

Renewable Gas / CBG

Deploying PRAJ RenGas Technology to boost Circular Bioeconomy

3rd EU – India Conference on Advanced Biofuels
3rd & 4th March 2020, New Delhi

Nitin Shete – PRAJ Industries Limited



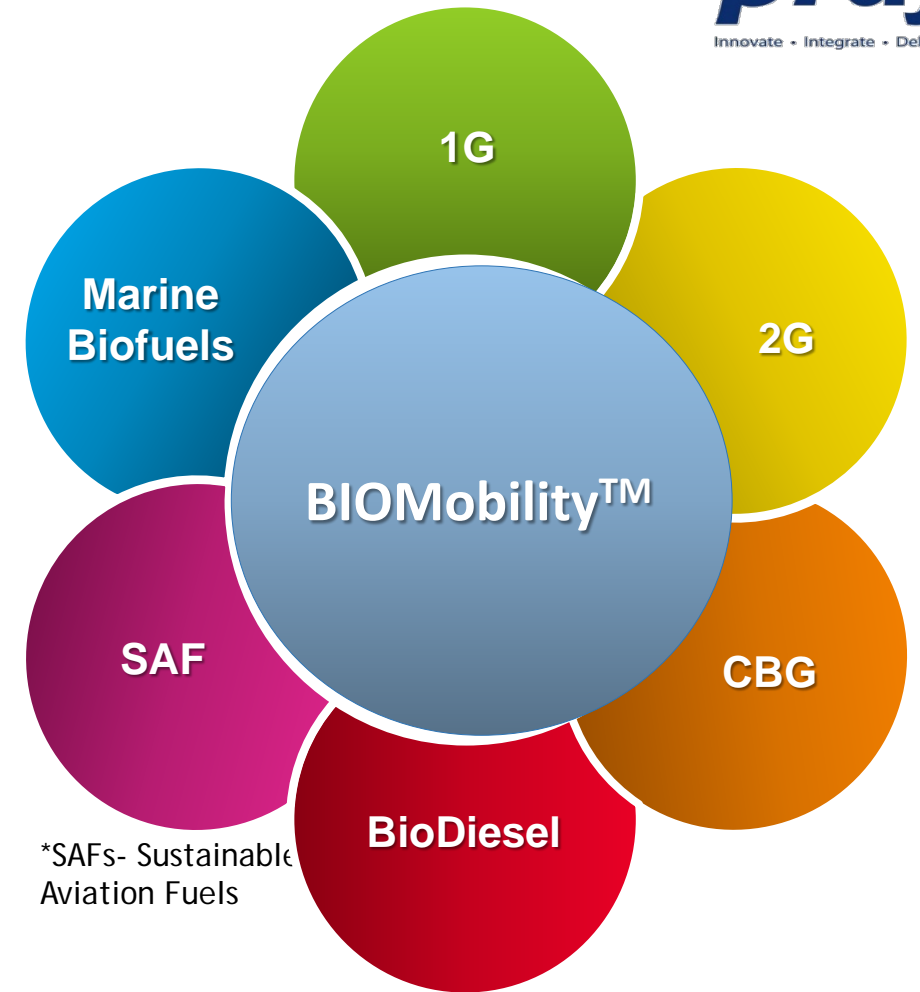
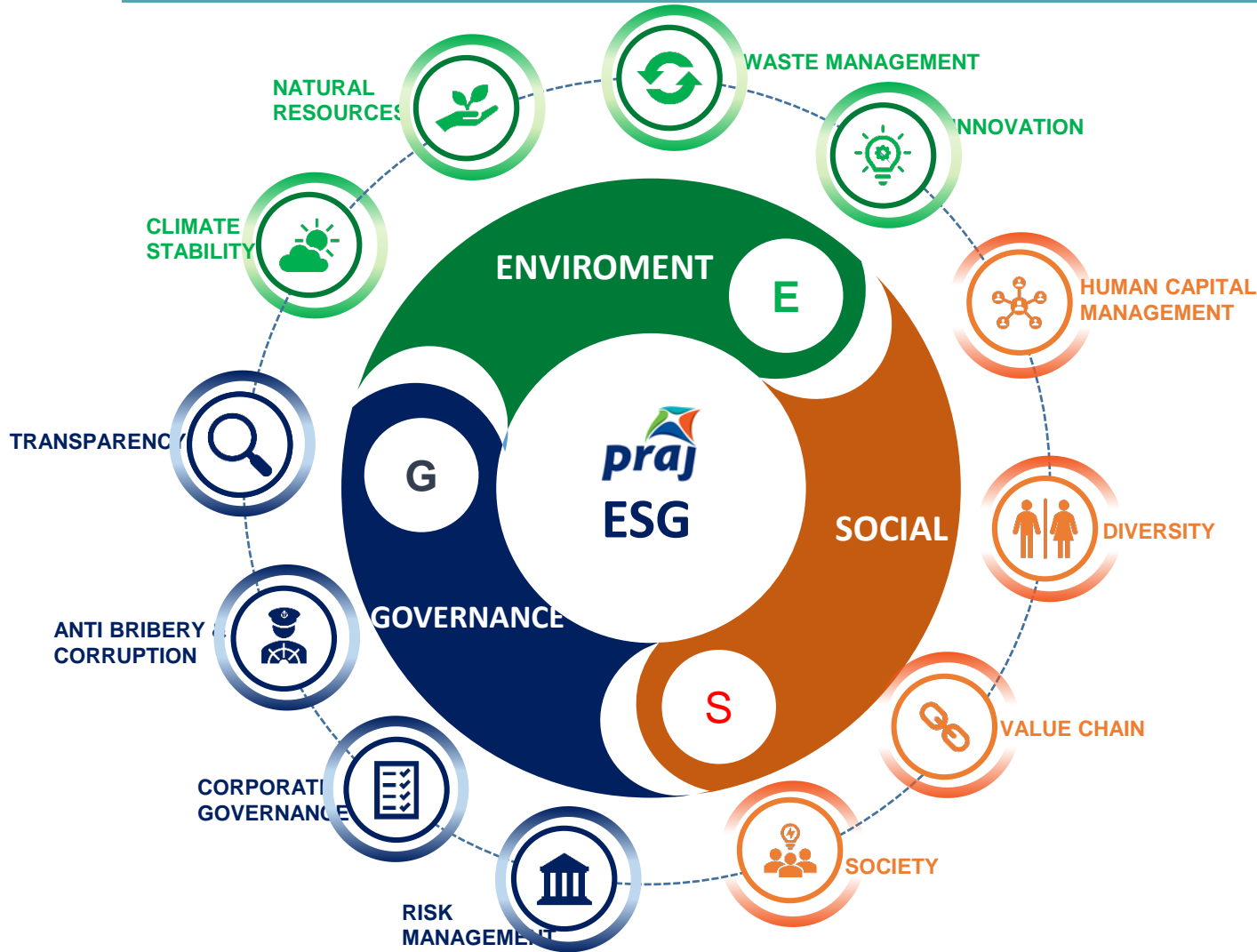
RenGas

