. Today, there are more than 45 countries which have a successfully implemented ethanol blending program and over 15 countries are planning ethanol blending program. As per the ethanol blending programme of Govt of India, Ethanol blending can help save 60 to 80% GHG emissions compared to gasoline. While 1st generation ethanol has been seamlessly integrated into the gasoline supplies in many countries, there is an ever present concern regarding food vs fuel issue, indirect land use and availability of ready abundant biomass round the year. These concerns led Praj to explore biomass like corn cobs, bagasse, rice/wheat straw, corn stovers, bamboo and Empty Fruit Bunches (EFB) as a feedstock which can not only produce ethanol but will also produce a host of biochemical and bioproducts to partially wean the world away from fossil fuels. 2nd generation biomass based ethanol presents infinite possibilities for a greener, cleaner and sustainable world. 2nd Generation Ethanol, which utilizes sugars available in the non-edible feed-stock such as, farm residue and forest residue, is not only an answer to the ‘food vs fuel’ debate but it also helps to create an added source of feed-stock for ethanol production.

2nd Gen Ethanol; Advantages over 1st Gen Ethanol

- Lower GHG Emissions
- Lower Carbon Footprints
- Expanding rural job opportunity
- Better value for agri-residue
- Enhancing sustainability of ethanol production
Building Energy Staircase:

From 1st Generation to 2nd Generation Ethanol Technology we thrive on challenges. In fact, challenges inspire us to innovate and create a whole new set of solutions. Our very first assignment involved a ‘mission critical’ technology which would ensure Zero Liquid Discharge from an ethanol plant. It had not been done before. But we did it and we won accolades for the same.

In fact, it made us realize that merely supplying an ethanol plant is not enough. We provide a complete solution – a solution which will not take away from the system but return value back to the system. This led us to innovate and introduce many technologies that have created a benchmark in the world of ethanol plants.

For over three decades, quest for sustainable energy sources have inspired a whole range of our solutions. Today, we have more than 650 ethanol plant references in over 65 countries operating on sugar and starch based feed-stocks. Each of these plants carry our signature of technology innovation and integration, delivering lowest water and energy footprints. Each technology is delivered after rigorous laboratory, pilot and demonstration scale trials.

Working with bioprocesses for ethanol production has also given us an innate knowledge of how we can reduce the risk factors.

We began R & D work in 2007. In 2009, we set up a pilot plant operating on variety of feed-stocks including corn stover, sugarcane bagasse, corn cobs, rice/wheat straws, cotton stalk and Empty Fruit Bunches (EFB). After years of rigorous testing and 800,000 manhours of technology development efforts enable us to scale it up to 500 MTPD.
Technology Development Highlights:

- The technology development involved cross-functional team of Chemical engineers, Microbiologist, Molecular Biologists, Organic/Analytical chemists and Agronomists.
- Efficient pre-treatment technology developed after extensive screening.
- Enzymatic hydrolysis optimized after evaluation of numerous enzyme cocktails.
- Studied behaviour of feed-stocks from different geographies applying different process treatment.
- Enzymatic hydrolysis reactor design based on CFD modeling studies.
- Developed fermentation process using robust co-fermenting yeast strains.
- Research was conducted on several modes of biomass fermentation including Separate Hydrolysis and Fermentation (SHF), Simultaneous Saccharification and Fermentation (SSF) and Consolidated Bio-Processing (CBP) using different bacterial and yeast species.
- Strain development involved both classical and targeted techniques for improved yields and titer.
- 'enfinity' technology brings highly efficient Distillation, Dehydration & Evaporation (DDE) systems and zero liquid discharge ETP scheme.
- Process Design Package (PDP) prepared with heat and energy integration strategies for different process streams. Apart from major unit operations, technology development also focused on assessment of efficient material handling systems, Solid-Liquid (S/L) separation units and washing systems.
- Technology audited at pilot scale by internal and government agencies and Life Cycle Analysis (LCA) studies of biomass to ethanol have also been studied.
- Residue which is rich in lignin used as fuel for boiler to generate steam & electricity.

