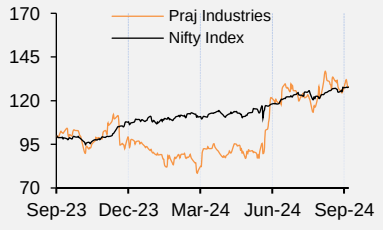
MIRAE ASSET
Capital Markets

Initiate
September 19, 2024

Rating	**Buy**
Target Price (INR)	**890**
Share Price (19/09/24, INR)	735
Expected Return	21%

Revenue (25E, INR mn)	39,679
Consensus Rev. (25E, INR mn)	39,813
EPS Growth (25E, %)	28.3
Market EPS Growth (25E, %)	28.7
P/E (25E, x)	44x
Market P/E (25E, x)	23.1
NIFTY	25,416
Market Cap (INR bn)	135.3
Shares Outstanding (mn)	183.8
Free Float (%)	65.4
Foreign Ownership (%)	20.0
52-Week Low	448
52-Week High	813

(%)	1M	6M	12M
Absolute	-2.2	55.4	26.6
Relative	-5.6	38.9	0.4



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PRAJIND • Midcap – Capital Goods

Praj Industries

Stalwart of Bio-Economy Revolution!

A strong hand ensures a high probability of winning: With 3 Aces & 2 Jacks in hand, It's a Full House for Praj!! (A) ETCA (A) CBG (A) SAF (J) 1G (International) (J) ZLD/ETP

Praj is an engineering company which leverages its technological prowess of fermentation of organic materials (via Thermochemical / Enzymatic routes) to produce energy a much greener way replacing the traditional way of carbon intensive manufacturing with high reliance on non-renewable resources. The company sells these engineering services & products to other manufacturing entities. **It's Not just an Ethanol Story Now!**

Praj's ETCA (Energy Transition & Climate Action) segment is focused on providing innovative engineering solutions and products for reducing the carbon intensity of manufacturing processes by carbon capture or carbon reduction systems. Praj has recently commissioned its Mangalore facility with a core focus on this ETCA segment. We expect macro tailwinds of sustainable growth will be a key growth driver for the engineering segment going ahead. We expect this segment to contribute 40%-50% of total revenues by FY2027, with the revenue mix positively changing towards international orders.

CBG Blending to replicate the EBP Success! – A large part of Praj success in the last 2 years was derivative of successful implementation of EBP which showed an exponential executional curve with a long flat tail in beginning. Will CBG blending have the same fate, we believe not, and the executional curve to be flatter with shorter tail because as**:** CBG has much broader blending potential with city gas lines, CNG for vehicle usage, industrial usage, etc which will ensure stable demand offtake, multiple raw material sources to ensure stable supply. useful byproducts leading to better commercial viability of the project. Early entry of Oil & Gas players & large private industrial players.

Sustainable Aviation Fuel (SAF) – With significant commitments of SAF blending in a range of 2%-6% in coming 2-5 years by several countries such as USA, Brazil, India & Euro. The demand for SAF is expected to grow exponentially in coming years which would trigger the demand for ethanol. 50+ aviation players have committed for SAF. We expect the total opportunity for SAF related ethanol capex to be pegged at around INR 150 – 200 bn in the coming 2-3 years. Praj's superior technology gives it the right to win a large share of this pie!

Valuation & Outlook – Praj's currently trades at 33x FY26E earnings & 27x FY27E earnings. Praj's presence in a rapidly growing industry, with a dominant market share which converts into large order wins, we have factored in Revenue/EBITDA/PAT to grow at a strong 17%/27%/27% CAGR over FY24-FY27E. This along with highly driven management, clean corporate governance makes a compelling investment case. We value the stock at 40x FY26E which translates to target price of 890/share implying a 21% upside potential.

Earning and valuation metrics

(YE Mar)	FY23	FY24	FY25E	FY26E	FY27E
Revenue (INR mn)	35,280	34,663	39,679	49,064	56,048
EBITDA (INR mn)	3,078	3,718	4,882	6,369	7,579
EBITDA margin (%)	8.7%	10.7%	12.3%	13.0%	13.5%
Adjusted PAT (INR mn)	2,042	2,399	3,079	4,102	4,948
EPS (INR)	11.1	13.1	16.8	22.3	26.9
P/E (x)	66.8	56.9	44.4	33.3	27.6
EV/EBITDA	43.6	36.1	27.5	21.1	17.7
ROE (%)	20.5%	20.4%	21.6%	22.9%	22.1%
ROCE (%)	27.9%	26.9%	29.0%	30.9%	29.9%

Source: Company data, MACM Research

Story in Charts

Exhibit 1. Healthy Order Book Growth

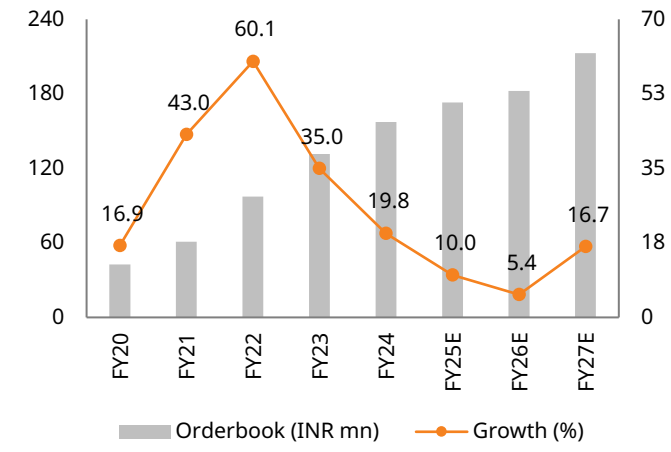


Exhibit 2. Along with improving Orderbook Mix

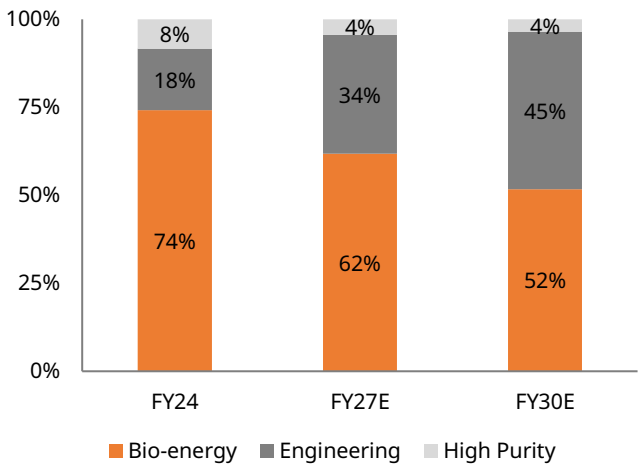


Exhibit 3. Revenue to grow at 17% CAGR

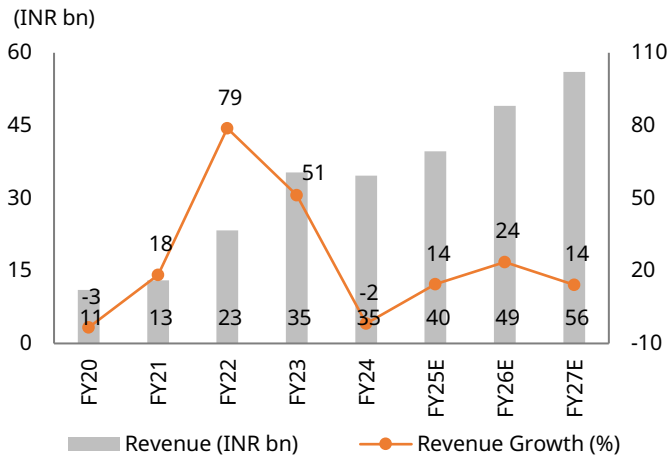


Exhibit 4. and EBITDA at 27% CAGR as Margins improve

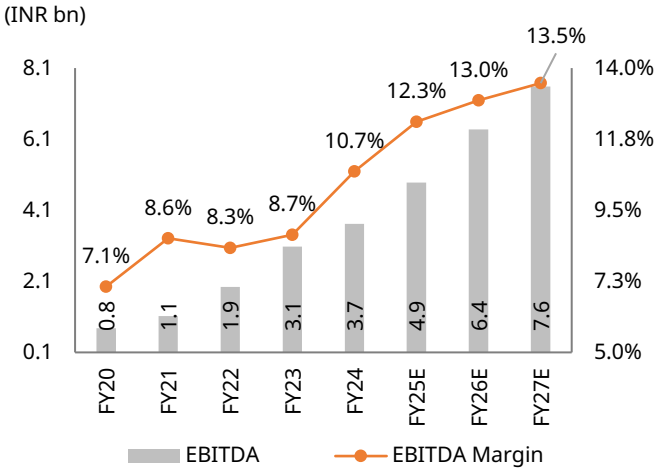
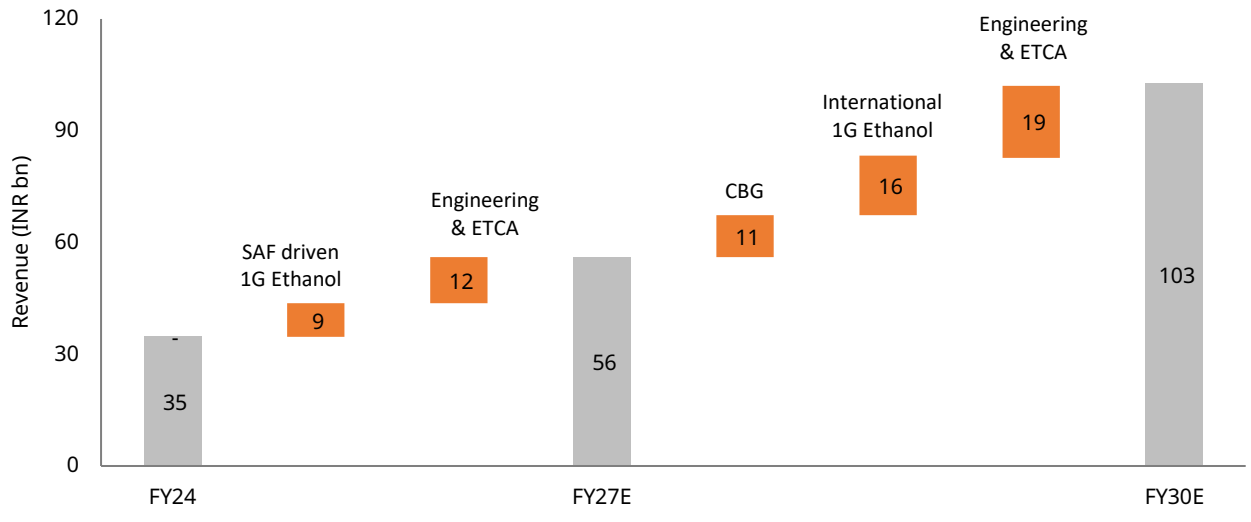


Exhibit 5. Incremental Revenue Growth Breakup



Source: Company data, MACM Research

Exhibit 6. And higher profitability PAT and PAT Margin

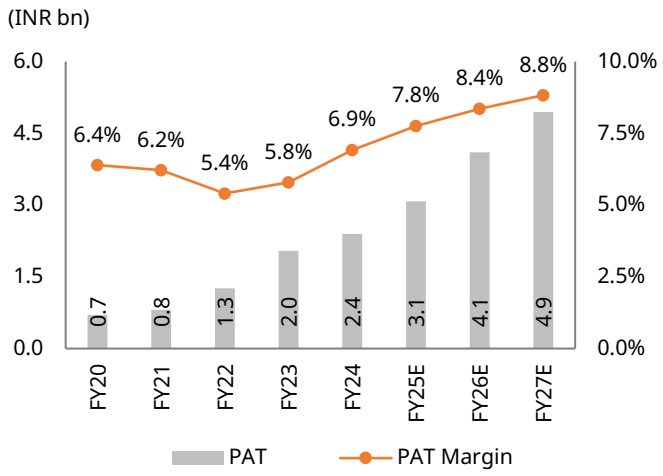


Exhibit 7. Leading to improvement in Return ratios (%)

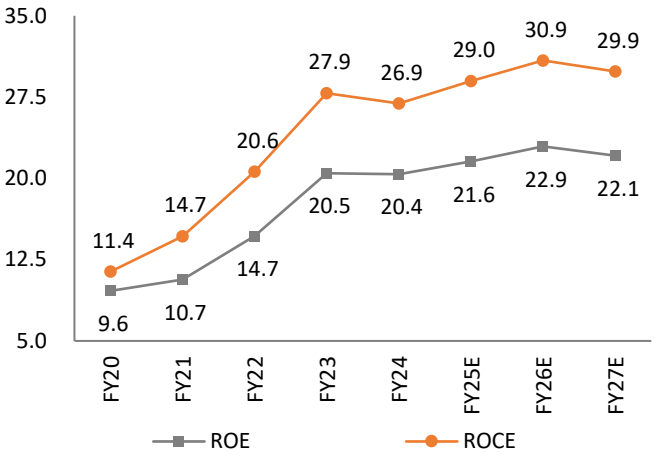


Exhibit 8. Improving Asset Turnover (x)