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Praj through its Bio-Mobility™ solutions is at the fore-front of ESG



Bio-Mobility facilitates decarbonization through circular bio-economy



CBG – Need of the Hour

CBG as an Enabler

Environment



- ❑ Growing Emission – Vehicles & Burning Agriwaste
- ❑ Industrialization impact on Ecology balance
- ❑ Climate change affecting monsoon

Challenges

Solutions

- ❑ Renewable fuels & Gas Economy
- ❑ Captive feed stocks- Cleaner renewable fuels
- ❑ Fulfill COP 21 Paris Summit obligations

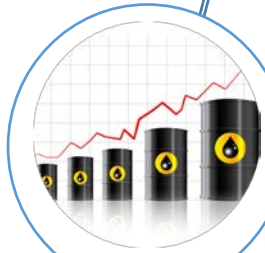
Social



- ❑ Rural unemployment
- ❑ Traders gaining at the expense of farmers
- ❑ Farmers in dire states - drought, untimely rains

- ❑ Agri-residue as alternate revenue stream
- ❑ Creating rural Agri-employment
- ❑ Helping farmers improve farm income
- ❑ Circular Bio-economy

Economic



- ❑ Extreme dependency on imported crude oil
- ❑ Heavy forex payout
- ❑ Insecurity of availability & pricing

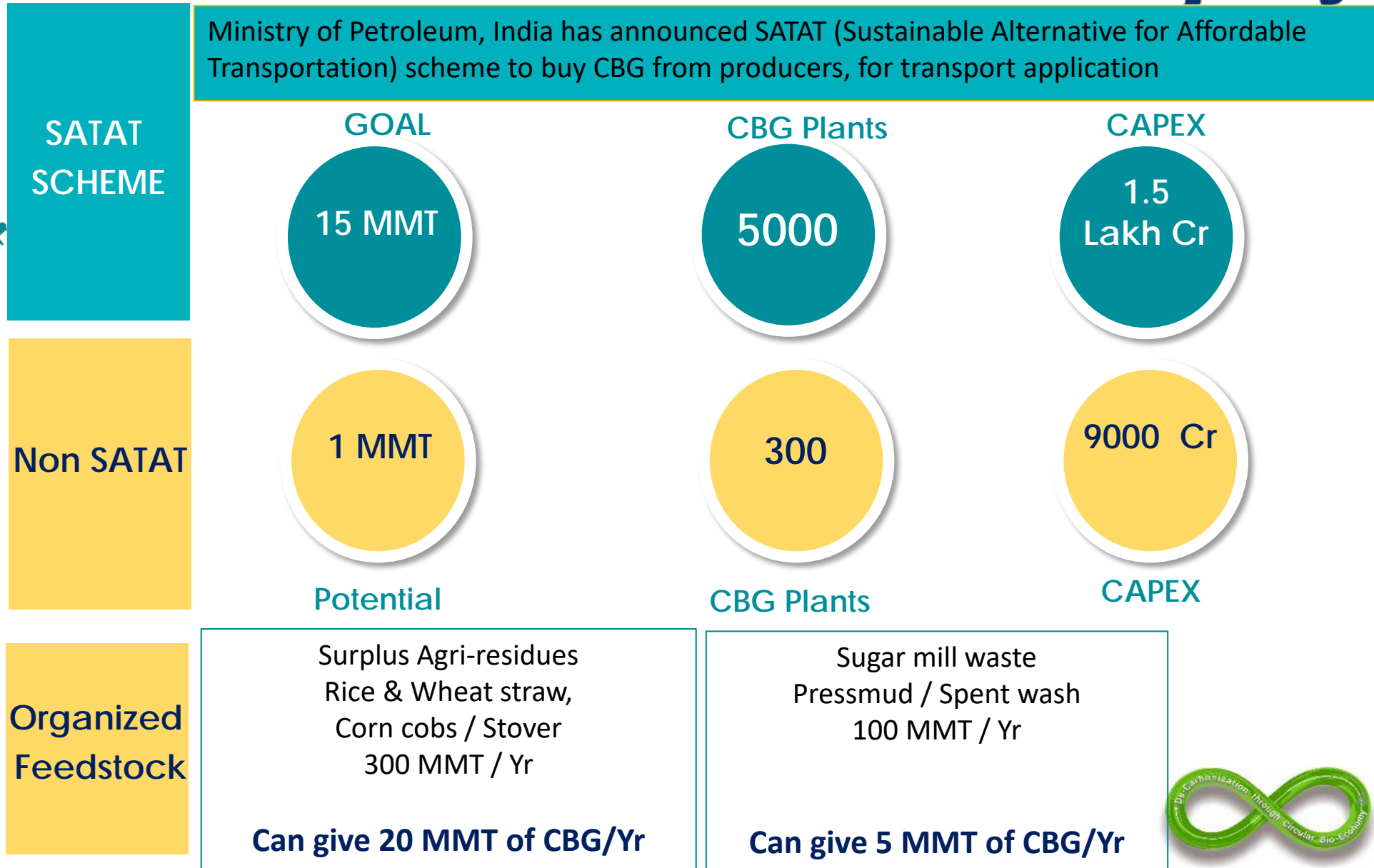
- ❑ Change to Renewable Gas – within Country
- ❑ Blend Ethanol in Petrol
- ❑ Use indigenous renewable waste feeds
- ❑ Secure Indigenous Fuels Reduces forex bills



