

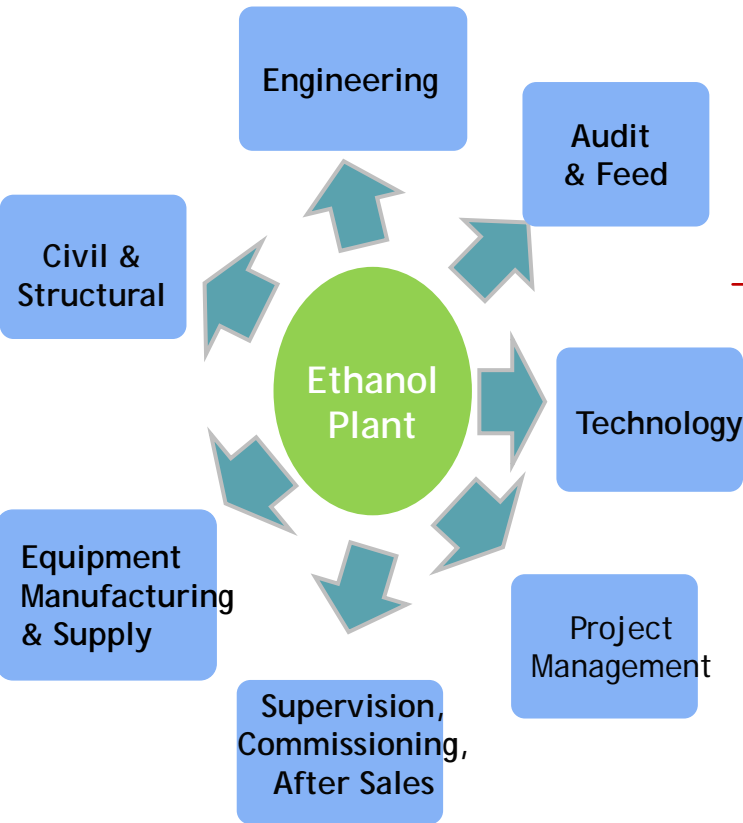
*“Praj’s Integrated
Advance Bio refinery
solutions driving
Sustainability”*



Vasudeo Joshi
Vice President, Praj Industries



Praj's Global Bioenergy Leadership



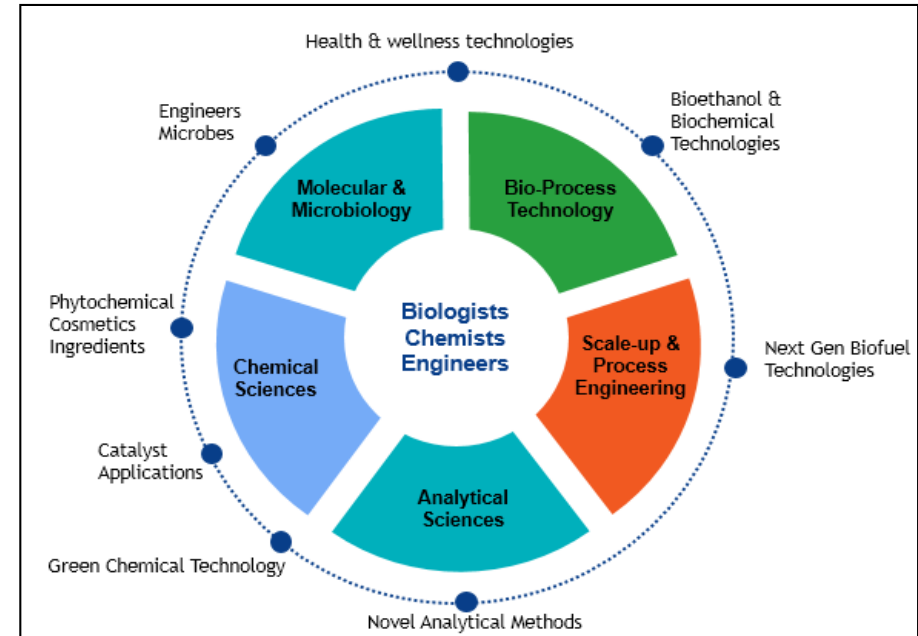
Only Ethanol Technology player with references across 5 continents
 Demonstrated Large Plant Capacity up to 1.2 MLPD (1200 KLPD)