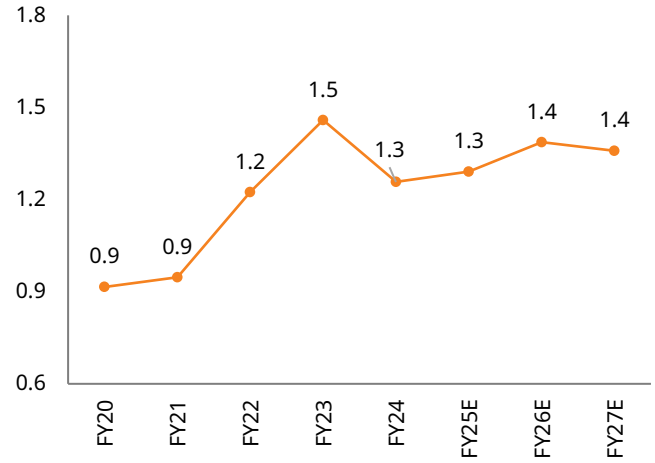


Exhibit 9. Will lead to Free Cash Flow greneration (INR mn)

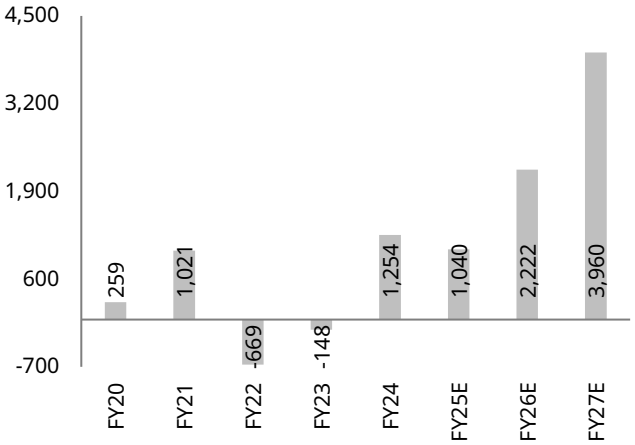


Exhibit 10. Gross Margins v/s Steel Prices

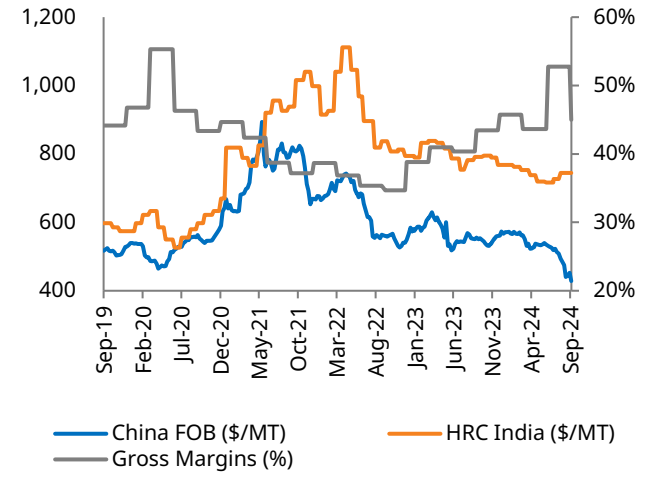
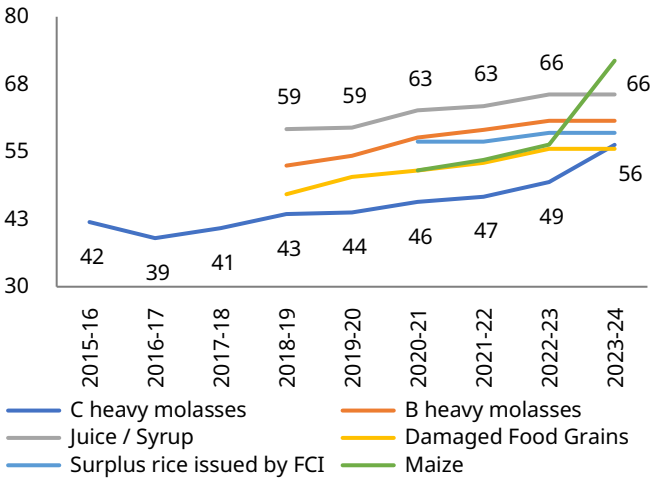


Exhibit 11. Minimum Ethanol Offtake Price (ESY)



Source: Company data, MACM Research

Key Investment Thesis

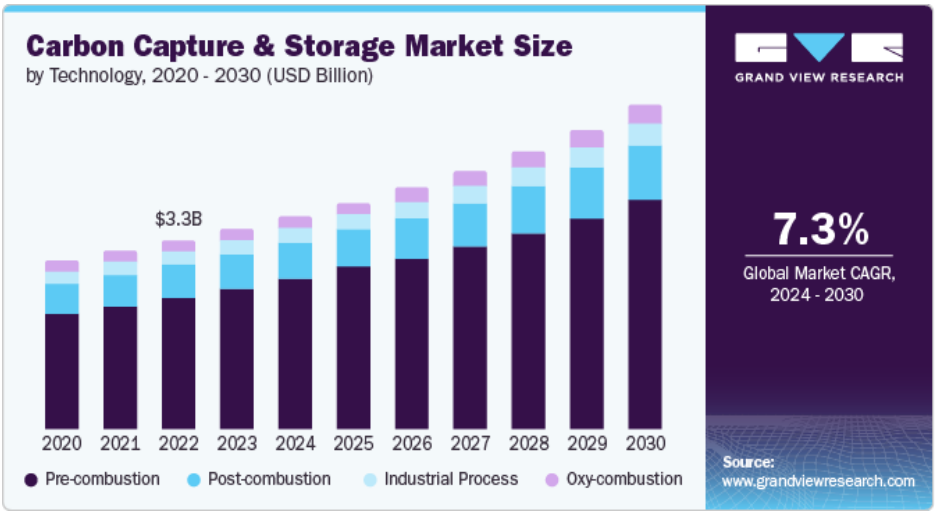
Energy Transition & Climate Action (ETCA) to trigger next leg of growth for Praj Industries

So, what exactly is ETCA? – Any capex done by the carbon intensive manufacturing activities towards reduction of their carbon footprint, either by process/yield enhancements or engineering modifications to either reduce carbon release or capture the carbon or any other harmful substance emitted in the process of manufacturing, falls under the broader umbrella of ETCA.

Things that would fall under this broader umbrella of ETCA would be Investment in improving the Energy Efficiency of production process, Investments in Renewable Energy sources & applications, Carbon Management. Various govt policies, personal commitments of private players and countries towards decarbonization and turning Net Zero are made across various international accords and agreements which are driving investments in the ETCA domain.

The part of ETCA which concerns the most to our investment thesis in Praj Industries is the Carbon Management segment. The carbon market includes carbon capture, utilization, and storage (CCUS) technologies. This is a rapidly growing segment within the broader energy transition and climate action market. The global carbon capture and storage market size was estimated at USD 3.47 billion in 2023 and is projected to grow at CAGR of 7.3% from 2024 to 2030 as per Grand View Research* There are other private research estimates which have projected the industry to grow at range of 10-15% CAGR over next 5 years, but even with the most conservative assumptions the market for CCUS would be $ 5.3 Bn by FY30.

Exhibit 12. Carbon Capture & Storage market size (by Technology)



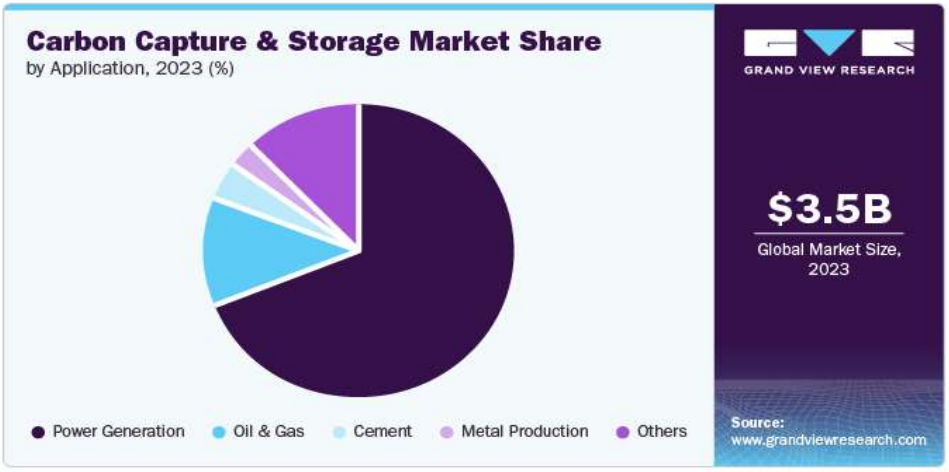
Source: www.grandviewresearch.com

Climate change concerns have prompted the global adoption of carbon capture and storage technology largely by traditional carbon intensive manufacturing entities such Power Generation, Oil & Gas players, Steel Manufacturers, Cement Manufacturing and other such players thereby leading to the strong growth of the CCUS market. These technologies and engineering solutions will be crucial to reach the global net zero or carbon reduction targets imposed/ targeted by various govt or private entities. Thus, investments in this domain are imperative and due in near period.

Understanding the CCUS Market – Technology & Industry Dynamics

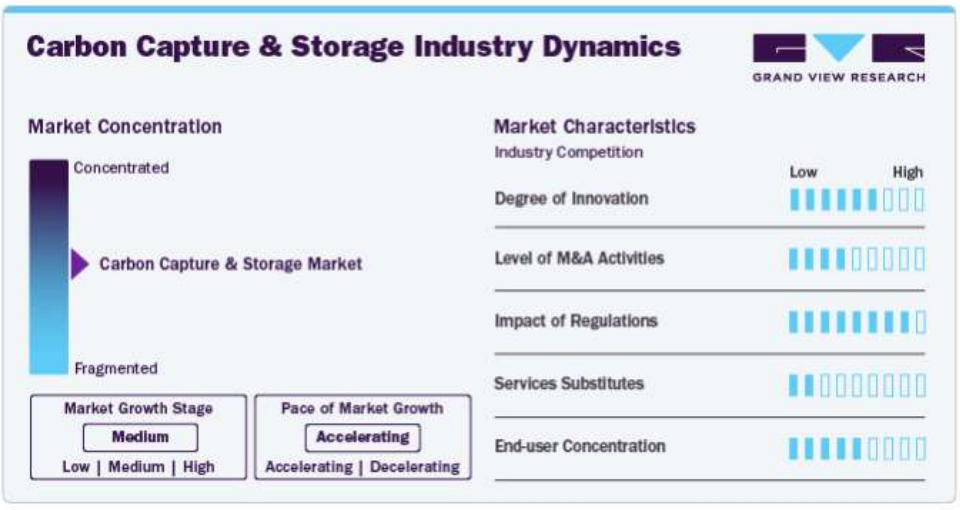
Currently the CCUS market is broadly categorized into four segments: 1) pre-combustion, 2) post-combustion, 3) oxy-combustion, and 4) industrial process segments. Among these, the pre-combustion technology accounted for the largest revenue share of over 70.28% in 2023. Pre-combustion CO2 capturing with the usage of water-gas shift reaction (WGSR) and its removal with acid gas removal (AGR) process is commercially carried out across the world at present. However, the major obstacle in the extraction of carbon dioxide from the atmosphere is the high proportion of nitrogen in combustion air. The solution adopted to overcome this challenge is known as the integrated gasification combined cycle (IGCC). The oxy-combustion technology segment is expected to grow at the fastest CAGR of 7.4% over the forecast period 2024-2030. *https://www.grandviewresearch.com/industry-analysis/carbon-capture-storage-ccs-market*

Exhibit 13. Carbon Capture & Storage market size (by Application)



Source: www.grandviewresearch.com

Exhibit 14. Carbon Capture & Storage Industry dynamics



Source: www.grandviewresearch.com

ETCA segment (CCUS for Blue Hydrogen & Green Hydrogen).

What is Green, Blue, Grey, Pink/Purple Hydrogen ?

The hydrogen market is rapidly evolving, with significant research and investment going into making cleaner hydrogen production methods more economically viable. The future hydrogen economy is likely to see a mix of these production methods, with a gradual shift towards greener options as technology improves and costs decrease.