CBG: Potential Opportunity (India)



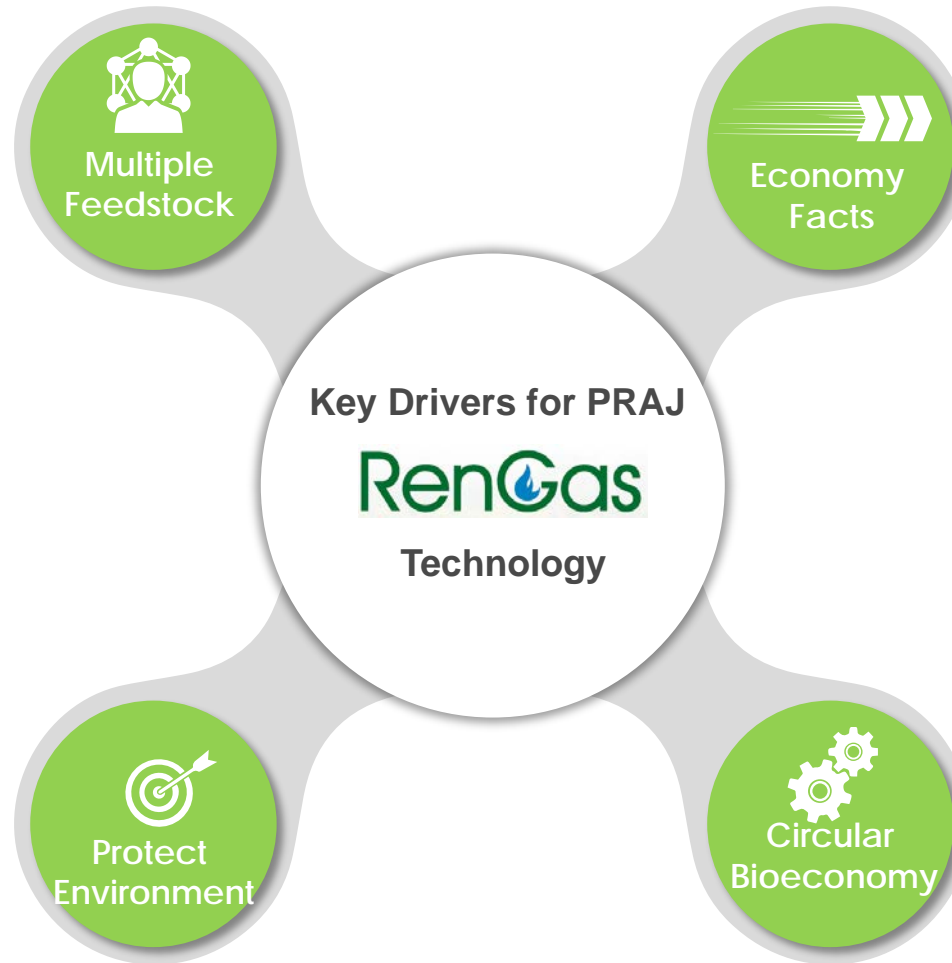
Ministry of Petroleum, India has announced SATAT (Sustainable Alternative for Affordable Transportation) scheme to buy CBG from producers, for transport application



India – Need Best Fit CBG Technology – Circular Farm Bioeconomy

- Preferably from **Farms waste** & **Organizable** supply
- Rice & Wheat Straws, Corn Stover / cobs, Bagasse
 - **Agro-based Sugar mill** waste- Pressmud / Spent wash

- Minimize **emissions** –CBG based transport
- Stop **Stubble** burning
- Zero budget farming- **Organic manure** as co-product
- Replace as much **Urea Import**



- Replace CNG Import (15 MMT/Yr)
- For **Clean Transport**
- Replace **UREA** – By Organic Manures –Zero Budget Farming
- Substitute CNG in **Industrial Power & Heat** (Non-SATAT)
- Replace **Static / local diesel consumption** in Farm sector
- USD **5 to 7 Billion saving** Opportunity
- Re-inject in Farm economy – Improve **Farming income**
- Local **Jobs** Creation
- CBG Agro-based industry –**distributed**
- **Local** production & consumption