Praj Matrix : The Innovation Center



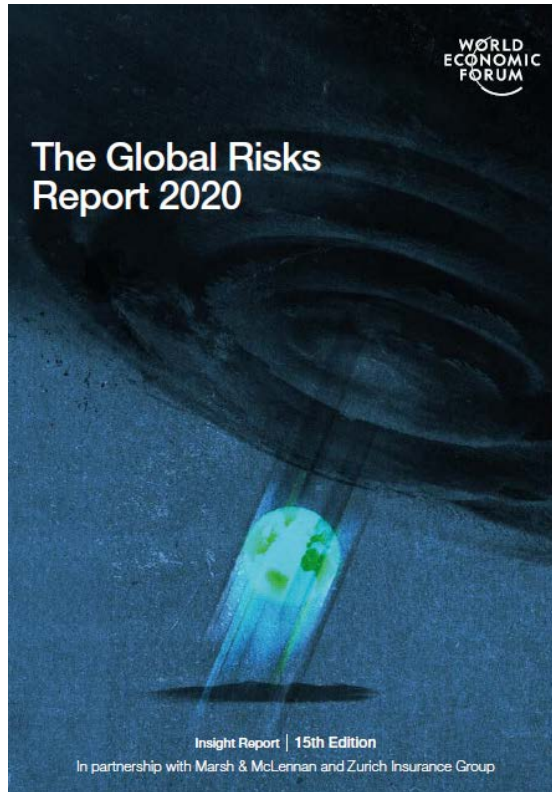
*Department of Scientific and Industrial Research



- In-House R&D laboratory - Certification by DSIR*, GOI
- \$ 25-30 mln investment from own funds
- First of its kind R&D facility with Bench and Pilot scale facilities which enable validation of scientific assumptions and rapid commercialization
- 90+ technologists and growing
- Continuous research on performance improvement & cost efficiency



Climate risk dominate top 10 Global Risks



- 1 Extreme weather
- 2 Climate action failure
- 3 Natural disasters
- 4 Biodiversity loss
- 5 Human-made environmental disasters
- 6 Water crises
- 7 Cyber attacks
- 8 Data fraud & theft
- 9 Global governance failure
- 10 Asset bubbles

- ◆ Environmental
- ◆ Economic
- ◆ Societal
- ◆ Geopolitical
- ◆ Technological

Investment in Sustainable & De-carbonization projects -
An imperative To mitigate Climate Risk



India : Challenges

Social

Job opportunities in rural areas

Health issues due to pollution

Eco-system under developed

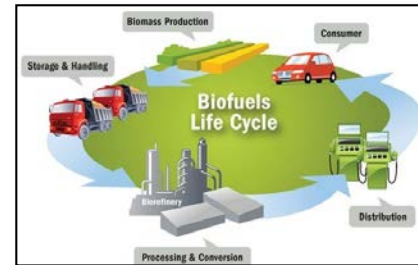


Energy

Heavy reliance on imports

Energy Mix skewed to fossil

Energy Security



Environment

Global warming
Rising GHG emissions

Pollution due to rapid industrialization

Climate change



Economy

Demand -Supply energy gap

Accelerate Rural Economy

Huge Forex /import bill

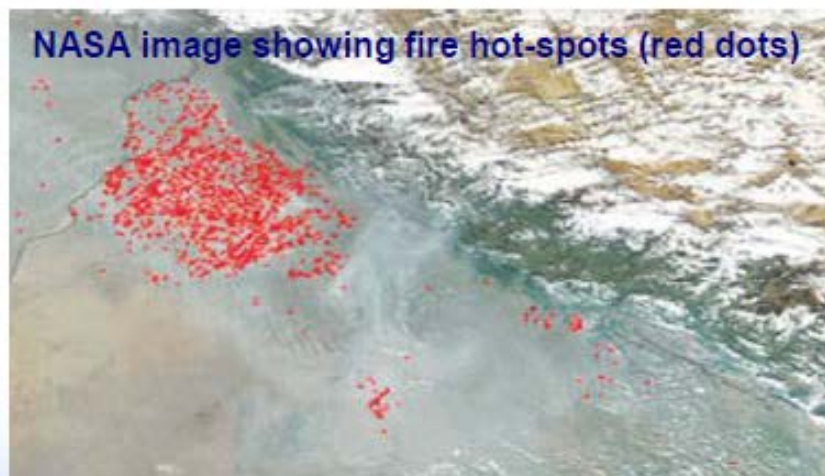
2G Smart Bio Refinery has potential to addresses issues.