Grey Hydrogen Vs Blue Hydrogen Vs Green Hydrogen Vs Pink/Purple Hydrogen

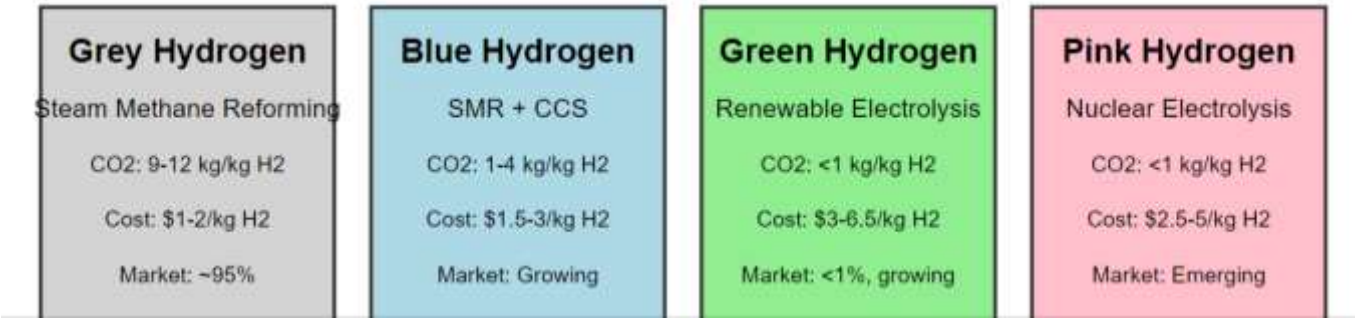
1. **Grey Hydrogen:** Currently the most common form of hydrogen production. Produced through steam methane reforming (SMR) of natural gas or coal gasification. The process involves reacting natural gas (primarily methane) with high-temperature steam to produce hydrogen and carbon dioxide. It has the highest carbon footprint: Approximately 9-12 kg CO2 per kg H2 produced. With 95% of hydrogen production globally via grey route due to its cost advantage (~$1-2 per kg H2 varies by region and natural gas prices). The scope for the other cleaner routes is immense. Hydrogen is primarily used in oil refining and ammonia production.

2. **Blue Hydrogen:** The transitional solution in the move towards cleaner hydrogen production blue hydrogen is produced using the same process as grey hydrogen (SMR or coal gasification). **Coupled with Carbon Capture and Storage (CCS) technology to capture and store CO2 emissions (this is where Praj comes in).** BH has a lower carbon footprint than grey hydrogen: Approximately 1-4 kg CO2 per kg H2, depending on the efficiency of CCS (typically 85-95% capture rate). The market share of BH is growing with several large-scale projects in development as costs have come down to ~$1.5-3 per kg H2, including CCS costs.

3. **Green Hydrogen:** Currently considered the cleanest form of hydrogen production. It involves water electrolysis using renewable electricity (solar, wind, hydroelectric, bio energy). (It is important to understand that within all the renewable sources, bio-energy route has much higher carbon score as it reduces the amount of carbon released in the atmosphere due to converting bio-waste into energy). The process splits water (H2O) into hydrogen (H2) and oxygen (O2) using an electric current. The process has Near-zero carbon emissions, that is less than 1 kg CO2 per kg H2. Under the case of Bioenergy based electric source the projects have negative carbon footprint which opens the possibility of selling carbon credits in future (distant future in India). Although currently this route has less than 1% market share of global hydrogen production, it's one of the rapidly growing routes as cost of renewable sources are coming down. Currently Green Hydrogen costs ~ $3-6.5 per kg H2, with projections to decrease to $1-2 per kg by 2030 in optimal locations which would make economic and ecological sense for projects to move to greener routes. Similar to traditional routes, green hydrogen has further emerging uses in transportation, energy storage, and as a feedstock for various industries.

4. **Pink/Purple Hydrogen:** Pink hydrogen, also sometimes referred to as purple hydrogen, is a newer category in hydrogen production. Produced through water electrolysis, like green hydrogen the electricity used in this case comes from nuclear power plants rather than renewable sources, although the waste generated is nuclear waste which needs to be disposed very judiciously it is far more efficient process than the tradition grey route given the low carbon footprint with emissions, less than 1 kg CO2 per kg H2 just like green hydrogen and ~cost of $2.5-5 per kg H2, depending on electricity costs from nuclear plants. Currently a very small market share, with potential for growth in countries with significant nuclear power capacity.

Exhibit 15. Hydrogen Manufacturing Comparison



Source: MACM Research

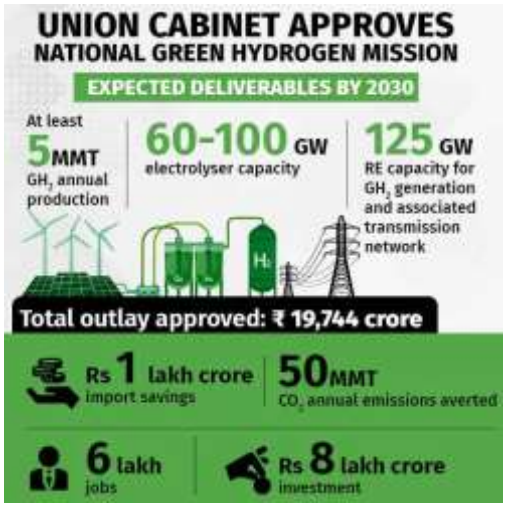
Where does Praj stand in the Green & Blue Hydrogen Race ?

Praj has been positioning itself to benefit from the emerging green and blue hydrogen markets with multiple approaches i.e. CCUS solutions for blue hydrogen and developing bio-route for green hydrogen. Anticipating the huge market potential, Praj commissioned its largest greenfield expansion in Mangalore, the facility has commenced operations from Feb 24 and has started receiving regulatory approvals for manufacturing for the key components from various customers.

Proof of concept - Praj Industries recently bagged an order to build modules for a large Blue Hydrogen project in Europe. The company is currently executing the project from this new Mangalore facility.

The facility focused on ETCA segment can generate a maximum topline of INR 2000 Cr with the current plant size, which the company believes would be easily scaled in a span of 2-3 years. In the Mangalore facility, the company still has 1/3rd land available which can be later utilized to increase the production capacity with minimal costs in future, which will increase the total revenue potential of the Mangalore facility to INR 3000+ Cr.

Green Hydrogen - Praj Industries has been actively working on developing technologies for green hydrogen production through bio route. In 2021, they announced their entry into the green hydrogen market with their "Bio-Prism" portfolio. This involves using bio-based feedstocks and renewable energy sources to produce hydrogen with minimal carbon footprint. The company plans to utilize its extensive experience in bioenergy and process engineering to develop efficient and cost-effective hydrogen production solutions. The company is particularly interested in developing biomass-to-hydrogen technologies, which aligns with their strengths in handling bio-based feedstocks. The company is positioning itself to benefit from India's National Hydrogen Mission and other government initiatives promoting clean hydrogen production and use. While initially focusing on the Indian market, Praj aims to expand its hydrogen technologies globally, leveraging its existing international presence.



Praj's Product Offerings in the Hydrogen Production foray

Critical Equipment's offered by Praj for Hydrogen production, includes:

- **Electrolyser**: - They offer skid-mounted electrolyser, which are crucial for producing GH from water using renewable electricity.
- **Hydrogen Purification Systems**: Equipment for purifying hydrogen to meet the required specifications for various applications.
- **Compression and Storage Solutions**: Systems for compressing and storing hydrogen, which is essential for its transportation.
- **Pressure Vessels**: - Custom-designed pressure vessels for various stages of hydrogen production and storage.
- **Heat Exchangers**: - Specialized heat exchangers for efficient thermal management in hydrogen production processes.
- **Columns and Reactors**: - Critical components for both green and blue hydrogen production processes.

For Blue hydrogen production, which involves natural gas reforming coupled with carbon capture, Praj offers:

- **Steam Methane Reformers (SMR)**: These are key components in the production of hydrogen from natural gas.
- **Carbon Capture Units**: - Equipment designed to capture CO2 emissions from the hydrogen production process, making it "blue" hydrogen.
- *https://www.grandviewresearch.com/industry-analysis/carbon-capture-storage-ccs-market*: - Various equipment for processing and purifying the hydrogen produced through SMR.

Additional Services:

- **Engineering and Design**: - Praj offers engineering services for designing complete hydrogen production facilities.
- **Skid Mounting**: They provide skid-mounted solutions for easy installation and commissioning of hydrogen production equipment.
- **Quality Assurance**: Adherence to international standards and codes for hydrogen-related equipment.

Customised Modules

CI Reduction –
Step Towards Green Manufacturing

Green Module

40% Reduction in Water
& Energy Consumption

By offering this range of critical equipment and services, Praj Industries is positioning itself as a key supplier in both the green and blue hydrogen value chains. Their approach allows them to cater to different hydrogen production technologies and scales, from small modular units to large industrial installations. This diversified approach enables Praj to serve various customers in the emerging hydrogen economy, from renewable energy companies focusing on green hydrogen to traditional oil and gas companies transitioning to blue hydrogen production

Key Growth Drivers for the CCUS segment

- Increasing government regulations, penalties or additional duties imposed on high carbon intensity producing countries
- Carbon pricing mechanisms adopted by various governments to incentivize efficient manufacturing and controlling high carbon manufacturing processes.
- Growing corporate commitments to net-zero emissions across the globe.
- Technological advancements making carbon capture more efficient and cost-effective
- Rising demand for low-carbon products and services, carbon awareness & demand for eco-friendly alternatives for end consumers.

Government Policy – The Catalyst

Global Policies Driving Adoption of Cleaner Technologies & the potential impact of these changing Govt. Regulations

European Union's Carbon Border Adjustment Mechanism (CBAM) in its European Green Deal, aimed at reducing GHG emissions and promoting sustainable practices globally largely targeting carbon intensive sectors such as iron and steel, cement, fertilizer, aluminum, and electricity generation. The implementation started in May 2023 with a transition period for certain countries to adapt. Full implementation is expected by 2026. The European importers will have to buy carbon certificates corresponding to the carbon price that would have been paid had the goods been produced under the EU's carbon pricing rules.

Implications of CBAM - Indian exports to the EU, particularly in sectors like 1) Steel - India is the world's second-largest steel producer, with the EU being a key export market 2) Aluminum: The third-largest aluminum producer globally, India exports significantly to the EU 3) All Thermal power supported manufacturing entities: Embedded electricity in manufactured goods could also be affected, more clarity is needed on this rule.

Potential Impact of CBAM – There would be increased costs for Indian exporters & reduced competitiveness in the EU market but on the brighter side these industries will be forced to faster adoption cleaner technologies and processes & could stimulate increased clean technology transfer to developing countries

Challenges and Rebukes to CBAM - India, along with other developing countries, has raised several concerns about the CBAM as they claim violation of WTO principles such as common but differentiated responsibilities (CBDR). Many countries have hinted at retaliatory measures. Other such policies introduced or to be introduced around the world:

Singapore's Carbon Pricing Act

Status: Implemented. Key Features - Imposes a carbon tax on large emitters. Considering border adjustment measures in the future Potential Impact: As a major trading hub, Singapore's policies could have ripple effects throughout Southeast Asia and beyond

US FAIR Transition and Competition Act

Status: Proposed legislation. Key Features: Would impose a fee on carbon-intensive imports, Aims to level the playing field for US manufacturers Potential Impact: Could significantly affect global trade patterns and encourage cleaner production methods among US trading partners

Japan's Carbon Pricing Mechanism

Status: Under consideration. Key Features - Considering a carbon pricing mechanism that may include border adjustments. Aims to reduce domestic emissions and maintain competitiveness

Potential Impact: Could affect Japan's trading partners and encourage cleaner production methods in countries exporting to Japan

The Indian Angle

India's is the world's third-largest emitter of greenhouse gases; India faces increasing pressure to reduce its carbon footprint while maintaining its economic growth trajectory. The carbon capture and storage (CCS) market in India is expected to play a crucial role in achieving this balance and to abide with changing global norms and self-imposed decarbonization targets. Government Initiatives - The Indian government has been increasingly supportive of CCS technologies, recognizing their importance in meeting climate goals:

- India's Nationally Determined Contribution (NDC): Commits to reducing emissions intensity by 33-35% by 2030 compared to 2005 levels
- National Mission on Advanced Ultra Supercritical Technologies: Aims to develop more efficient coal-based power plants with integrated CCS
- Department of Science and Technology (DST): Funding research and development in CCS technologies, National Action Plan on Climate Change (NAPCC): Includes promotion of clean energy technologies

All being said and done, as India strives to meet its climate commitments while sustaining economic growth, the carbon capture market is poised for significant expansion in the coming years. Success will depend on overcoming current challenges such as High costs: Implementation of CCS technologies remain expensive, deterring widespread adoption, Lack of infrastructure: Limited CO2 transport and storage infrastructure, Regulatory framework: Need for more comprehensive policies and incentives through continued government support, technological innovation, and increased awareness.