Say No to Fossils

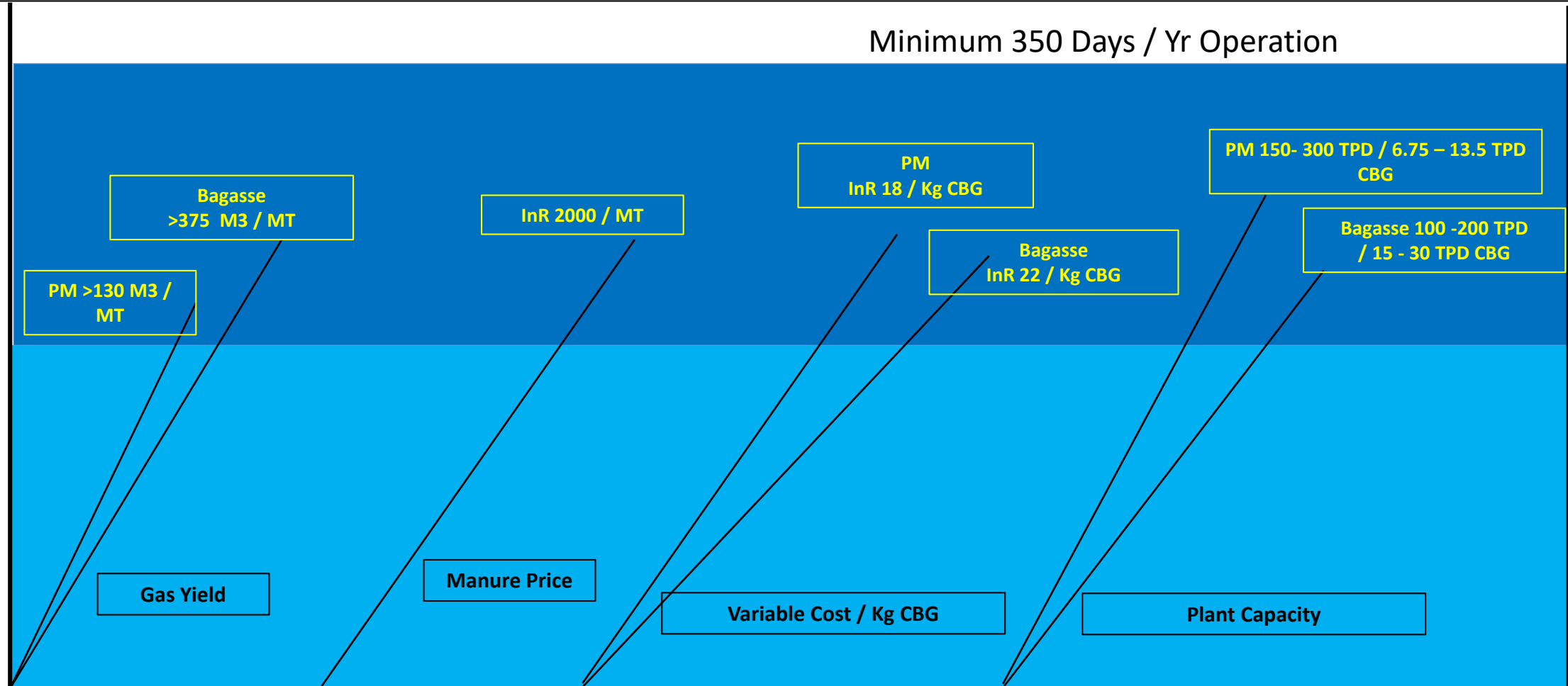


RenGas

Key Drivers

Rengas Plant designs are the Key: Viability Bench marks

- CBG feedstocks in Sugar Industry:- Pressmud and Bagasse
- Technology must deliver highest performance for viable returns



The RENGAS Technology Focus

Feedstock Pretreatment

Sugar Mill Pressmud

- 5 to 6 months production
- Highly Perishable
- Needs Stabilization of VS for 350 days CBG production

PM STAB Technology for Pressmud Preservation (> 350 days operation)

Agri-residues

- Ligno-cellulosic VS needs critical hydrolysis
- Minimum Hydrolysis Costs

BM Solve Technology for Biomass hydrolysis

Biomethanation

- High Degradation efficiency very high yields
- Very High Mixing at low energy – mass transfer
- Avoid VS loss - Bypassing
- Two stage design - Acidogenic & Methanogenic
- Low maintenance & shut downs (350 Days operation)
- Handling of solid waste
- **PRAJ-DVO Duel Plug Flow reactor plants**

Gas Purification

- Simple cost effective & robust
- Should operate in remote areas
- High quality of CBG
- Efficient H₂S & CO₂ removal
- **PRAJ -DVO Duel Plug Flow reactor plants**

High Value Organic Manure

- High quality balanced Organic manure co-product
- **NOCA certification for both Pressmud and Biomass CBG plants**

PRAJ RENGAS CBG PLANTS - USPs

Sugar Mill Pressmud based

PM STAB Technology for Pressmud Preservation (> 350 days operation)

High Biogas Yield above 130 M3/MT (Low Opex)

Feasible Project IRR > 20%

Proprietary Rumen Culture

Proprietary Plug Flow Design Reactor

Round the Year Operation

NOCA Certified Organic Manure

Agri-residue Biomass based

BM Solve Technology for Biomass Hydrolysis (Low cost Microbial hydrolysis)

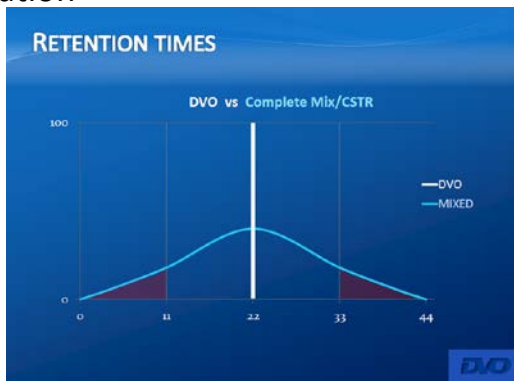
High Biogas Yield above 400 M3/MT

Feasible Project IRR > 15%

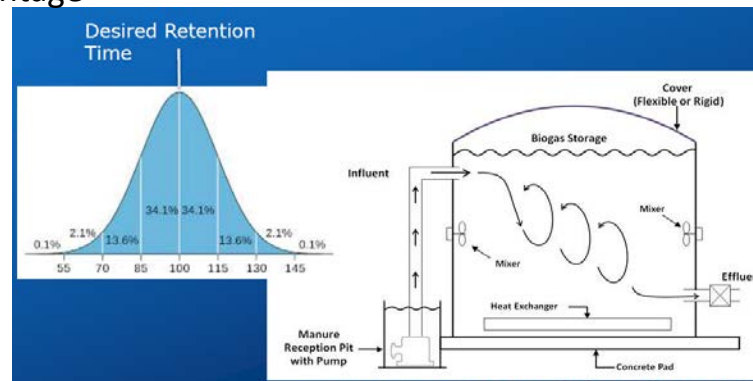
PRAJ -DVO Duel Mixed flow digester Plants Vs CSTR