Crop residue burning



Images from The Guardian



Source: NASA, Hindustan Times Nov 7, 2013



Air pollution from crop stubble burning costing \$ 30 Bn/ Yr*

Estimated Biomass Surplus availability @ 141 Mn.MT/PA



Pillars of growth of Biofuels

Flagship government programs

- Make in India
- Swachh Bharat
- Doubling farmers income
- Energy self reliance - 10% cut in crude oil import by 2022

Strategic Policy environment

- 10% cut in crude oil import by 2022
- National **Biofuels policy-2018**,
- **SATAT** (Sustainable Alternative towards Affordable transportation)
- **Feasible pricing** mechanism for Ethanol

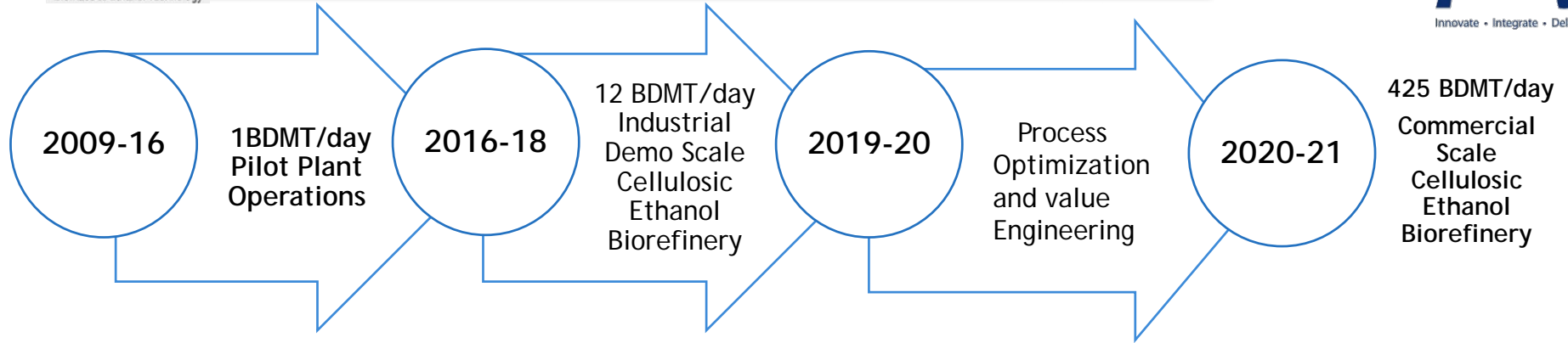


Enfinity: Praj's 2G Technology



Our technology brings **infinite possibilities** to the environment and energy challenges confronting mankind... by making use of nature's **endless** resources. That's why we proudly call it.....**enfinity**.





Biomass tested

Corn Cobs, Corn Stover
Sugarcane Bagasse, Cane trash, Pith
Rice straw, Wheat straw, Cotton stalk