Government policies across the world, along with Acts/Policy Initiative like EU's CBAM, US's FTCA represent a global shift towards integrating climate considerations into economic and trade policies. While they vary in scope and implementation, they all share the potential to drive faster adoption of cleaner technologies globally. The cumulative effect of these measures is likely to be significant, pressure for industries worldwide to reduce their carbon footprint. This could lead to accelerated innovation in clean technologies, shifts in global supply chains, and a faster transition to a low-carbon global economy. Although only future holds the answer to how this story unfolds, we have already started seeing early signs adoption of cleaner technologies across world either by force or self-implementation based on personal or countries decarbonization targets

Conclusion: Proof of Concept - Praj has already contracts won from Thailand and Zambia, for Biogenic CO2 capture. Praj expects 300+ Bn investment in clean energy infrastructure by 2030 largely initiated by Energy giants which will be investing in Blue and Green Hydrogen, Green Ammonia, Waste-To-Energy projects. Traditional Oil & Gas players are expected to make investments to the tune of $250 Bn over the next 7 to 10 years. LNG infrastructure investment is expected to be around $150 Bn in coming 5 years. Praj has some serious advantages in these domains with relatively low competitive intensity on the global front as the market is too big for everybody and Praj's service and product offering on global standards. Increasing demand for Modularization acts a key positive for Praj which has demonstrated its ability to successfully deliver complicated modularized solutions at various scales.

The ETCA driven market demand is not a question of IF, it's a matter of When. And it seems Pretty Soon!

Why ETCA Actions? Need for immediate intervention

Do I need to convince you more about why ETCA actions would be the need of hour rather than some CSR outlook or just another coffee table conversation version of govt. talks. If not, you can skip to the next three pages.

Presenting a dozen of Scary Facts About Climate Change

1. Heat-Related Deaths: Climate change is increasing the frequency and intensity of heatwaves, leading to more heat-related deaths. Between 2000 and 2016, the number of people exposed to heatwaves increased by around 125 million. In 2003, a European heatwave caused an estimated 70,000 deaths. Source: WHO, Climate Change and Health, 2018.

2. Water Scarcity: Climate change is exacerbating water scarcity, affecting billions of people worldwide. By 2025, half of the world's population will be living in water-stressed areas. Climate change could cause a 20% increase in water scarcity for an additional 7% of the global population by 2050. Source: United Nations (UN) Water, 2020 Report.

3. Increased Disease Spread: Climate change is altering the distribution of disease vectors, potentially exposing more people to diseases like malaria and dengue fever. Climate change is expected to cause approximately 60,000 additional deaths from malaria in 2030 and 250,000 additional deaths per year from malnutrition, malaria, diarrhea and heat stress between 2030 and 2050. Source: World Health Organization (WHO), Climate Change and Health, 2018.

4. Food Insecurity: Climate change is threatening global food security through impacts on agriculture and fisheries. Climate change could push an additional 100 million people into poverty by 2030. Global crop yields could decrease by up to 30% by 2050 due to climate change. Source: World Bank, Climate Change and Agriculture, 2020.

5. Economic Losses: Climate change is causing significant economic losses through damage to infrastructure and disruption of economic activities. The global economy could lose up to 18% of GDP by 2050 if no action on climate change is taken. In the U.S. alone, climate change could cost $500 billion per year by 2090. Source: Swiss Re Institute, The Economics of Climate Change, 2021.

6. Extreme Weather Events: The frequency and intensity of extreme weather events have increased due to climate change. The number of weather, climate, and water extremes has increased by a factor of five over the past 50 years, causing on average 115 deaths and US$ 202 million in losses daily. World Meteorological Organization (WMO) Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes, 2021.

7. Arctic Ice Melt: The Arctic is warming faster than the global average, with summer sea ice extent decreasing rapidly. Arctic sea ice extent has decreased by 40% since satellite observations started in 1979. The rate of decrease in summer sea ice extent is 13.1% per decade relative to the 1981-2010 average. Source: National Snow and Ice Data Center (NSIDC), 2021.

8. Ocean Acidification: The oceans have absorbed a significant amount of excess CO2, making them more acidic. The ocean has absorbed about 20-30% of total anthropogenic CO2 emissions since the 1980s. This has led to a decrease in surface open ocean pH of around 0.1 units since the beginning of the industrial era (high confidence). IPCC Special Report on the Ocean and Cryosphere in a Changing Climate, 2019.

9. Air Pollution-Related Deaths: Climate change is worsening air quality, leading to increased respiratory and cardiovascular diseases. Air pollution, exacerbated by climate change, causes an estimated 7 million premature deaths annually. By 2060, outdoor air pollution could cause 6-9 million premature deaths annually. Source: OECD, The Economic Consequences of Outdoor Air Pollution, 2016.

10. Conflict and Security Risks: Climate change is increasingly recognized as a threat multiplier, exacerbating existing conflicts and potentially triggering new ones. A 1°C increase in temperature is associated with a 54% increase in the risk of conflict between groups, and 17% increase in interpersonal violence. Source: Marshall Burke et al., "Climate and Conflict", Annual Review of Economics, 2015.

11. Food Security Threats: Climate change is projected to reduce crop yields, particularly in lower-latitude regions, threatening global food security. Climate change could reduce global agriculture yields by up to 30% by 2050. The number of undernourished people could increase by 7.6 million by 2050 due to climate change. Source: World Bank, Climate Change and Agriculture, 2020.

12. Forced Migration: Climate change is forcing people to leave their homes due to rising sea levels, extreme weather events, and resource scarcity. By 2050, up to 216 million people across six world regions could be forced to move within their countries due to climate change impacts. Source: World Bank, Groundswell Report, 2021.

Some Other Data in numbers

Greenhouse Gas Emissions: The primary cause of global warming is the increase in greenhouse gas (GHG) emissions, particularly CO2. The energy sector is the largest contributor to these emissions.

Exhibit 16. Global CO2 Emissions from Fossil Fuels (Billion Tonnes)

Year	Emissions
1900	2.0
1950	6.0
2000	23.1
2019	36.4
2023	36.8

Source: Our World in Data based on the Global Carbon Project

Exhibit 17. Extreme Weather Events: The frequency and intensity of extreme weather events have increased. Number of Climate-Related Disasters per Decade

Decade	No. of Disasters
1980s	1,457
1990s	2,794
2000s	3,967
2010s	3,956
2020s	4,623

Source: EM-DAT, CRED / UC Louvain, Brussels, Belgium

Exhibit 18. Estimated Annual Costs of Climate Change (% of GDP)

Warming Scenario	Global Cost (% of GDP)
1.5°C	0.30%
2°C	0.50%
3°C	1.40%
4°C	1.80%

Source: OECD (2015)

Carbon Budget:

To have a 66% chance of limiting warming to 1.5°C, the IPCC estimates that we can only emit about 420 Gigatonnes of CO2 from 2018 onwards. At current emission rates, this budget will be exhausted by 2028.

Energy Sector's Role:

The energy sector accounts for approximately two-thirds of global GHG emissions, making it crucial for decarbonization efforts.

Exhibit 19. Global GHG Emissions by Sector (2016)

Sector	2016	2022
Energy	73.20%	45.40%
Agriculture, Forestry, etc.	18.40%	37.80%
Industrial Processes	5.20%	12.10%
Waste	3.20%	4.70%

Source: Climate Watch, World Resources Institute

Renewable Energy Growth

The transition to renewable energy is crucial for decarbonization. While progress has been made, it needs to accelerate significantly.

Exhibit 20. Share of Renewables in Global Electricity Generation

Year	Share of Renewables
2010	19.90%
2015	22.80%
2020	29.00%
2022	29.10%

Source: International Renewable Energy Agency (IRENA)

Compressed BioGas (CBG) – The next success story!

Let's start with basics, what is CBG?

Biogas is an energy-rich gas produced by anaerobic decomposition of biomass. It is produced from waste / bio-mass sources like agriculture residue, cattle dung, sugarcane press mud, municipal solid waste, sewage treatment plant waste, etc. Biogas, is a renewable fuel, constitutes mainly of methane (~60%), carbon dioxide (~40%), and traces of hydrogen sulfide. It can be burned directly as a fuel or purified & upgraded by removing carbon dioxide (CO2), hydrogen sulfide (H2S) and compressed to make Compressed Bio-Gas (CBG). The CBG has methane content of more than 90%, which is like the commercially available natural gas in composition terms and energy potential

How is CBG produced?

CBG can easily replace CNG. The bio-manure produced in the plant is an additional source of revenue. The estimated capital expenditure for a 15 tonne per day CBG plant is around INR60-100 crores, depending on the feedstock and the land requirement of approx. 15 acres. Also, the byproduct of process can be sold at INR 1000/tonne in the market which enhances the IRR of CBG project investment.

Exhibit 21. Feedstock Requirement (for 1 Ton CBG)

Feedstock	Raw material Required
Agriculture Residue	10 ton
Press Mud	25 ton
Spent Wash	10KL
Municipal Solid Waste	20 ton
Cattle Dung	50 ton
Napier Grass	10 ton

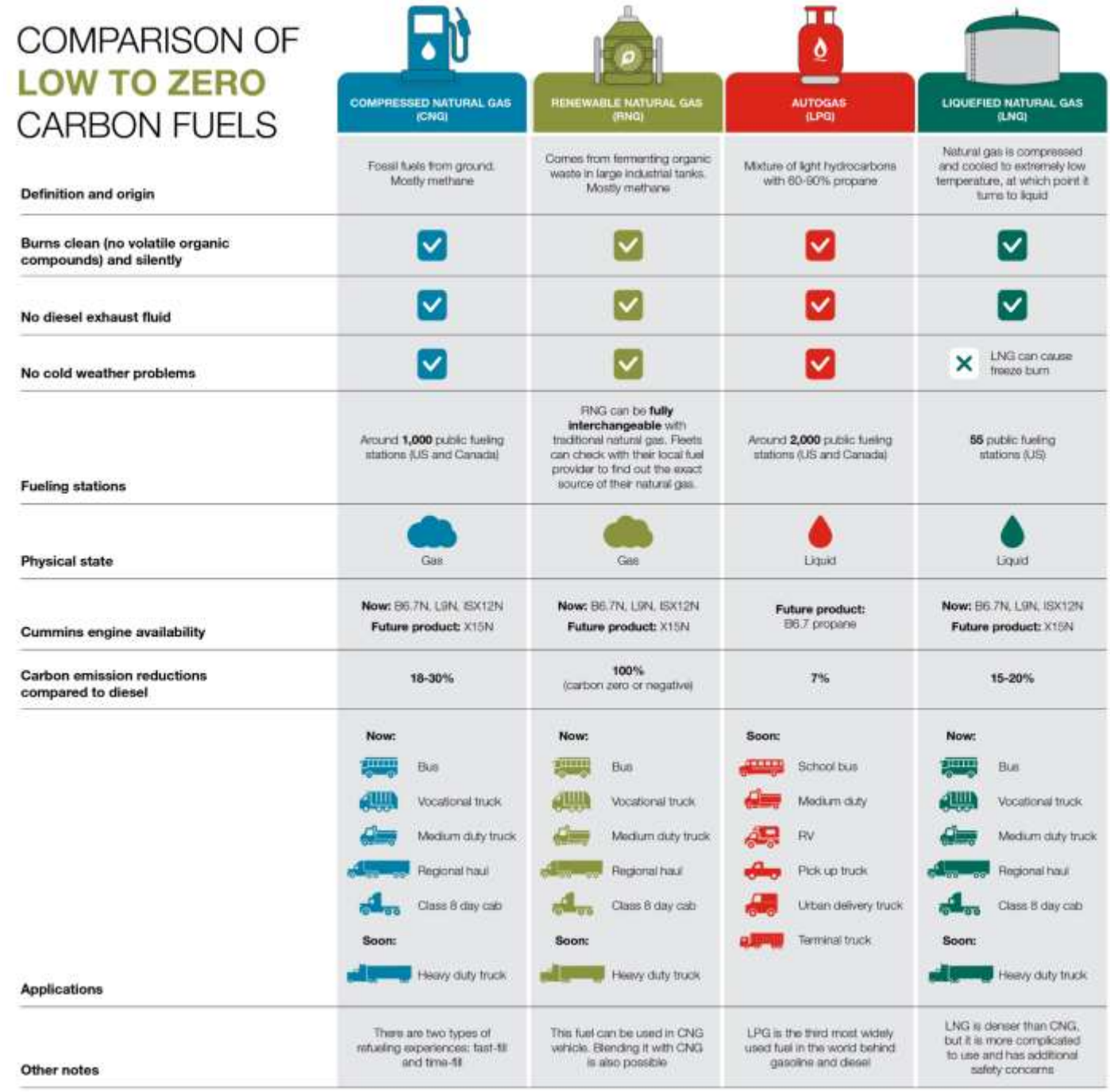
Source: MoPNG CY2022 SATAT Review

Exhibit 22. Cost of CBG Plants

Feedstock	Plant Capacity	OBG Output	Project Cost
Paddy Straw	100 TPD	12 TPD	70-80 Cr
Press Mud	100 TPD	5 TPD	25-30 Cr
Cow Dung	100 TPD	5 TPD	31 Cr

Source: MoPNG CY2022 SATAT Review

Why CBG ? CBG Vs CNG



Source: Cummins

CBG has calorific value and other properties like CNG and hence can be utilized as green renewable automotive fuel. Thus, it can replace CNG in automotive, industrial and commercial areas. Ministry of Road Transport and Highways, Government of India had permitted usage of bio-compressed natural gas (bio- CNG) for motor vehicles as an alternate composition of the compressed natural gas (CNG). Plants must follow CBG Specifications as per IS 16087:2016 Standard to be allowed for blending.

