Accelerating Commercialization of 2nd Generation Integrated Bio refinery

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Building success ladder 1G → 2G

Praj’s core competencies

Technology & Integration engineering

Engineering & Manufacturing

Project & construction management

Quick scale-up & technology Commercialization

Research & Development

Knowledge base of 750 References
75 countries
5 Continents

16 Patents

Over 3 Decades of rich experience of ethanol industry along with Praj’s core competencies enabled us in developing sustainable future ready technologies
Technology optimization journey

Biomass to Bio refinery

- Operational since - January 2009
- Raw material processing capability -
  - Corn Cobs + Corn Stover
  - Sugarcane Bagasse, Cane trash, Pith
  - Rice straw, Wheat straw, Cotton stalk
- Pilot plant trials validated work done at laboratory & bench scale with Consistence performance
Key Highlights of Praj’s Integrated Demo Plant

- Integrated Bio refinery Demonstration Plant: Capacity - 1 MLPA Ethanol production
- Multi feedstock processing capability: Rice (paddy) Straw, Cotton stalk, Corn Cobs & Corn Stover, Sugar Cane bagasse & Cane trash, Wheat Straw etc.
- Multi-product - The plant is designed to produce Bio-ethanol, Bio-gas / Bio-CNG, Bio fertilizer, Provision for Production of Bio chemicals, Isobutanol - Jet fuel
- End to End Technology demonstration from feedstock processing till end product and waste water treatment
- Zero Process Liquid Discharge
- Process Integration for optimization of Energy & Water consumption

Oil Marketing Company officials witnessed demo plant operations
Inauguration of Demo Plant - 7th May 2017
Praj ‘s 2G demonstration plant

MATERIAL HANDLING SYSTEM
Praj ‘s 2G demonstration plant
Praj’s 2G demonstration plant

Hydrolysis and CO-Fermentation

2G Enzyme Storage

Hydrolyzed Slurry
Praj ‘s 2G demonstration plant

WASTE WATER TREATMENT
Pretreatment

Enzymatic Hydrolysis

Fermentation

Distillation & Dehydration

Waste Water Treatment

End to End integrated process

Leveraging expertise in Process optimization & Integration
Praj expertise in technology scale-up

Quick scale-up & commercialization expertise

- End to end solutions from feedstock processing to final product
- Integration engineering - water/energy optimization
- Front end engineering & design (FEED)
- Process & equipment design
- SKID mounted systems
- PMC, EPCM Services

Praj’s 1G Ethanol Plants - across globe

6 KLPD

100 KLPD

200 KLPD

1200 KLPD

2nd Gen Pilot → Demo → Commercial Scale

Praj has rich expertise of over 3 decades of technology scale-up
Update on Commercial Projects

- Received Purchase Order from Bharat Petroleum Corporation Limited (BPCL), for Praj’s proprietary technology, basic engineering and design package (BEDP).
- This is a major milestone towards commencement of work on the 2nd Generation ethanol bio refinery with production capacity of 100 kiloliter per day to be set up by BPCL at Bargarh, Odisha.
- The Purchase Order was awarded to Praj after the performance evaluation of its 2nd generation integrated bio refinery demonstration plant located in Maharashtra.
- Majority of the BEDP is ready for Execution.
Accelerating the Implementation

- Licensor selection and BEDP Completion
- Completion and Approval of Project Cost Estimations (+/- 10%) based on BEDP
- Land acquisitions and development
- Expediting EC related activities
- Releasing Work Orders for Long lead equipment and EPC
- Finalisation of Biomass Supply Contractors
- Rolling out VGF Policy
- Differential Pricing for 2G Ethanol
Sustainability Matrix

- Volatility in Feedstock, Product & Energy cost
- Uncertainty in Policies and Regulations
- Capex Optimization
- Value Maximization

- Sweating the existing assets
- Environmental care
- Profitability Improvement
- Return to Farmers

- Round the Year Operation
- Zero Liquid Discharge
- Energy and Water Reduction
- Multi-product Facility
Multi-Feedstock, Multi Product ‘SMART Bio Refinery’

**Multi-Feedstock**
- Corn Residues
- Sugarcane Residue
- Cotton Stalk
- Rice/Wheat Straw

**Multi-Product**
- Fuel Ethanol
- Bio-CNG
- Bio-Chemicals*
- Power export

**CO₂**

- Bio Fertilizers

**Biomass cost ~ INR 2000 - 5000 / MT**

**Total Revenue potential ~ INR 16,000 - 20,000 / MT**

Note: 1) Liquid CO₂ market price of INR8/Kg 2) Bio-CNG price INR 50/KG 3) Bioethanol price INR 39/Liter 4) Power price INR 4/Kwh 5) Carbohydrate content in biomass assumed at ~55%

* Bioethanol yield will reduce when sugars are diverted for bio chemicals

Praj innovative 2G Bio refinery provides higher returns
Many 1G ethanol plants operate 150-200 days / annum
- Additional 150-180 days operation using 2G bolt-on module
- Results in year round operations of bio-ethanol complex
- Higher asset utilization
- Fewer unit operations hence lower capEx
- Substantial increase in ethanol production capacity at lower capEx

Hydrolyzed slurry
SMART Bio Refinery - Multi-Feedstock & Products

Multi-Feedstock

1st Gen
- Molasses
- Juice
- Grain
- Ligno-cellulosic
- MSW

Next Gen

Multi-Product

CO₂

- Bio Fertilizers
- DDGS
- Biogas
- Lignin cake

- Fuel grade Ethanol
- Pharma grade Ethanol
- Bio-Chemicals
- Bio-Jet Fuel

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Praj Approach ...

- **Process Know-how**
  - Understanding Feedstock
  - Pretreatment & Fermentation Technologies
  - Waste water treatment & recovery

- **Ethanol & Ethanol based Chemicals**
  - Beverage Alcohol
  - Fuel Alcohol
  - Pharma Alcohol
  - Ethylene
  - Propylene
  - Acetic Acid
  - Ethyl Acetate

- **Biochemicals**
  - Furfural
  - Xylitol
  - Ethyl Levulinate
  - Levulinic acid
  - Lactic acid
  - Succinic acid
  - Acetic acid

- **Co-Products**
  - CO2 Recovery
  - Liquid /Solid Bionutrients
  - Bio-CNG
  - Biogas to Power

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Biochemicals From Biomass

1. Mechanical and Hydrothermal Pretreatment

   - Biomass

2. Step: I Dehydration

   - Furfural
   - C5 sugars
   - C6 sugars

3. Step: II Catalytic Conversion

   - Tetrahydurfuran (THF)
   - Xylitol
   - Levulinic acid/ Ethyl Levulinate
   - Ethanol
   - 2,3 Butanediol
   - Phenolics / BTX

4. Enzymatic Hydrolysis

   - C6 stream
   - Lignin and residues

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Biofuels & Biobased Chemicals from Sugar (Juices and Molasses)

1st Gen BioFuels & Biobased chemicals

Large Integrated Plants for Advanced Biofuels & Biobased Chemicals from LC

Integrated BioRefining Technologies

High Performance Synthetic BioFuels & Functional Chemicals

Customized Advanced Biofuels & Bio Based Chemicals

SUGARS

Molasses, Juice

LignoCellulosic Biomass

Natural / Customised Micro-Organisms

Green Catalysts

Fermentations

Green Chemistry

Down Stream (Recovery & Purification)

Bio Ethanol & Advanced BioFuels

Biopolymers

Bulk Chemicals

H & W Ingredients

Pharma Ingredients

Power

Emerging Global Trend – Multi Product Biorefineries
Thank you

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