<u>Biomethanation</u>	<u>Continuous Stirred Tank reactors</u>	<u>DVO Mixed Duel Plug Flow reactor</u>
Reaction mechanism	Inefficient - Prone to bypassing of substrate	Highly efficient reaction - plug flow ensures no bypassing
Reaction	Single phase – No separation of acidogenic & methanogenic stages	Allows Multiple stages
Robustness	Sensitive to feed and parametric variations	Steady & robust operation internal recycle of adapted bacteria
Conversion efficiency	Low (< 60 %)	High (65 to 75%)
Gas yields	Low due to low degradation	30% higher than CSTR
Retention time	Very high - Makes plant bigger & expensive	Low Fast conversion - Plant small and compact
Mixing efficiency	Low due to agitators	High due to gas circulation which gives highly efficient and rigorous mixing.
Flexibility & expansion	Low - Multiple reactors difficult to synchronize High cost expansion	High due to single plug flow design Easy and low cost to expand capacity
Electricity consumption	High due to large multiple mechanical agitators	Low because one blower sparges Biogas through multiple internal nozzles
Start-up and restart time	High due to slow reaction	Quick and fast start up and restart
Maintenance	Frequent and High cost - due to mechanical agitators and membrane domes	Rare and Low cost - because there is no moving / plastic parts
Maintenance Shut downs	Complete shutdown – Every alternate year - Loss of production for 2 months	No shut downs - continuous full scale operation for 5 to 10 years
Operation	Complex to automate - High manpower	Easy to automate & very low manpower.

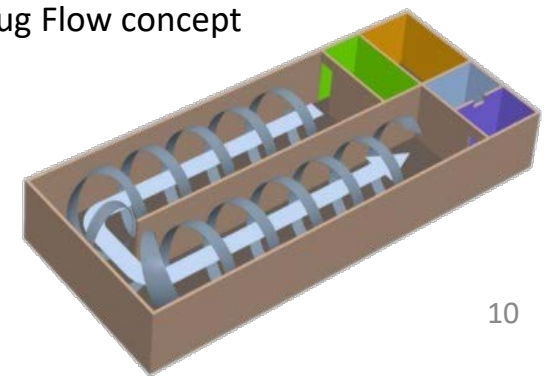
CSTR limitation



DVO advantage



Plug Flow concept



A typical PRAJ DVO dairy installation.

barns



Bio-solids

utility bldg

DVO Plug Flow Digester

PRAJ Pressmud to CBG Technology & Plants

➤ **PRESSMUD is organic waste generated by cleaning of cane juice in a mill**

- Typically 10000 TCD mill gives 400 MT/day pressmud (4% by weight)
- Contains 30 % solids & 70 % moisture - Solids Comprise Soil, Organic solids and sugars
- Mill runs 150 days / year – 60000 MT annual pressmud generation
- However Round the year CBG plant is designed @ 200 TMT/day Pressmud input.
- **This means pressmud needs at least 6 months storage without yield loss**

➤ **Pressmud is very perishable and degenerates naturally reducing organic matter & Gas yield**

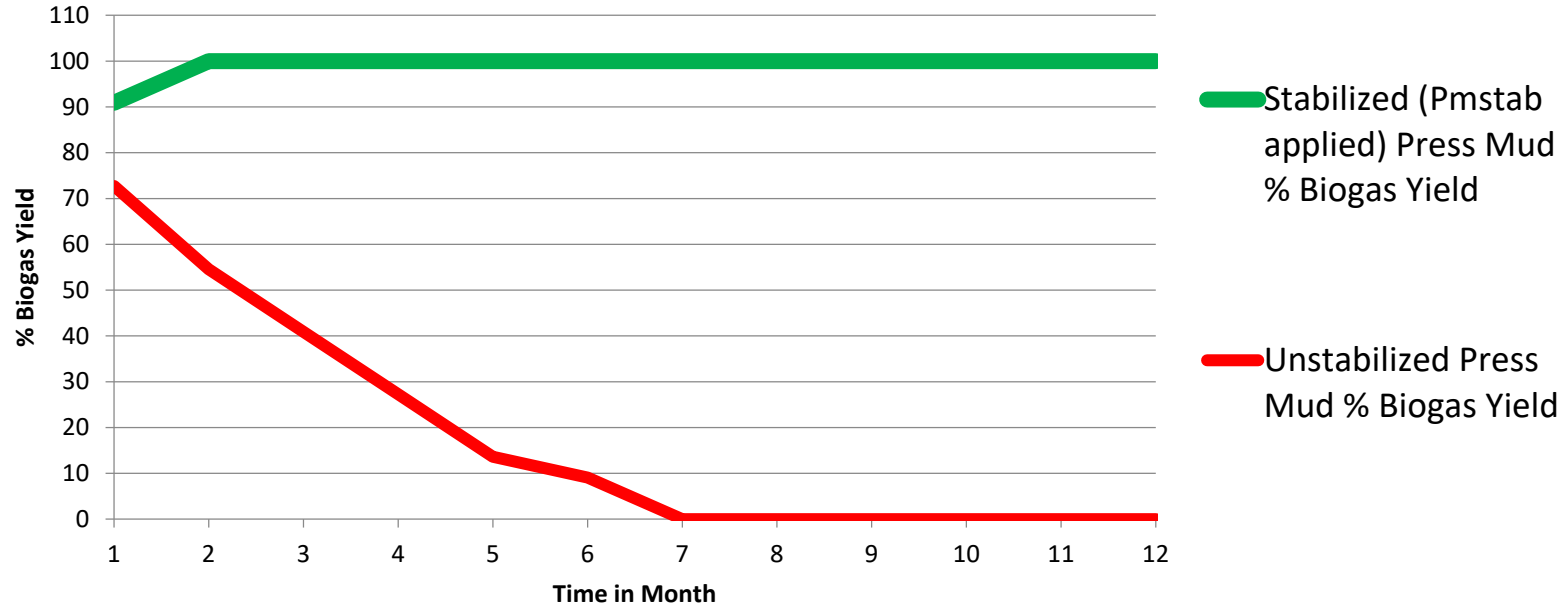
- PRAJ has developed
- **Unique patented PM Stab** Microbial technology to preserve
- pressmud without losing gas yield