Can CBG Blending repeat the EBP Success!!

The CBG story started with a **DISTANT Govt DREAM** of post an announcement in October 2018 by the MoPNG ministry, for SATAT aim of achieving production of 15 MMT of CBG from 5,000 plants by 2023. An investment of over 2 lakh crore was expected to be pumped into setting up these plants.

A large part of Praj stock performance success in the last 2 years was derivative of successful implementation of EBP which showed an exponential curve for order fallout to Praj industries which started from H2FY22. Although it is necessary to know that EBP had seriously long narrow tail in beginning, which tested patience for lot of early investors of EBP story. **Will CBG blending have the same fate with high uncertainty of the initial order fallout, WE BELIEVE NOT, and the order fallout curve for CBG to be more flattish but with a much shorter tail because of the following reasons**...

Continued strong Govt & Policy support for CBG Infrastructure development:

What is SATAT? Sustainable Alternative Towards Affordable Transportation (SATAT) was launched on 1st October 2018 aiming to establish an ecosystem for production of Compressed Bio Gas (CBG) from various waste/ biomass sources in the country. Under SATAT, Oil and Gas Marketing Companies IOCL, BPCL, HPCL, GAIL and IGL have invited Expression of interest (EoI) to procure CBG from potential entrepreneurs for further marketing. They encourage business development support entrepreneurs to set up CBG plants and supporting infrastructure such as storage, waste collections, etc.

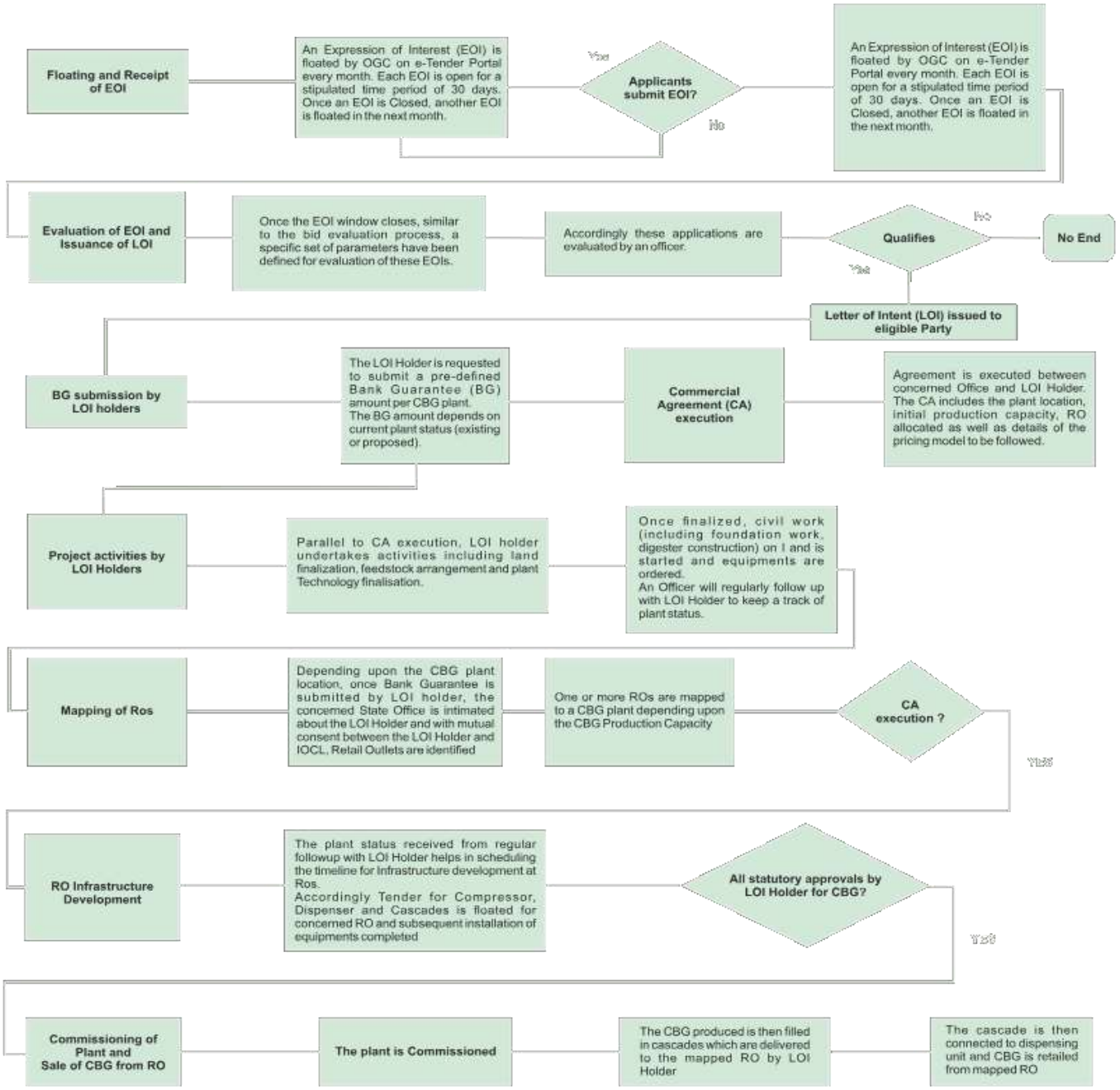
"Anyone who operates or intending to setup a biogas/ CBG/ Bio CNG plant in India can obtain a registration number by registering in the unified GOBARdhan Registration Portal. The registration number is required to avail benefits/ support from other Ministries/Departments. So far there are 72 CBG plants commissioned across India & LOI for 2212 CBG plants have been received across India. These plants produce & supply CBG to Oil Marketing Companies (OMCs) for sale as automotive & industries.

List of the recent initiatives taken be the Ministry to promote SATAT is as under:

- Oil & Gas marketing companies are executing long term agreements for off-take of CBG at an assured price.
- Bio manures produced from CBG plants has been included as "Fermented Organic Manure" under Fertilizer Control Order 1985 vide gazette notification dated 13 July 2020.
- Reserve Bank of India has notified inclusion of CBG projects under Priority Sector Lending vide directives to Banks dated 4.9.2020.
- State Bank of India has also developed a new loan product for financing of CBG projects.
- Ministry of New and Renewable Energy has extended Central Financial Assistance (CFA) Scheme for FY 2020-21.
- State Level Committees have been constituted for implementation and monitoring of SATAT initiative in States of Haryana and Punjab
- MoPNG is also in discussion with Multilateral Financial Institutions like World Bank, Asian Development Bank (ADB) etc. for enabling financing options via line of credit for CBG developers.

Central Ministry Initiatives: Centre has directed state Government to create enabling mechanism for establishing Bio mass supply chain to ensure sustainable supply of bio mass at a stable price for at least a period of 10 years. Ministry of Agriculture and Farmers Welfare to include Digested Bio Gas Slurry (DBGS) produced from CBG projects under FCO. Central Pollution Control Board categorizes CBG Projects under 'White Category'. Department of Fertilizer to extend benefits of Market Development Assistance in form of Rs. 1500/ton to FOM and direct fertilizer companies and marketing entities to co-market FOM with fertilizers. Department of Economic Affairs to facilitate creation of line of funding from multilateral financial institutions for CBG projects. Government of India has approved the Scheme for providing financial assistance to Compressed Bio Gas Producers (CBG) producers for procurement of biomass aggregation machinery to support collection of biomasses with a total financial outlay of INR 564.75 crore for the period of FY 2023-27

Exhibit 23. The entire CBG Process from application to commissioning & sales



Source: SATAT

Multiple Alternatives of Raw Material for CBG production

Unlike EBP which was earlier largely dependent on sugar for Ethanol production, CBG is much more flexible, with multiple non-food feedstocks enabling production. There are few recent highly promising advents such as Napier grass which offers high yields, less water intensive & easy to grow and store.

Napier Glass - Napier Grass, scientifically known as Pennisetum purpureum, is a perennial tropical grass native to Africa. It is widely cultivated for its high biomass yield and is primarily used as fodder for livestock due to its nutritional value. Napier Grass is characterized by its tall, robust growth, reaching heights of up to 4 meters, and its ability to thrive in various soil types and climatic conditions. It is also known for its rapid growth rate and resilience to drought, making it an attractive option for farmers.

India potential – The grass has very less requirements (its grass) & already started to see adoption by farmers given a 150-200,000 revenue potential in a year per acre, primarily for bio-CNG production, this is especially attractive due to the growing demand for sustainable energy sources like bio-CNG in the country. Napier grass can produce a substantial yield of 150-200 tonnes per acre annually, which is considerably higher than other energy grasses like switchgrass and miscanthus. The main driver of Napier grass revenue is its use as feedstock in bio-CNG plants, allowing farmers to sell their harvested grass to energy companies with contractual agreements to support offtake.

Another such promising feed is usage of Pressmud, which comes from sugar industry.

Pressmud - Sugarcane byproduct pressmud can be used as a raw material for India's compressed biogas sector. India is largest sugar producer since 2021-22, surpassing Brazil. Pressmud, a residual byproduct in the sugar industry often known as filter cake or press cake, has been acknowledged as a valuable resource for green energy production. The byproduct can help Indian sugar mills generate extra revenue by utilising it as a feedstock for biogas production through anaerobic digestion and subsequent purification to create compressed biogas (CBG).

The use of pressmud as a feedstock for CBG offers several advantages. It eliminates the complexities associated with the feedstock supply chain, as found in the case of agricultural residue, where biomass harvesting machinery is required for harvesting and aggregation. Secondly, the feedstock is sourced from one or two producers or sugar mills, as opposed to agricultural residue, which involves multiple producers / farmers within a narrow window of 45 days per year. Pressmud's quality is not a concern, unlike municipal solid waste, where the presence of inorganic material can damage anaerobic digesters, leading to lower gas output & it also eliminates pretreatment costs as it lacks organic polymer lignin, unlike Agri residue. Lastly, in terms of conversion efficiency, approximately 25 tonnes of pressmud are needed to produce a tonne of CBG. In comparison, cattle dung requires 50 tonnes for the same gas output. Furthermore, its cost (Rs 0.4-0.6 per kilogram) makes it more economical than other feedstocks like agricultural residue (Rs 1.5-2/kg) and cattle dung (Rs 1-2/kg).

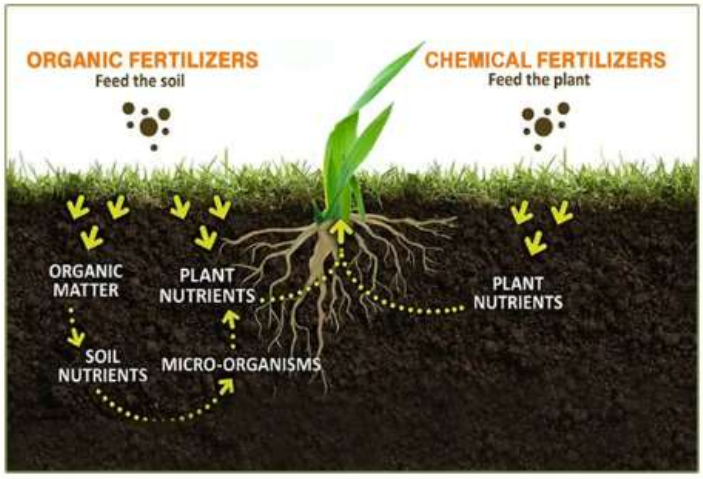
In the 2022-23 timeframe, among the 531 operational sugar mills in India, 330 were privately owned, 190 were cooperative and 11 were public. India's sugar production for the fiscal year 2022-23 amounted to 32.74 million tonnes, along with approximately 11.4 million tonnes of pressmud. This quantity has the potential to generate 460,000 tonnes of CBG valued at Rs 2,484 crore as per report published by Rahul Jain, Md Aamir Usmani in Bioenergy Times.

Compressed Biogas (CBG) is a versatile renewable fuel with numerous applications across various sectors which ensures stable demand.

1. Transportation Fuel - Vehicle fuel for cars, buses, and trucks (CNG replacement). Fuel for agricultural machinery and tractors & Marine transportation fuel
2. Industrial Applications - Heating and power generation in industrial processes. Fuel for industrial boilers and furnaces. It can also be used as raw material for chemical manufacturing.
3. Residential and Commercial Use - Cooking fuel (replacement for LPG). Heating in homes and commercial buildings in cold countries
4. Power Generation - Fuel for smaller size gas-based power plants with combined Heat and Power (CHP) systems & Backup power generation
5. Agricultural Sector - Fuel for grain drying, Greenhouse heating, On-farm electricity generation
7. Blending in Domestic Gas Grid – Blending into CNG pipelines (after purification) which can contribute to renewable energy targets in gas networks

These diverse applications make CBG a valuable component in the transition towards a more sustainable and circular economy, offering solutions across multiple sectors and making it more investable across different geographies, to support greenhouse gas and waste reduction

The CBG manufacturing process produces bio-manure as byproducts which enhances the commercial viability of the project improving the project IRR and helps improving soil quality .