Leveraging expertise in Process Integration & Optimization

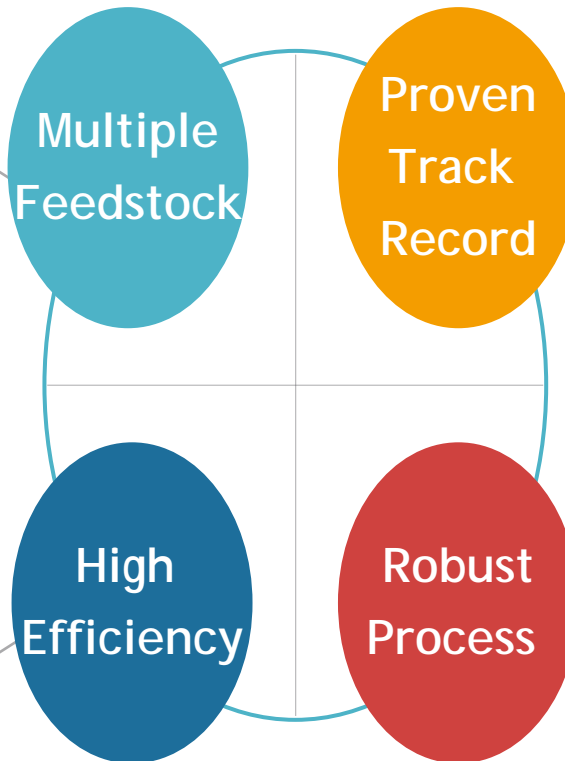


Update on enfinity commercial projects in India

- **BPCL Bargarh (Odisha)**
- **Praj Scope: Technology license, BEDP, Proprietary equipment, Mandatory Services**
 - Plant Capacity: 100 KLPD Fuel ethanol, Feedstock :Rice Straw
 - BEDP, FEED Completed, EPC execution started
 - **Expected Mechanical Completion June 2021**
- **IOCL Panipat (Haryana)**
- **Praj Scope: Technology license, BEDP, Proprietary equipment, Mandatory Services & EPCM**
 - Plant Capacity: 100 KLPD Fuel ethanol, Feedstock :Rice Straw
 - BEDP, DFR, Majority of Detailed Engg & Tendering completed
 - **Expected Mechanical Completion June 2021**
- **HPCL Badaun (U.P.)**
- **Praj Scope: Technology license, BEDP, Proprietary equipment, Mandatory Services**
 - Plant Capacity: 100 KLPD Fuel ethanol, Feedstock :Rice Straw
 - BEDP, FEED Completed
- **MRPL Davangere (Karnataka)**
- **Praj Scope: Technology license, BEDP**
 - Plant Capacity: 60 KLPD Fuel ethanol, Feedstock : Corn Cob / Rice Straw
 - BEDP Completed



- Complex feedstock handling experience
- Wheat Straw, Corn Stover, Rice Straw, Bagasse, etc.
- Best-in-class yields
- Low processing costs



- Having processed agricultural feedstock - variations
- Delivering Ethanol plants for more than 35 years
- No solids handling issues due to focus on parameters needed for high plant availability
- Well integrated process physically and chemistry wise



Achieving Viability of Commercial Plants

- Sustainable supply & Quality of Biomass
- Performance of Material handling system & its synchronisation with the upstream process
- Feedstock agnostic (Flexibility with optimal Capex)
- Vendor development for key Equipment and Packages
- Alternate Material of Constructions
- Optimization of Chemical consumptions
- Enzymes: Customization, Local manufacturing, OSM
- Maximization of Yields
- Maximization of Capacity factor
- Value added by-products - Bio fertilizers, Lignin Valorization
- Bolt - On / Co-located units
- The 4Rs - reduction, reuse, recycling and recovery