Patented PressMud
Stabilization Technology

Press Mud Deterioration with ageing & Loss of Gas Yield

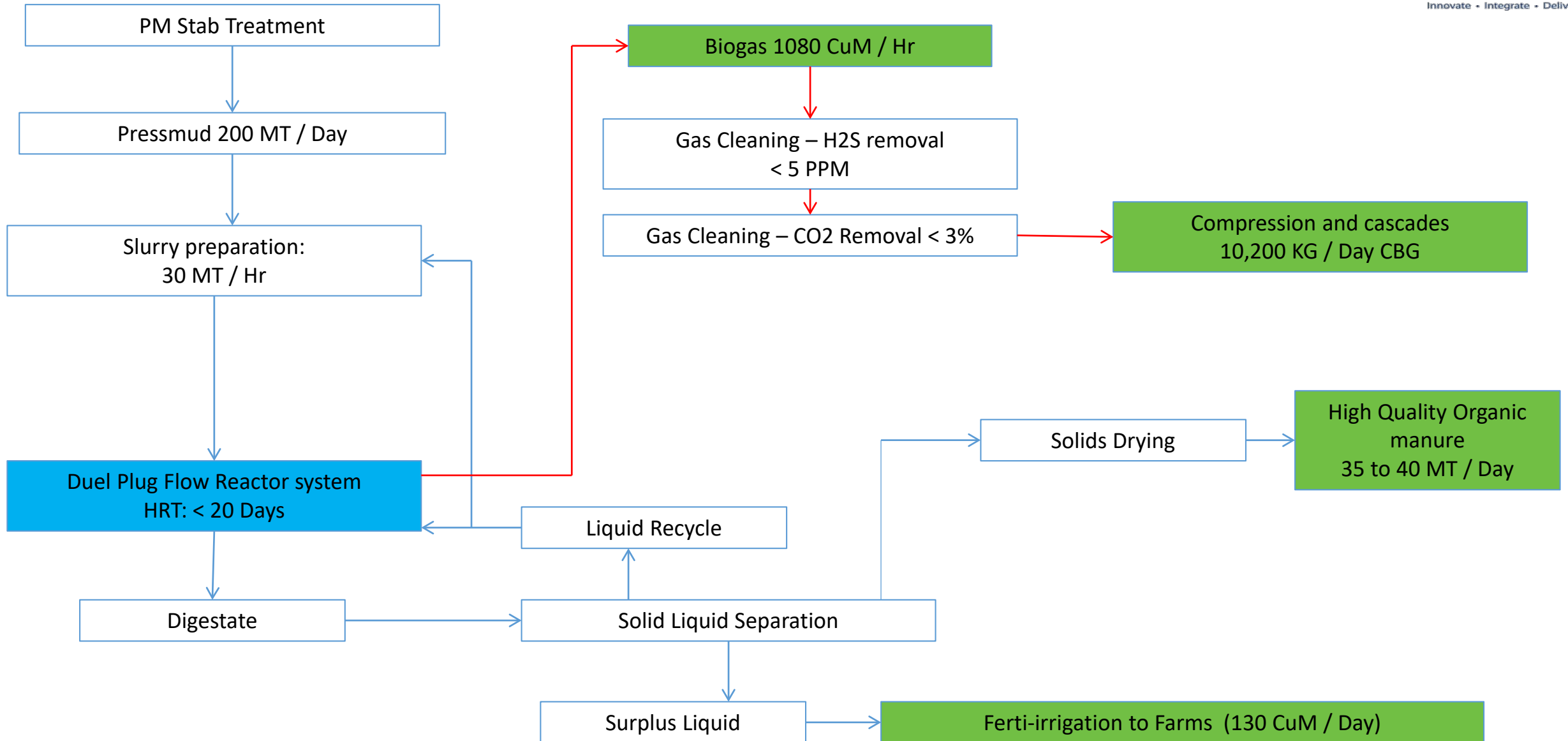
Effect of PM Stab - Percent Biogas yield Vs Storage Time



- Only PRAJ has the knowhow of preserving pressmud round the year
- With PM Stab and Proprietary Biomethanation the yield is increased >130 CuM gas / MT

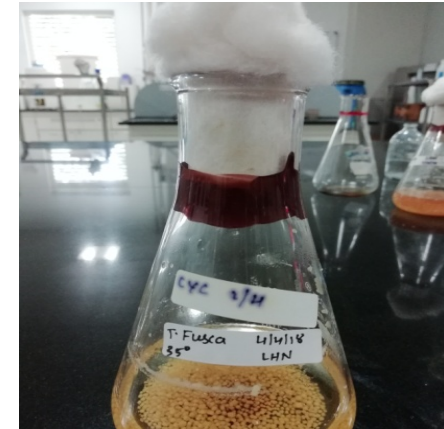
~20% Degradation in 1st Month & up to 50% Degradation by 4th Month