To promote the manure produced from CBG plants, Fermented Organic manure and Bio-slurry have been included under FCO 1985. More opportunities are being explored for marketing Fermented Organic Manure through Oil & Gas Cos. network.

The Department of Fertilizers, Ministry of Chemicals & Fertilizers, and Government of India has notified the scheme for promotion of City Compost on 10.02.2016. Under the scheme, Market Development Assistance (MDA) in the form of fixed amount of INR 1500 per tonne City Compost. Government is undertaking various initiatives to promote organic fertilizer/compost in turn to encourage sustainable agriculture practices.

Enhanced Commercial Viability: The production of bio-manure as a byproduct improves the commercial viability of CBG projects in two ways: First - Additional Revenue Stream, the bio-manure can be sold to farmers or used on-site, creating an additional source of income for the project. Many plants have already started to sell this bio-manure at Rs 10/kg rate on various retail outlets and online stores are getting good reviews.

Second - Waste Reduction, by utilizing the digestate as bio-manure, the project reduces waste and associated disposal costs. This approach promotes a circular economy model, where waste from one process becomes a valuable input for another. CBG is typically produced through anaerobic digestion of organic waste materials such as agricultural residues, animal manure, food waste, or sewage sludge.

Early entry of large Oil & Gas players & Small Renewable EPC companies will support in development of the infrastructure & ecosystem

Several large private players have been entering the Compressed Biogas (CBG) market in recent years, recognizing its potential as a renewable energy source and its alignment with sustainability goals.

The entry of these large private players is significant as it brings substantial capital investment into the sector & contributes to scaling up CBG production and distribution infrastructure which helps in creating a robust supply chain and market for CBG. These players also accelerate technological development in the space leading to better ecosystem for smaller players

Here are some of the notable names that have made significant investments in CBG space:

Indian Oil Corporation (IOCL): The clear leader with the most substantial investments in the Bio-energy space. IOCL leads the pack with more than 50% of the plants commissioned in India are owned by IOCL. The company plans to set up 900 CBG plants . Guess who is to benefit, Praj Industries has signed a JV with IOCL. The collaboration with an IOCL will help green energy transition journey for O&G giant to achieve their goal of net-zero operational emissions by 2046

Exhibit 24. Letter of Intent (Lols) for CBG Plants

Company	Number of LOIs Issued	Land Finalized	Financial Closure	CBG Plant Commissioned / Sale Initiated	CBG Sale Initiated (Retail Outlets)	CBG Sale Initiated (Injection Points
IOCL	2,249	156	37	18	31	-
BPCL	299	37	7	12	-	-
HPCL	413	64	28	3	1	1
GAIL	255	45	18	6	1	1
IGL	47	26	-	-	-	-
Total	3,263	328	97	35	45	2

Source: MoPNG CY2022SATAT Review

Reliance Industries Limited (RIL): India's largest private sector company had given order to build five 20 TPD plants. Guess who got this order – Praj Industries has recently delivered the turnkey CBG plant order to Reliance at Jamnagar, and expects more orders to flow in future as Reliance aims to be a major player in the clean energy sector

Adani Group: Diversified conglomerate is exploring opportunities in the CBG sector as part of its renewable energy portfolio

Some other big names:
Shell: The global energy giant is investing in CBG projects in various countries, including India

Total Energies: The French multinational energy company is investing in biogas and biomethane projects globally. Partnering with local companies in various countries for CBG production

Mahindra & Mahindra: M&M is exploring CBG production through its subsidiary, Mahindra Waste to Energy Solutions

Neste: Finnish oil refining and marketing company is investing in renewable fuels, including biogas and CBG

As the CBG market continues to grow, we can expect more large companies from various sectors (energy, agriculture, waste management, etc.) to enter this space, further driving growth in the industry.

Global Scenario for CBG (more commonly known as RNG internationally)

Globally CBG/RNG has been very highly accredited due to its carbon reduction potential, as it significantly reduces greenhouse gas emissions. Some RNG pathways can achieve carbon intensities as low as -400 gCO2e/MJ, making it one of the lowest carbon intensity fuels available. As per International Energy Agency (IEA) the global potential for biomethane production from organic waste is estimated at 570 million tonnes of oil equivalent (Mtoe), which is equivalent to about 20% of current global natural gas demand. In USA alone the CBG/ RNG production capacity has increased dramatically from 51 million ethanol gallon equivalents (EGE) in 2017 to 279 million EGE in 2021, representing a 447% absolute increase. The global market for CBG / RNG is expected to reach USD 7.9 billion by 2030, expected to grow 12.5% CAGR over the next 6 years.

Praj is setting up a pilot plant in the US for testing RNG generation from waste-stream.

International Competitors in CBG space

1. Clarke Energy - Clarke Energy specializes in the design, installation, and maintenance of gas engine power plants. Their engines can run on various gases, including biogas and CBG. They provide integrated solutions for biogas upgrading, which is essential for producing high-quality CBG from organic waste. Clarke Energy collaborates with various stakeholders, including waste management companies and agricultural sectors, to promote the production of biogas and its conversion to CBG.
2. Wärtsilä - known for its advanced engine technology that can efficiently utilize CBG. Their engines are designed for high efficiency and low emissions, making them suitable for CBG applications. They offer solutions for biogas upgrading and storage, which are critical for the effective use of CBG in energy generation.
3. Siemens AG - a global technology company with a strong focus on electrification, automation, and digitalization. They are involved in various energy sectors, including renewable energy and bioenergy.
4. GE Renewable Energy - focuses on providing renewable energy solutions, including wind, solar, and bioenergy technologies. GE offers technologies for biogas production and upgrading, facilitating the conversion of organic waste into CBG. They develop integrated energy systems that combine various renewable sources, including CBG, to provide reliable energy solutions.
5. Air Liquide - is a global leader in gases, technologies, and services for industry and health. They are involved in various sectors, including energy and environmental solutions. Air Liquide provides technologies for upgrading biogas to CBG, ensuring high purity and quality for energy applications. With a presence in over 80 countries, Air Liquide supports CBG projects worldwide, facilitating the adoption of renewable energy.

Competition on the Domestic Front

EverEnviro and Thermax Bioenergy have signed a Memorandum of Understanding (MoU) with a Danish firm to enhance India's Compressed Biogas (CBG) production capacity.

There are several other small EPC players who cater services related to CBG Infrastructure development in India, some of these EPC players are customers for Praj Industries for the engineering products and services for Praj's RenGas technology.

Everything seems Great, What's the Catch?

The Hurdles – Factors that are causing delay in scaling of CBG Ecosystem. The three biggest factors for the delay in Indian CBG are:

Infrastructure Limitations: Lack of adequate infrastructure for CBG distribution and retail. Challenges in integrating CBG into existing natural gas networks. Logistical & geographic pain points such as CBG produced from the CBG plant will largely be retailed through the CBG dispensing unit set-up by the Oil Marketing Companies within the radius of 25 kms, this can create minor operational challenges such as acquiring suitable land for CBG plants, especially near feedstock sources and gas grid connections. Availability of skilled labor and support staff at such locations

Feedstock Supply Chain Issues: Difficulties in establishing reliable and consistent supply chains for various feedstocks. Seasonal variations in agricultural residue availability create a challenge for continuous throughput at consistent yields.

Policy Implementation Challenges: Despite the SATAT initiative's ambitious goals, implementation at the ground level has been slower than anticipated. Delays in establishing a clear regulatory framework for CBG production and distribution, offtake agreement complexities leading to delays in finalizing long-term offtake agreements with OMCs.

Conclusion: Proof of Concept - Praj has already won several large CBG orders from Industrial players who have been the early entrants in the CBG space, such as the likes of Reliance who had awarded Praj with 5 CBG plants of 20 TPD capacity for 500 Crs, Reliance is considering 50 additional CBG plants across India in coming 3-5 years. Praj has been the preferred partner for IOCL for setting up CBG plants in India, IOCL has set up more than 50% of India's current CBG plants. Praj's JV with IOCL is a testament of their strong relationship which would ensure CBG order flow in future. Praj will also be entering the global RNG race, which has significant potential in agrarian economies like Brazil, Argentina, etc

Sustainable Aviation Fuel (SAF)

Sustainable Aviation Fuel (SAF) - One of Praj's key focus areas in near term within their bioeconomy and sustainable climate action initiatives with immediate market largely driven by SAF demand for Net Zero Goals in USA & Europe.

What is SAF? - SAF is a liquid fuel currently used in commercial aviation which reduces CO2 emissions by up to 80%. It can be produced from a number of sources (feedstock) including waste oil and fats, green and municipal waste and non-food crops. It can also be produced synthetically via a process that captures carbon directly from the air. It is one of the most 'sustainable' biofuel as, SAF recycles the CO2 which has been absorbed by the biomass used in the feedstock, unlike fossil fuels add to the overall level of CO2 by emitting carbon that had been previously locked away,

How SAF is Made? - 11 biofuel production pathways are certified to produce SAF, which perform at operationally equivalent levels to Jet A1 fuel. The production of SAF involves several steps and can use multiple feedstocks. Here's a detailed breakdown of the process:

1) **Feedstock selection** as SAF can be produced from a variety of sustainable feedstocks, including: 1) Used cooking oil and other waste oils 2) Agricultural residues 3) Forestry residues 4) Municipal solid waste 5) Purpose-grown energy crops (Maize / Algae)

2) **Feedstock preparation/processing -** The chosen feedstock is cleaned and prepared for processing. This may involve removing impurities, drying, or other pre-treatment steps depending on the feedstock.

3) **Conversion Process:** There are currently 11 pathways approved for SAF production and more are under research. The most common processes are:

    i) **Hydro-processed Esters and Fatty Acids (HEFA):** Used for feedstocks high in triglycerides (like vegetable oils or waste fats) The process involves hydrotreating (adding hydrogen) to remove oxygen and create hydrocarbons. Further processing (isomerization and cracking) creates the desired mix of hydrocarbons. (50% SAF produced in USA via HEFA route)

    ii) **Fischer-Tropsch (FT) Synthesis:** Used for feedstocks like municipal solid waste or agricultural residues. Feedstock is gasified to produce syngas (CO and H2). Syngas undergoes FT synthesis to create long-chain hydrocarbons These are then processed into jet fuel components

    iii) **Alcohol-to-Jet (ATJ): This is where Praj comes in!** Converts alcohols (ethanol or butanol) into jet fuel. Production of Low Carbon Ethanol via Maize/ Agri Residues/ Forest Residues. It involves dehydration, oligomerization, and hydrogenation

4) **Refining and Blending**: The resulting fuel is refined to meet the strict specifications for jet fuel. It's then blended with conventional jet fuel. Currently, SAF is approved for use in blends of up to 50% in conventional jet fuel. Source: U.S. Department of Energy

Why SAF? Monumental Advantages - SAF can reduce Carbon Emissions by up to 80% compared to conventional jet fuel over its lifecycle. Source: Air Transport Action Group (ATAG). SAF can be readily used in the current existing aircraft and fuel infrastructure without any modification, making it a practical solution for immediate implementation. Also, SAF typically contains fewer impurities than fossil jet fuel, which can lead to reduced particulate matter emissions, improving air quality around airports. The SAF industry can create jobs and economic opportunities, particularly in rural areas where feedstocks are grown or in waste collection infrastructure.

How Big is the SAF Opportunity: Global Commitments & Intents!

US SAF Opportunity - U.S. government's "SAF Grand Challenge" goal targets production of 35 billion gallons per year by 2050. A near-term goal of 3 billion gallons per year is established as a milestone for 2030. Of this 3 bn around 1.5 bn gallons is expected to be produced by traditional HEFA pathway beyond which there are feedstock restriction, the other 1.5 is expected from the ATJ pathway, which is the lowest carbon alternative, this ~1.5 bn gallon SAF capacity will require ~2 bn gallon of **L**ow **C**arbon Ethanol (LCE). So new LCE capacities or conversion of existing capacities into Low Carbon capacities would be required between now and 2030. An average Ethanol plant in USA has a capacity of 100 mn gallon Ethanol per annum, so this would require 20 plants to be upgraded over next 3-4 years. An average plant upgradation cost would range from $10-30 million per plant. This translates to ~2,500 Cr market potential in USA alone just from ethanol for SAF demand, on a conservative basis. This is where Praj comes in, Praj will be developing both new low carbon intensity 1G ethanol plants as well as converting exiting ethanol plants into low carbon intensity plants.

Proof of Concept: Praj has now been awarded a contract for full scale engineering and modulization of a SAF project in United States that is going to be a full large scale commercial ATJ project. The engineering time could be up to about six to eight months. Once the engineering model is completed Praj will get a full view of what project cost. Praj is discussing 5-6 other SAF projects.