Bolt on: Sugar mill attached distillery

1G Process Plant



Feedstock Storage



Fermentation



Distillation



Dehydration

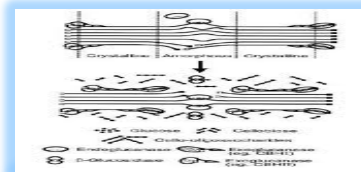
2G Process sections



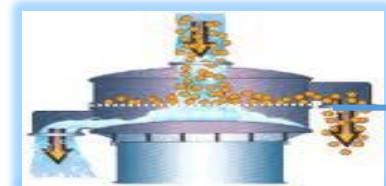
Material Handling



Pre-Treatment



Hydrolysis



S- L Separation

Lignin Cake



Cooling Tower



WWTP



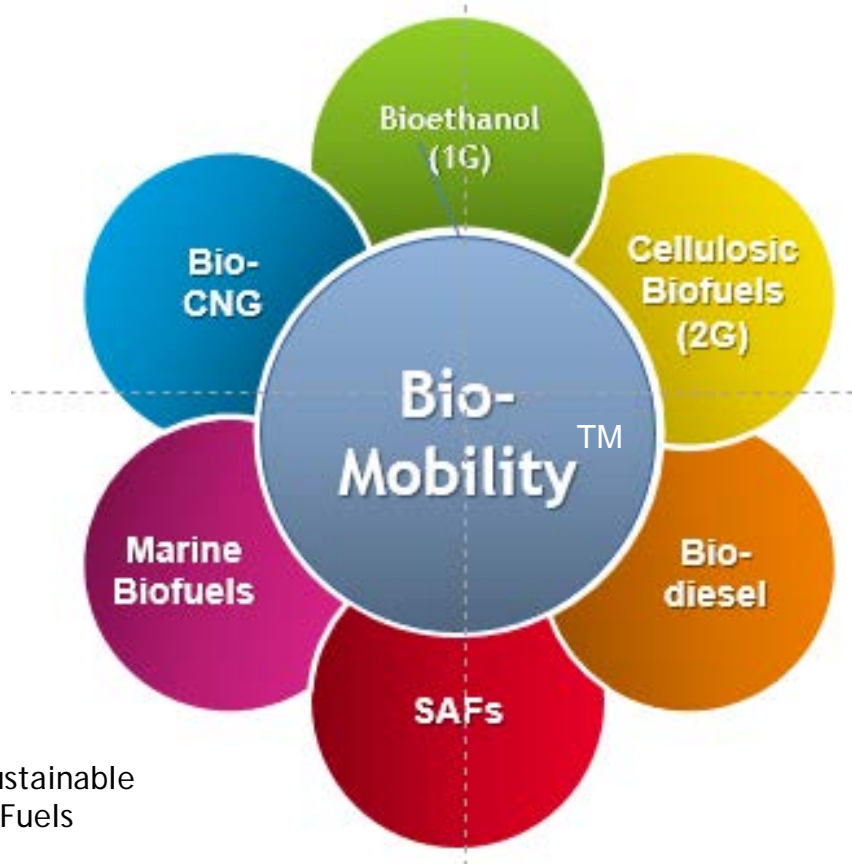
Power Plant

Utilities from Sugar mill

Efficient Integration of 1G & 2G Process Plant is the key to success



Bio-Mobility™ denotes carbon neutral renewable fuel produced from Biological resources