PRAJ 200 TPD Press Mud CBG Plant: Configuration



PRAJ Biomass to CBG Technology & Plants

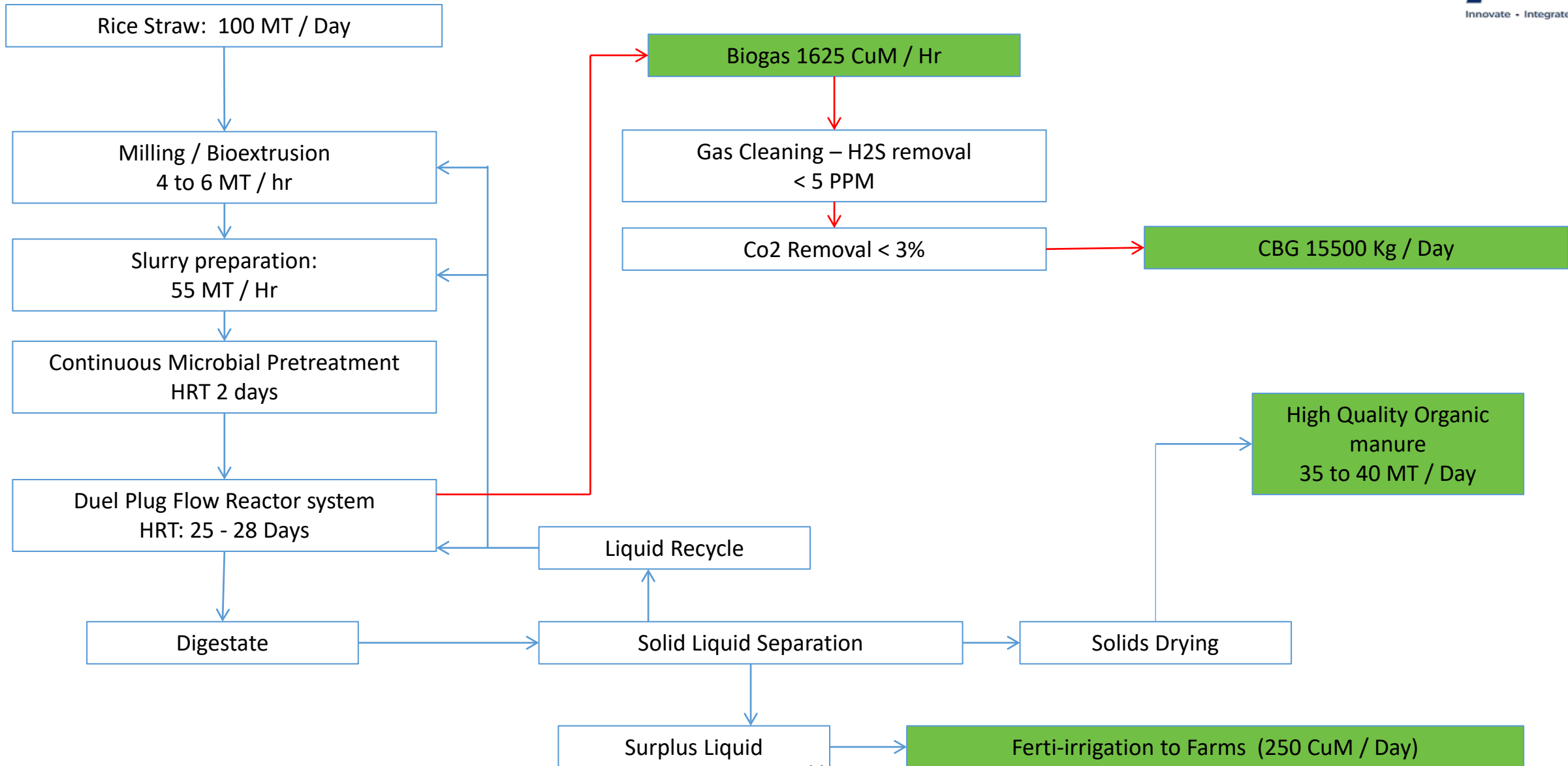
- **PRAJ CBG Plants produce CBG from Agri-residues: Rice Straw, Wheat Straw, Corn Stover & cobs**
- PRAJ **BM Solve Technology** uses special microbe to hydrolyze the Ligno-cellulose and convert into Volatile solids
- High efficiency conversion / **No** Chemicals, Enzymes or Steam is required
- Hydrolyzed biomass is directly biomethanated to Biogas in **one step**
- Very high gas yields **400 to 500 CuM** (Depending on type of feedstock)