Tax credits for Biofuel manufacturing in US under IRA - Recent developments regarding SAF now make ethanol and soy-based biofuels eligible for tax credits under the Inflation Reduction Act (IRA). The Energy Information Administration has released projections for the growth in domestic SAF production capacity for 2024. They state a substantial increase from 30 mn to 460 mn gallons per year.

Euro SAF Opportunity: The ReFuelEU policy in the Fit for 55 initiatives in Europe is one of the most far sighted policies. The initiative calls for sustainable aviation fuels (SAF) to account for at least 2% of the total aircraft fuel used starting next year. Under the new rules, the share of SAF blended with fossil kerosene applies throughout the European Economic Area (EEA)—the EU's 27 member states plus Iceland, Liechtenstein, and Norway. The mandates prohibit member states from setting higher or lower mandates. This minimum increases every five years, to 6% in 2030, 20% in 2035, 34% in 2040, 42% in 2045, and 70% in 2050. A specific proportion of the fuel mix—1.2 percent in 2030 progressively rising to 35 percent in 2050—must be synthetic low-carbon aviation fuels like e-fuels or e-SAF using power-to-liquid technology.

The Brazilian government has announced $ 6 billion (US$ 1.09 billion) to finance the construction of biorefineries focused on producing SAF and sustainable marine fuels

The investment will come from Brazil's National Bank for Economic and Social Development (BNDES) and FINEP, a government funding agency, with both institutions making an equal investment of R$ 3 billion into the initiative. By now, both Agencies have published a public call for proposals to which business plans, aimed at developing and implementing biorefineries to produce either SAF or sustainable marine fuel, are being invited. This funding opportunity is on a competitive basis for Brazilian companies that work in fuel production or related research and development activities concerning sustainable aviation or marine fuel technologies. An award could be directed to spending on the activities and related expenditures of research, technological development, and engineering projects; pilot plants; working capital including shares of machinery and equipment; and other related forms. The deadline for applications is October 31.

South Korea plans to mandate airlines for SAF and biodiesel usage starting in 2025, as reported by The Korean Economic Daily.

The government is expected to unveil this initiative on following the European Union's 2023 legislation requiring 2% of jet fuel to be sustainable by 2025 and 70% by 2050. This eco-friendly initiative could also impact South Korea's position as a leading exporter of aviation fuel. Domestic refineries currently process imported crude oil into jet fuel at competitive prices but lack SAF production facilities.

To support the adoption of SAF, the government plans to offer subsidies to oil refineries that install SAF refueling infrastructure at domestic airports and to relax relevant regulations, similar to measures taken by the US, Japan, Germany, and the Netherlands. Additionally, South Korea may consider tax reductions for SAF-related facilities. Building a SAF facility with a capacity of 500,000 tons of fuel costs approximately 1 trillion won ($752 million). In 2022, South Korea exported 14.8 trillion won worth of jet fuel, surpassing the 10.3 trillion won from mobile phone exports. However, the country lags behind others like the US and China in the SAF sector. Globally, there are 323 SAF production facilities, none of which are in South Korea.

The International Air Transport Association projects that global SAF demand will exceed 400 billion tons by 2050, matching current jet fuel demand of 350 billion to 400 billion tons, implying that all airplanes will use SAF by then.

Airlines and member states of the International Civil Aviation Organization (ICAO) committed to net-zero carbon dioxide (CO2) emissions by 2050 at the 77th International Air Transport Association (IATA) AGM in 2021 As of 2024, over 50 airlines have used SAF for commercial flights, demonstrating growing industry adoption.

The International Energy Agency (IEA) targets and that SAF could meet 10% of projected aviation fuel demand by 2030 and about 20% by 2040. (https://www.iea.org/reports/aviation). A study by the U.S. Department of Energy's Argonne National Laboratory found that SAF made from used cooking oil can achieve a 68% reduction in lifecycle greenhouse gas emissions compared to conventional jet fuel. In 2019, SAF use resulted in 215,000 metric tons of CO2 savings.

Global SAF Opportunity: The global SAF market is expected to grow from $219.91 million in 2021 to $6,261.93 million by 2030, at a CAGR of 56.4% from 2021 to 2030.

India SAF Opportunity

The Global Biofuel Alliance is milestone moment for the biofuels industry which was anchored by India, the United States, and Brazil with India leading the GBA. 19 Countries & 12 International organizations have already agreed to be part of it, many more to follow. Member countries have committed to facilitate access to technology, fostering an ecosystem and initiating policy interventions & alterations. India has a huge role to play in technology transfer, policy support, expertise in project life cycle management

As per CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) agreement, 1% blending will be mandatory from 2027 & 2% from 2028 which would create a demand of ~120 / 240 mn litres of SAF within 24-26 months from today. Praj is already engaging in dialogue and expects traction towards end CY24.

Praj has successfully tested SAF on a commercial passenger flight in 2023, marking a significant milestone. AirAsia India flight i5-767, powered by a blend of indigenous SAF supplied by Indian Oil Corporation in partnership with Praj Industries successfully completed the journey between Pune and New Delhi.

The SAF sourced for this initiative was made possible through a partnership with Gevo using Gevo's Alcohol-to-Jet (ATJ) technology. **Praj has signed a Construction License Agreement (CLA) with Gevo, Inc, USA dated 4th April 2019,** to commercialize technology to produce Isobutanol using sugary based feedstocks, such as juice, syrup and molasses. Pursuant to the CLA, Praj will provide Engineering Procurement and Construction (EPC) services to 3rd parties using a process design package developed by Praj. This package uses Gevo's proprietary Isobutanol biocatalyst on sugary-based feedstock. Isobutanol derived from said proprietary process is high energy renewable intermediate product that finds application in Aviation and Racing cars. Praj Industries produced SAF samples at its state-of-the-art R&D facility, Praj Matrix, which underwent rigorous testing at IOCL laboratories before being blended for the special flight.

Praj has also **signed MoU with Axens to work jointly on projects in India for production of SAF from low carbon alcohols through ATJ pathway.** Praj brings to the table proven expertise in modularized solutions, integration services for complete project and technology for production of low carbon isobutanol and ethanol from conventional bio-sourced feedstock. Axens will provide its Jetanol (Alcohol-To-Jet) technologies, catalyst solution, equipment and services (training, technical assistance) for conversion of alcohols to SAF.

Conclusion: Proof of Concept - Praj SAF has already been awarded with an order for full scale engineering and modulization of a SAF project in the United States. Engineering time for the project could be up to 6-8 months given the scale. Preliminary study shows positive results, and management expect more clarity post engineering study outcome to attune the size of project and order value. Praj is in advanced stages of dialogue with 6 more SAF projects across the world.

Based on our multiple interactions with Praj's management it seems likely that SAF will be the most likely venture for the Praj IOCL JV to start with. This will boost ATJ fuel production capacity in India & help in developing the infrastructure for the SAF market. Although the JV with IOCL hasn't materialised into any firm announcements as of today, largely owing to the bureaucratic process involved in PSU's the company is confident on taking some concrete steps in current fiscal year.

Ethanol Story – Is there anymore steam left?

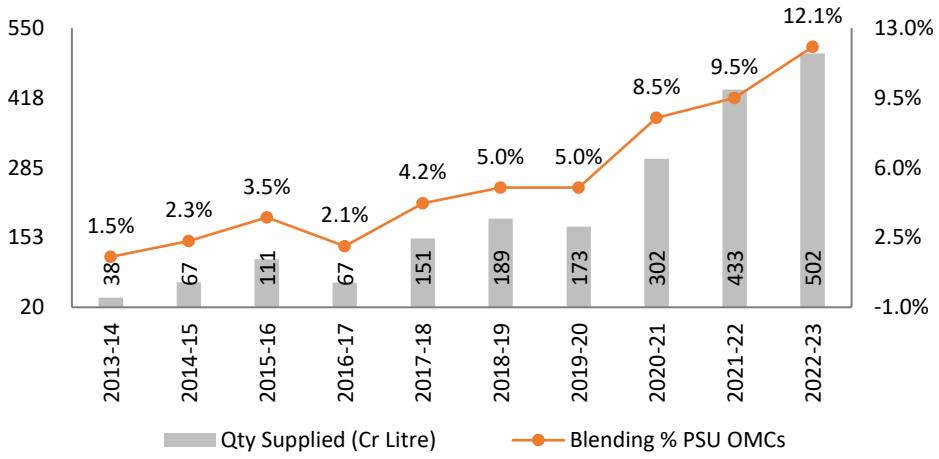
Domestic 1G - India's ethanol market was valued at USD 2.4bn in 2023* and is expected to touch USD 6.8bn by 2030 at 15.9% CAGR, as per industry reports. In volume terms, these numbers translate to a demand of ~1600-1700 crore litres of ethanol capacity to be installed in India by ESY 2025-26 from the current installed capacity of ~1000 crore litres in ESY 2023-24.

Although, there were certain hiccups lately in this capacity expansion as Govt rules prohibited supply of sugar & grain diversion towards preparation of Ethanol which hurt the investor sentiment in going forward with capex decision for Ethanol projects, but the problems have been resolved lately with availability of alternative crops such as maize, Napier grass whose cultivation and yields are rising owing to strong demand from ethanol manufacturing.

India's net Oil & Gas import bill (crude oil plus petroleum product plus LNG import bill minus exports) stood at USD 121.6 billion in 2023-24, down from USD 144.2 billion in 2022-23. Petroleum imports as percentage of India's gross imports (in value terms) stood at 25.1% in 2023-24 & 28.2%. With every $ increase in the crude oil price impacts India's annual import bill to the tune of INR 110 bn.

The government has been promoting blending of ethanol in petrol under the Ethanol Blended Petrol (EBP) Programme wherein Public Sector OMCs sell petrol blended with ethanol. Under EBP Programme, the blending of ethanol with petrol increased from 38 crore litres in ESY 2013-14 to more than 500 crore litres in ESY 2022-23 with corresponding increase in blending percentage from 1.53% to 12.06%. The blending percentage has touched 15.83% in the month of July 2024 and cumulative blending percentage has crossed 13% in the ongoing ESY 2023-24.

Exhibit 25. Sharp increase in Ethanol supplied and Blending % post ESY 2019-20



Source: Company data, MACM Research

Domestic 2G

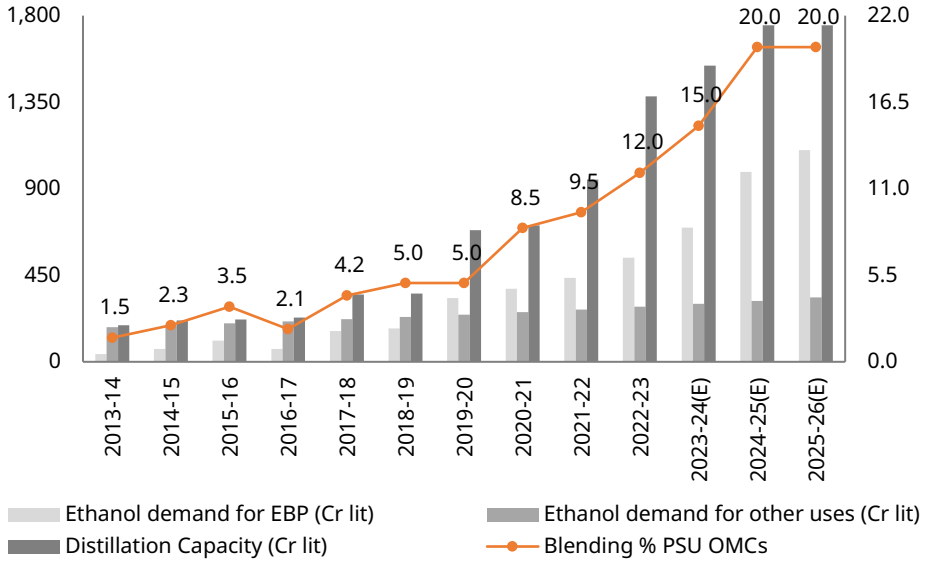
To meet the ethanol blending targets, the Government is also focusing on alternate sources like 2nd Generation (2G) Ethanol (Advanced biofuels). To encourage 2G ethanol capacity in the country and attract investment in this sector, "Pradhan Mantri JI-VAN Yojana" was launched in 2019 for providing financial assistance to 2G Bio-ethanol projects.

What is 2G Ethanol? 2G ethanol (2nd Generation Ethanol) refers to ethanol produced from non-food biomass materials rather than food crops. This includes a variety of feedstocks such as agricultural residues (like straw and corn stover), wood chips, municipal solid waste, and dedicated energy crops that are not suitable for human consumption. The term distinguishes it from 1G ethanol (first-generation ethanol), which is produced from food crops like corn, sugarcane, or sugar beets.

Praj offers its proprietary enfinity® technology for producing cellulosic ethanol (2G ethanol) from agricultural residues like bagasse, corn cobs, rice straw, wheat straw etc. This technology enables production of ultra-low carbon ethanol.