'enfinity' brings the following advantages:

- Multi-feed, multi-product processing capability
- Efficient degradation of biomass to sugars
- Technology proven on multiple enzymes
- Efficient hydrolysis to offer yield at par with globally known parameters
- Thermally integrated process to achieve low net energy usage
- Technology with zero process liquid discharge
Quick scale up & commercialization with over three decades of process design, engineering and project execution experience and with over 650 projects successfully commissioned, Praj is uniquely positioned to:

- Validate and build proof of concept
- Conceptualize various process schemes and ideas
- Evaluate freezing of process scheme & idea
- Process scale up
- Process optimization & integration engineering

**Technology & Process know-how:**
The team at praj brings you expertise in:
- End to end solutions right from feed-stock processing to final product
- Integration engineering – Energy & water optimization
- Efficiency enhancement
- Product recovery & Concentration

**Feed-stock Supply Chain Management**
- Biomass Mapping / Supply Calendar
- Biomass Harvesting / Handling / Transportation / Storage Techniques
- Economic optimization of biomass logistics chain

**Design**
- Concept Development
- Front End Engineering & Design (FEED)
- Equipment Design
- Process Design

**Engineering**
- Basic Engineering Packages for process plant
- Detailed Engineering Packages for process plants
- Engineering for off-sites including storage & handling, utilities, water treatment, steam generation, etc.
- Architectural and Civil Engineering Services

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**Multi-feedstock**

1st Gen
- Molasses
- Juice
- Grain

Next Gen
- Ligno-cellulosic
- MSW

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**CO₂**

**Smart Bio-Rfinery**

**Multi-Product**
- Fuel grade Ethanol
- Pharma grade Ethanol
- Isobutanol
- Bio-Chemicals
- Bio-Jet Fuel

- Bio Fertilizers
- DDGS, Bio-Gas, Bio-CNG
- Lignin Cake
Integrated Solutions

Quick scale up & commercialization

Supply of Equipment
- Process critical equipments
- Distillation columns, condensers, reboilers
- Evaporators, decanters, dryers, etc.
- Balance of Plant equipment
- Installation and Commissioning
- Procurement and Inspection Services for valves, pipes fittings, electrical etc.
- Commissioning - Supervisory services and training
- After Sales service

Waste Water Management
- Scrubbing Systems
- Secondary Treatment - High removal of BOD/COD, clarifier mechanism for sludge recycle.
- Tertiary Treatments - Sand filtration, chlorination, activated carbon column
Commercial Offerings

Innovative commercial offerings

• Modular design enables the Company to retro-fit existing 1st generation plant to enable it to run on 2nd generation input feed-stock

Advantages of bolt-on model:

• Utilizing existing infrastructure of sugar, power, 1G ethanol complex to reduce capital outlay
• Addition of fewer unit operations to the existing ethanol complex resulting in year round operations of ethanol complex

• Multi feed, multi product Ethanol complex
• Improved economic viability for 2G bolt-on module
• Higher returns per ton of feed-stock

Bio-Refinery

• Completion of the phase 2 of the project will demonstrate an operational bio-refinery

Biomass to bio-ethanol: Business model#1

Biomass to bio-ethanol: Business model#2
Praj Industries Limited

Praj is a global process solutions company driven by innovative and integration capabilities, offers solutions to add significant value to bio-ethanol facilities, brewery plants, water & wastewater treatment systems, critical process equipment & systems, high purity solutions and bioproducts. Over the past 3 decades, Praj has focused on environment, energy and agri process led applications. Praj has been a trusted partner for process engineering, plant & critical equipment and systems with over 650 references across five continents. Solutions offered by Praj are backed by its state of the art R&D Center called Matrix. Led by an accomplished and caring leadership, Praj is a socially responsible corporate citizen. Praj is listed on the Bombay and National Stock Exchanges of India.

For More information, visit www.praj.net

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