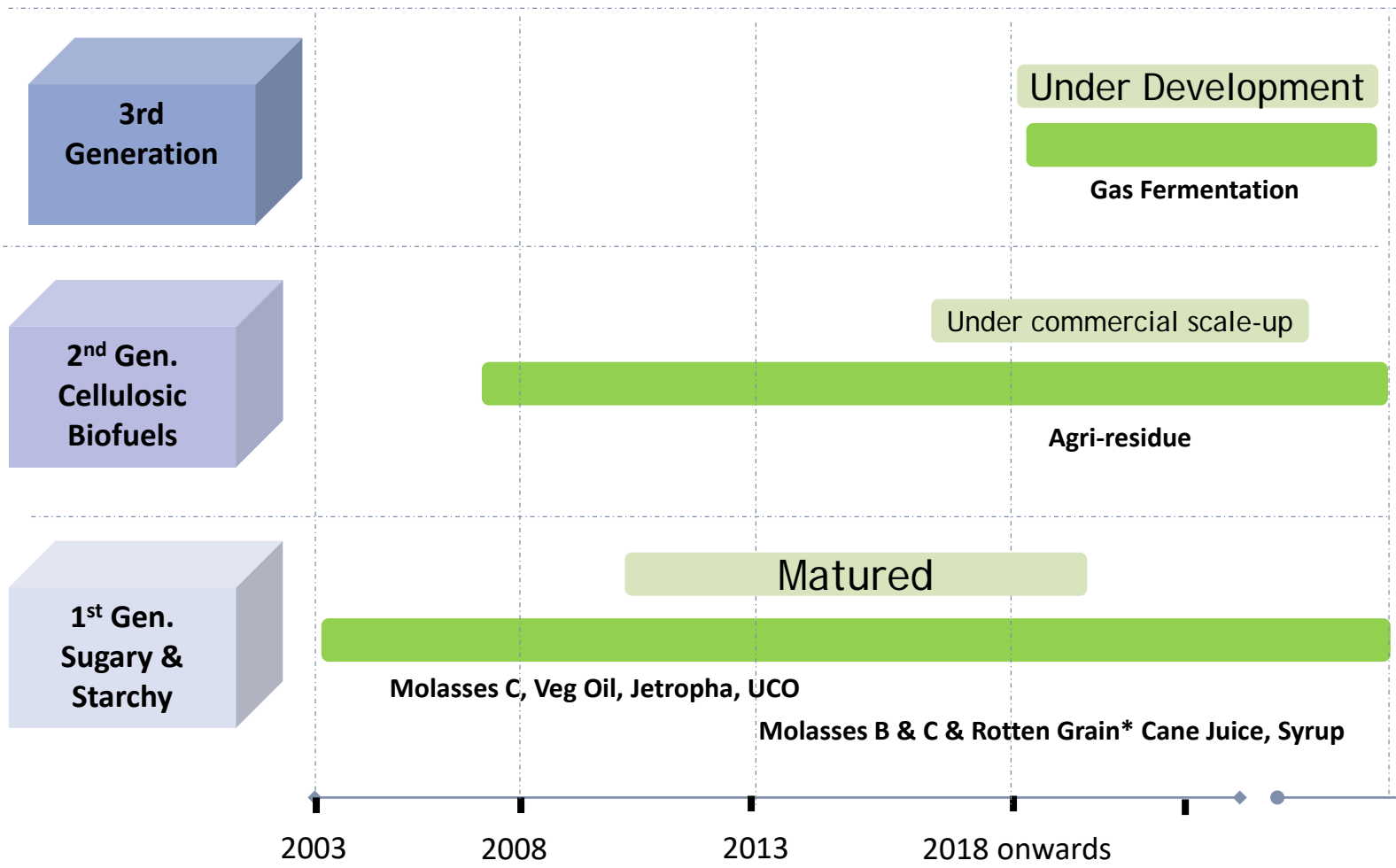
*SAFs- Sustainable Aviation Fuels

- Demand for transportation fuel is ever rising
- Transportation sector the major contributor to rising GHG emission
- Stubble burning causing brown clouding
- Both, major cause for environmental Pollution and major health hazard
- Bio-Mobility™ based transportation helps minimize carbon footprint

Bio-Mobility™ facilitates decarbonization through circular bio-economy



Technology Evolution



Product Basket

- Ethanol – 1G,2G
- CBG (Compressed Bio-gas)
- SAFs (Sustainable Aviation fuels)
- Renewable Chemicals
- Bio-Diesel
- Marine Biofuels

*Unfit for human consumption

Transformation from Hydrocarbon to carbohydrate led Bio-economy



Advanced Bio-Mobility™ Technologies



2nd Gen ethanol

Produced from agri-residues such as Bagasse, Corn Cob, Rice Straw, Wheat Straw etc

Marine Biofuels

Produced from Lignin based feedstock



Sustainable Aviation Fuel (SAF)

Bio based jet fuel produced using sugars, starch and biomass from renewable sources

Bio-CNG

Produced from renewable feedstock such as Bio-mass, Press mud etc



Bio Diesel

Efficient and cost effective Enzymatic technology

Facilitate energy self reliance, economy & growth of farming community



Advanced Bio-chemicals: Smart Bio-refinery

Biomass (Bagasse, Straw, Softwood, Hardwood)