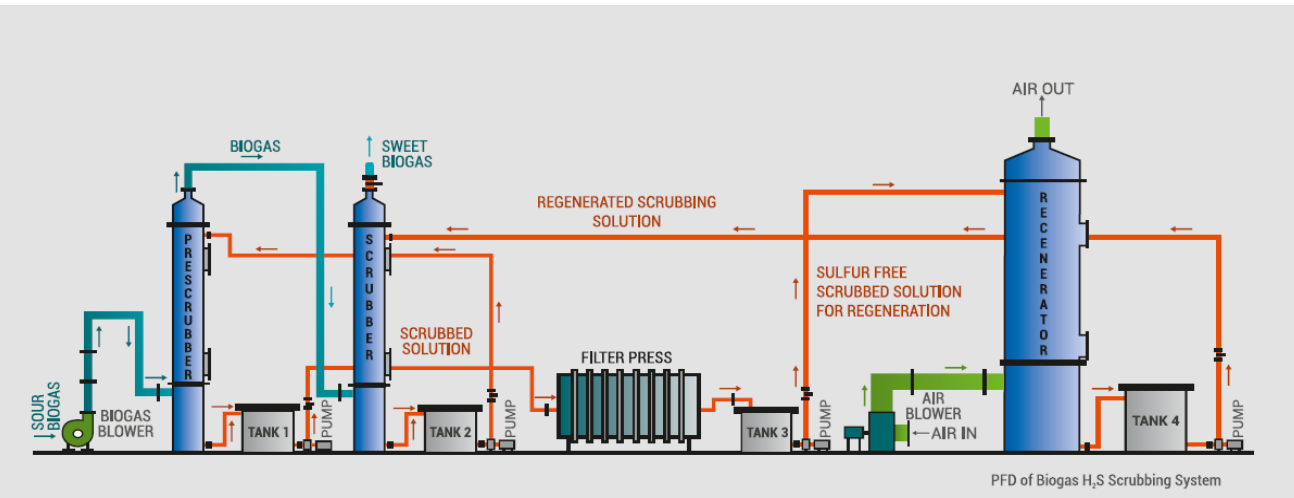
Highest Yield in the Industry



PRAJ Biomass to CBG plants configuration



PRAJ Rengas - CBG purification technology

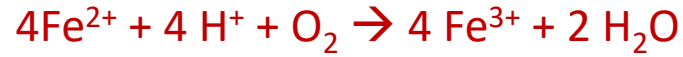


Catalytic H₂S removal

Reaction-I

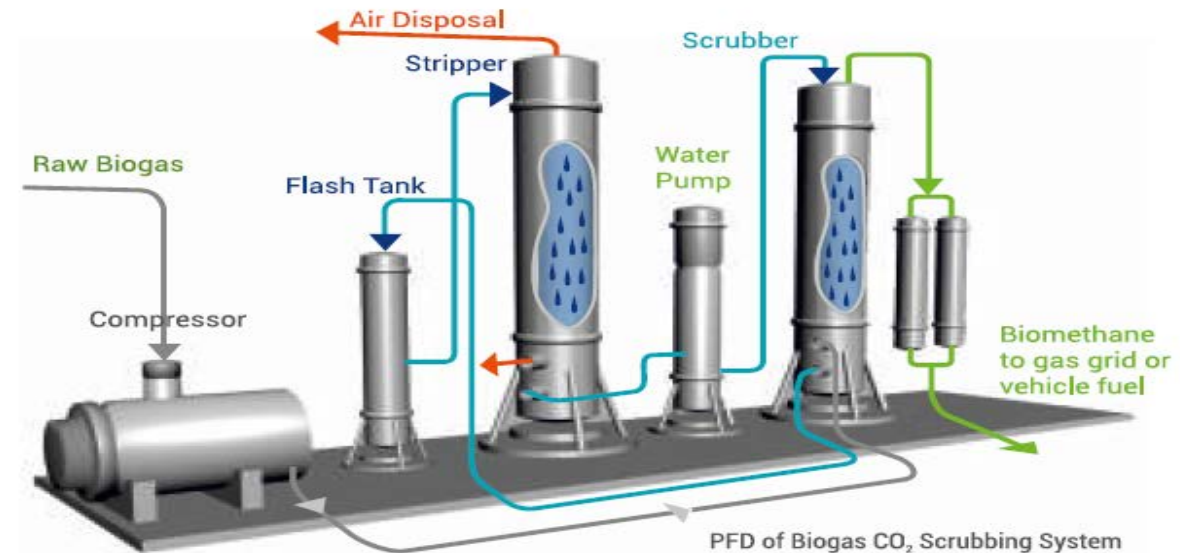


Reaction-II



- IS 16087 (2016)
- Clean methane
- CH₄: >95%
- H₂S :< 5 PPM
- CO₂ :< 3%

Water Based CO₂ Removal



PRAJ RENGAS - Organic Manure technology

Optional Technology for Recovering Manure with Value

- Ammonium Sulfate recovery System
- Phosphorous Recovery System
- Add- Back balancing for the Manure

High Performance Bio-manure

- Complete TVS degradation ensures Bio-manure with high minerals
- Stable characteristics with low degradation

NOCA Certification for all feedstocks

- National Organic Certification Agency approval for Bio-manure from various grades and feedstocks

STATEMENT OF COMPLIANCE

No. NPOP/IM/27818684

For Praj Industries Ltd.

Operator Address

Praj Tower, 274 & 275/2, Bhumkar Chowk-Hinjewadi Road, Hinjewadi,
State Maharashtra
District Pune
Taluk Haveli

Based on a signed contract and external inspection carried out in the August 2018, M/s. Natural Organic Certification Agro Pvt. Ltd., herewith confirms that the products mentioned in the list attached are manufactured by the above mentioned company, is in compliance for use in organic production as allowed/restricted product under NPOP.

Date of Issue : 27/08/2018

Valid upto : 09/08/2019

Place : PUNE

Seal
Authorized Signatory
M/s. Natural Organic Certification Agro Pvt. Ltd.



Production Detail(s)

No. NPOP/IM/27818684

Annexure

Name of Production Unit	Brand Name	Category of the product (Microbial preparations/herbal preparations/biodynamic preparations/manure)	Use for nutrient/pest control/growth enhancement	List of ingredients		Estimated Quantity (in MT)	Shelf life of the Product (in Months)
				Ingredient Name(s)	Percentage Used		
Praj Bio CNG R&D Unit -2, Shreenath Mhaskoba Sakhar Karkhana Limited	BIO-GREEN	Bio-Fertilizer	growth enhancement	Pressmud/Agri-Biomass	94.99800	25.000	24
				Cowdung	5.00000		
				PM Stab	0.00100		
				IRC Culture	0.00100		
Praj Bio CNG R&D Unit -2, Shreenath Mhaskoba Sakhar Karkhana Limited	BIO-NUTRA LIQUID	Bio-Fertilizer	growth enhancement	Pressmud/Agri-Biomass	94.99800	108.000	24
				Cowdung	5.00000		
				PM Stab	0.00100		
				IRC Culture	0.00100		



Biofertilizer

ORGANIC INPUTS OF PRAJ BIO CNG UNIT

Praj's Pressmud & Biomass to CBG - Demo Plant near Pune

Location: Shreenath Mhaskoba Sugar Karkhana
Year: Plant in operation since 2017



PRAJ RENGAS Technology Advantage



• End to End Solution with Performance Guarantees

• Flexible Technology:

- Rice straw & other Agri-residues
- Pressmud
- Distillery Spent wash
- Farm waste
- Modular capacity expansion

• Under one Roof

- Technology License
- Turn Key Plant supply
- Basic & Detailed Engg
- Equipment supply
- Piping & Instrumentation
- Electrical Automation
- Civil & Structural
- EPC Contracts

• Partnership:

- Pre-feasibility studies & permitting assistance
- Plant Supply
- Operation training and commissioning
- After sales support services such as trouble shooting, maintenance and expansion

• High Gas & Biopower yields with low Opex

• High Co-product credit from Bio-fertilizer

• Multiple applications: CBG / Biopower / Industrial gas / Heat

• Round the Year Operation – High Quality & Yields



Praj presence across the globe with 750+ references in more than 75 countries.

CPES references across the globe with >1500 equipment and >300 Skids in 20 countries.

THANK YOU