Advanced Chemical and Biochemical Fractionation Technologies

Sugar platform

Cellulose

Lignin

Hemicellulose

1G Sugars

2G Sugars

Nano-cellulose

Fibers

Composites

Xylitol
Furfural

Bio-Rubber

Bio-plastic

Bio-PET

PHAs

PLAs

Sulfonated lignin

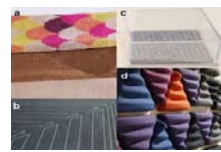
Bitumen/Adhesives

Nano Lignin

Marine Fuels

Health & Wellness

Applications in Various sectors



Rubber & Plastics

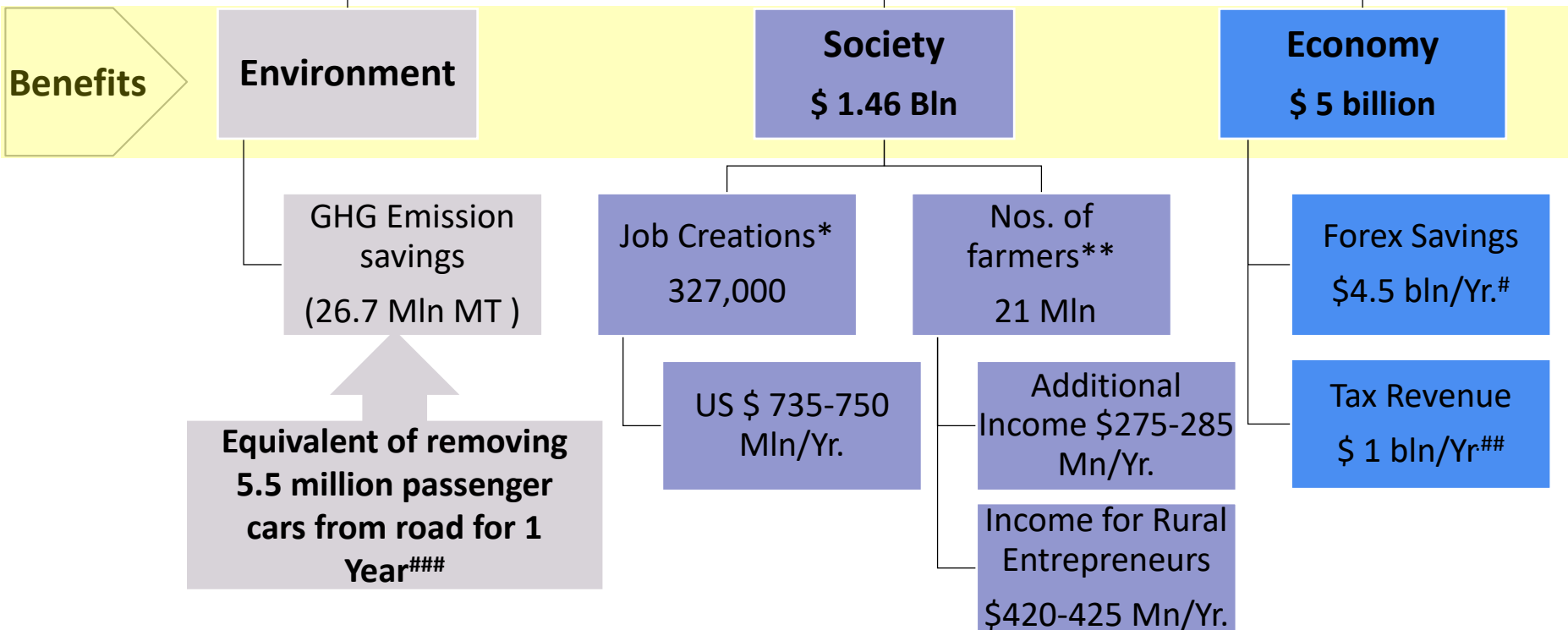
Textiles
Fabrics

Polymers, Adhesives, Roads, cement applications,
agriculture



Case Study India: Circular Bio-economy

20% EBP
(7000 Mn Liter of Cellulosic ethanol)



Bio based Technologies spinning wheels of Bio-Economy



*Note: 1) GHG emission saving from farm (by avoiding burning) - 19000 MT CO2 equivalent 2) GHG emission saving from ethanol production process - 42700 MT CO2 equivalent 3) GHG emission saving from ethanol blending - 60000 MT CO2 equivalent 4) Total GHG emission saving from farm to fuel for 100 KLPD plant is 121000 MT CO2 equivalent/year
 #1USD = 66 INR ## Average tax revenue to government from 100 KLPD rice straw to ethanol plant is INR 30 Crores/ Annum
 *Assuming 1500 Jobs for 100 KLPD plant covering (50 jobs for plant operations + 100 Village Level Entrepreneurs + 1350 Unskilled labor for biomass sourcing & supply chain) & 1.5 Lac income / Job **Assuming yield of 1.15 MT/Ha Rice Straw & Total land required for 100 KLPD plant will be 120000 MT/Year ***Assuming INR600/MT of rice straw realization to farmer ****Assuming INR 900/MT of rice straw realization to rural entrepreneurs

Commitment towards circular Bio-Economy

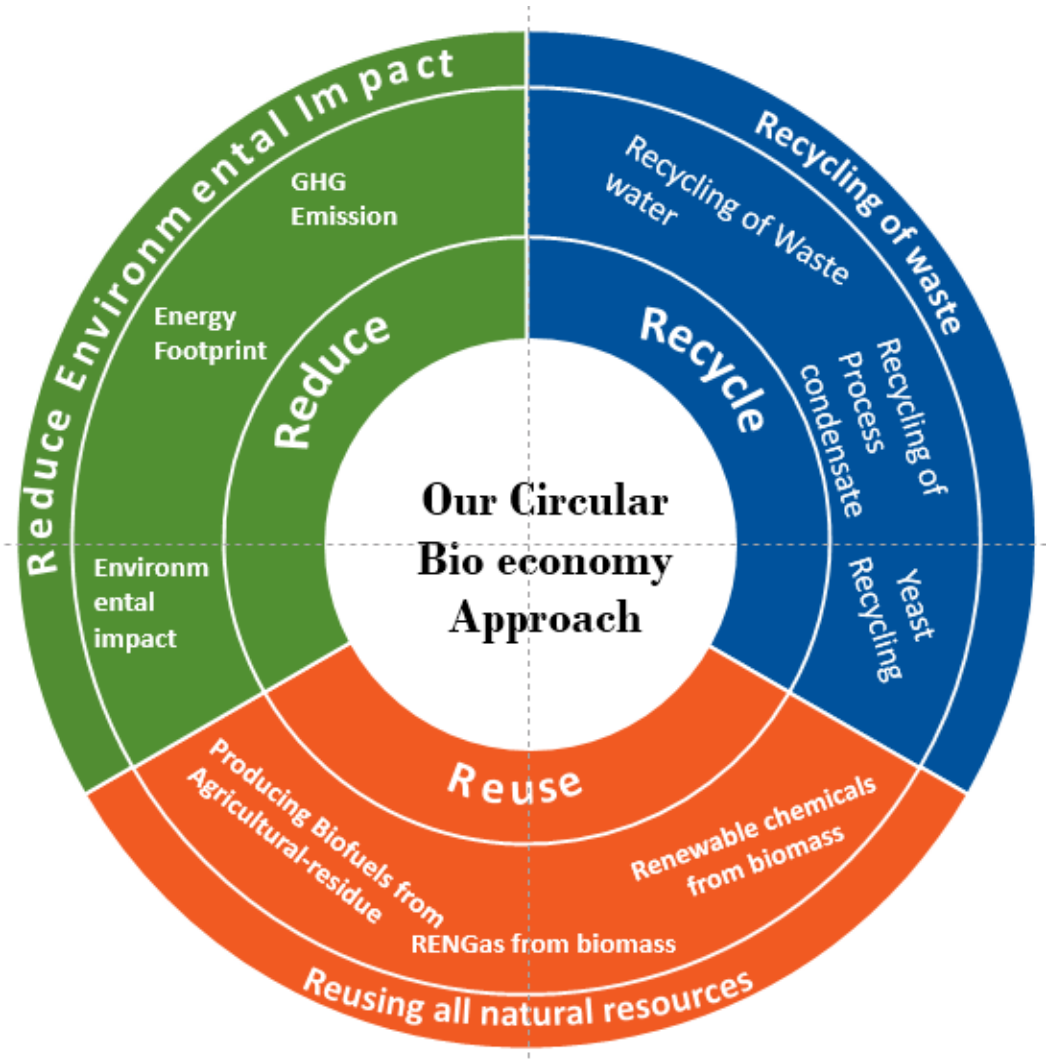
❖ Circular Bio-Economy

❖ Bio-Economy

❖ Bio-Energy

❖ Bio-fuels & Bio chemicals

❖ Bioethanol



3 decades of leadership in Bio-Industrial space



Arial view of PRAJ's integrated 2nd Generation Bio refinery
Demonstration Plant - Pune, India



Thank you

www.praj.net, info@praj.net