India has set a target of 20% ethanol blending in petrol by 2025-26. The government has approved 2G ethanol projects with a total capacity of 1016 million liters per annum. OMCs are on course to achieve the 20% blending target by the end of ESY 2025-26. It is estimated that over 1,100 crore litres of ethanol will be required during ESY 2025-26 to achieve 20% blending for which 1,750 crore litres of ethanol distillation capacity needs to be installed which will be difficult to achieve without 2G Ethanol.

Exhibit 26. Ethanol Data



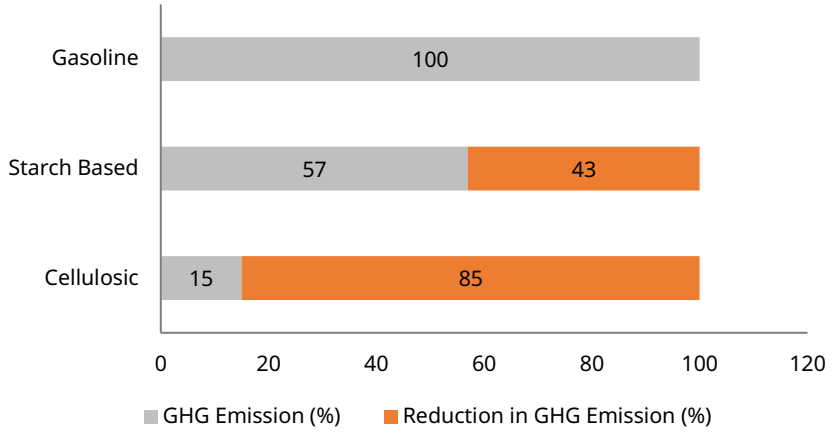
Source: Company data, MACM Research

Why 2G Ethanol is gaining traction and why do we believe this will continue?

2G ethanol typically has much lower carbon footprint than fossil fuels and even first-generation (1G) ethanol, especially when produced using sustainable practices. This aligns with global efforts to reduce greenhouse gas emissions and combat climate change. Praj is involved in setting up three 2G ethanol plants for oil marketing companies in India (IOCL, BPCL, HPCL), each with 100 KLPD capacity.

At present, Northern India is facing significant pollution issues in many states due to the large-scale wastage and burning of agricultural residue, which is often the most convenient method for farmers. By utilizing 2G technology, greenhouse gas (GHG) emissions can be considerably lowered, and farmers could earn additional income by properly disposing of this waste. Research shows that starch-based biofuels can achieve around a 43% reduction in GHG emissions, whereas cellulosic-based biofuels can reduce emissions by approximately 85-95%.

Exhibit 27. Reduction in GHG emission using starch-based Biofuel



Source: Company data, MACM Research

Indian 2G Ethanol projects

Under the Pradhan Mantri JI-VAN scheme, the first 2G Ethanol Project was set up by Indian Oil Corporation Limited at Panipat, Haryana in August 2022. The other 2G commercial projects being set up by BPCL, HPCL and NRL at Bargarh (Odisha), Bathinda (Punjab) and Numaligarh (Assam) respectively, are also nearing completion.

Exhibit 28. Since commencement of PM JI-VAN Yojana, INR 7,500 mn have been approved by Govt for the following 2G projects

Company	Estimated Cost (INR mn)	Approved Financial Assistance (INR mn)	Completion timeline	Company offering Engineering solutions
Indian Oil Corporation Ltd.	9,000	1,500	Completed in July 22	Praj Industries
Bharat Petroleum Corporation Ltd.	16,070	1,500	In final stage of construction	Praj Industries
Hindustan Petroleum Corporation Ltd.	14,000	1,500	Trail runs under progress	Praj Industries
Numaligarh Refineries Limited	42,000	1,500	Commissioning in July 2024	Engineers India Ltd
Mangalore Refinery and Petrochemicals Ltd	11,000	1,500	Commissioning in 2025	LanzaTech Global

International 1G & 2G

The global advanced biofuels market size was valued at USD 22.3 billion in 2021 and is expected to grow at a CAGR of 36.2% from 2022 to 2030. Europe, as per RED III mandate, is moving towards 2nd Generation ethanol, creating opportunities for Praj's technology

Whenever there is a substantial growth of plants, there is potential for their use in cellulosic ethanol production. Nearly any type of plant material, whether waste or specifically cultivated, can serve as a substrate for 2G ethanol. However, varying levels of natural chemical modification of cellulose can affect the ease of utilization of different sources. Additionally, storing raw biomass without degradation can be quite challenging, and the lack of supply chains makes transportation to processing locations difficult.

Exhibit 29. Country wise feedstock availability for Ethanol

Region	Major feedstock source	Potential for Cellulosic Ethanol Production	Details
North America	Wood industry byproducts (wood chips) and grasses from prairies	High potential due to widespread plant cultivation	Forested areas in Canada and northern U.S. have existing wood industries.
U.S. Agricultural Belts	Agricultural waste from main crops (corn, cotton, rice)	Significant opportunities for utilizing large volumes of agricultural waste	Includes the corn belt in the Midwest and cotton and rice belts in the South.
India	Municipal solid waste, rice straw, bagasse	Profitable due to large quantities of available feedstocks	Approximately 62 million metric tons of municipal solid waste generated annually.
China	Similar crops to India, including rice straw and bagasse	Promising potential for 2G ethanol production	BLACKBOX !
South America	Corn stover and sugarcane bagasse	Can produce feedstocks for cellulosic ethanol	Brazil has Raízen and GranBio using bagasse, with three new plants planned.
Europe	Corn, wheat, sugar beets, and low-quality wood	Potential for ethanol production from plant pulp and other biomass	Northern and Eastern Europe have sustainable forests providing low-quality wood during maintenance.

Source: MACM research

Countries are increasingly looking to secure their energy supplies by reducing dependence on imported fossil fuels. 2G ethanol can be produced domestically from locally sourced biomass, enhancing energy independence and resilience. The global push for renewable energy sources is expected to expand the market for biofuels, including 2G ethanol. Countries seeking to transition to clean energy will look to 2G ethanol as a viable option for achieving their renewable energy targets.

Praj has fulfilled 100% of Colombia's fuel ethanol program by installing ethanol production plants. Production of the first fuel ethanol plant began in October 2005 with an output of 300 KLPD in the Cauca Region. By March 2006, four More plants in the Cauca Valley were operational with a combined capacity of 1.05 million litre per day or 357 million litre per year.

Global Shift to Bioethanol: A Sustainable Solution to Energy Challenges

Worldwide, there is a strong shift towards clean and renewable energy to address global warming challenges and the increasing costs of fossil fuels. Biofuels, particularly bioethanol, have become a viable alternative as a renewable energy source due to their sustainability, efficiency, safety, and ability to reduce greenhouse gas emissions. The United States and Brazil, which together represent approximately 81% of ethanol production, have successfully implemented large-scale ethanol initiatives. In 2023, global ethanol production reached 112 billion litres and is projected to maintain this trajectory, primarily driven by the rising mandatory blending policies.

Increasing awareness of climate change and the need to reduce greenhouse gas (GHG) emissions have prompted countries to seek cleaner energy alternatives. Bioethanol is seen as a more sustainable option compared to fossil fuels, as it can significantly reduce carbon emissions when produced and used correctly. Major economies like USA, EU, China, Brazil, and India have taken many initiatives to tackle carbon emissions.

Exhibit 30. Important norms announced by key ethanol producing nations

Country	Norm/Policy	Details	Year(s)
United States	Renewable Fuel Standard (RFS)	Mandates the use of renewable fuels, including bioethanol, in transportation fuel.	2005 (amended multiple times)
	Ethanol Blending Requirements	Sets specific volume targets for bioethanol blending (e.g., ~15 billion gallons in 2020).	Annual updates
	Small Refinery Exemptions	Exemptions for small refineries from blending requirements.	Ongoing discussions
	Infrastructure Investment	Initiatives to expand biofuel infrastructure (e.g., Biofuel Infra structure Partnership).	Ongoing
Brazil	National Alcohol Policy (Proálcool)	Promotes sugarcane ethanol production and use.	Since 1970s (modified)
	Ethanol Blending Mandates	Minimum ethanol blend in gasoline (e.g., E27).	Recent years
	RenovaBio	Promotes sustainable biofuel production through carbon credit sales.	Introduced in 2017
European U nion	Renewable Energy Directive (RED II)	Targets for renewable energy, aiming for 32% share by 2030.	Adopted in 2018
	Sustainable Biofuels Requirements	Criteria for the sustainability of biofuels, limiting food-based biofuels.	Ongoing
	Fuel Quality Directive	Greenhouse gas reduction targets for fuels promoting biofuels.	Ongoing
India	National Biofuel Policy (2018)	Aims for 20% ethanol blending in petrol by 2025.	Established in 2018
	Ethanol Blending Program	Program launched to enhance ethanol use, with increasing blending targets.	Annual updates
	Incentives for Sugarcane Farmers	Incentives to boost sugarcane production for ethanol.	Recent years
China	Biofuel Development Policy	Emphasizes development of biofuels in the 13th Five-Year Plan.	2016-2020
	Ethanol Vehicle (E85) Promotion	Encourages use of E85 vehicles in certain regions.	Ongoing
	Renewable Energy Law	Supports renewable energy sources, including bioethanol.	Updated over past decade

Source: MACM Research

Europe RED II and RED III norms

To promote the use of renewable energy, including biofuels, the EU has set targets for 2020 and 2030. Most of the member states did not achieve the 2020 targets for share of renewables in transport and greenhouse gas emission intensity reduction. In addition, EU supports deployment of biofuels from wastes and residues by financing research and demonstration plants.

Exhibit 31. RED Norms

Targets 2030	Targets in RED II (2018)	Targets in RED III (2023)
Advanced biofuels (feedstocks listed in Annex IX, part A)	• **3.5% share** of advanced biofuels in final consumption of road and rail transport	• **5.5% share** of advanced biofuels and renewable fuels of non-biological origin (RFNBOs), in final consumption of all energy supplied to transport, with a 1% RFNBO minimum share
	• X2 multiplier	• Indicative goal of at least 1.2% of energy used in maritime transport to come from RFNBOs in 2030
		• X2 multiplier for advanced biofuels and RFNBOs
		• Additional multipliers in aviation and maritime transport: x1.2 for advanced biofuels and x1.5 for RFNBOs
RFNBOs	• No sub-target	• X2 multiplier for advanced biofuels and RFNBOs
	• Additional multipliers in aviation and maritime transport: x1.1	• Additional multipliers in aviation and maritime transport: x1.2 for advanced biofuels and x1.5 for RFNBOs
Biofuels and Biogas from used cooking oil (UCO) or animal fats (feedstocks listed in Annex IX, part B)	• Use of biofuels and biogas from UCO and animal fats is limited to 1.7% in final consumption of energy in road and rail transport	• Use of biofuels and biogas from UCO and animal fats is limited to 1.7% in final consumption for all energy used in transport
	• X2 multiplier	• X2 multiplier
Conventional biofuels (food- and feed-based)	• Share of conventional biofuels consumed in 2020 in road and rail transport in Member States +1%, but a maximum of 7%	• Share of conventional biofuels consumed in 2020 in the transport sector in Member States +1%, but a maximum of 7%

Source: MACM Research

Inflation Reduction Act (USA)

The Inflation Reduction Act (IRA), enacted in August 2022 in the United States, includes various provisions aimed at promoting clean energy, reducing greenhouse gas emissions, and fostering the development and use of renewable energy, including biofuels. A significant provision in this act is Section 45Z. This provision introduces a new Clean Hydrogen, Biofuel, and Biochemical Production Credit, providing production tax credits for biofuels based on their lifecycle greenhouse gas (GHG) emissions reductions compared to conventional fossil fuels. The credits incentivize the production of biofuels that demonstrate lower emissions, encouraging sustainable practices.

Exhibit 32. IRA Norms pertaining biofuels in the Inflation Reduction Act

Technology Grouping	Credit Name
Renewable Energy Generation	• Section 45 renewable electricity production credit
	• Section 48 energy investment tax credit
	• Section 45Y clean electricity production credit
	• Section 48E clean electricity investment credit
	• Section 45U zero-emission nuclear power production credit
Carbon Sequestration	• Section 45Q carbon sequestration credit
Clean Fuels	• Section 45V clean hydrogen production credit
	• Section 45Z clean fuel production credit
Manufacturing	• Section 48C advanced energy project credit
	•Section 45X advanced manufacturing production credit
Clean Vehicles	• Section 30C alternative fuel vehicle refueling property credit

Source: www.irs.gov

Praj Industries will benefit from the implementation of Section 45(z) of IRA act in the USA as it allows an income tax credit for the domestic production of clean transportation fuel. However, there is an important consideration from the IRA's perspective for notifying the 45(Z) applicability that's grid legal requirement which is still not clarified.

Exhibit 33. Praj's Carbon Intensity Reduction Potential for Corn based Ethanol Plants

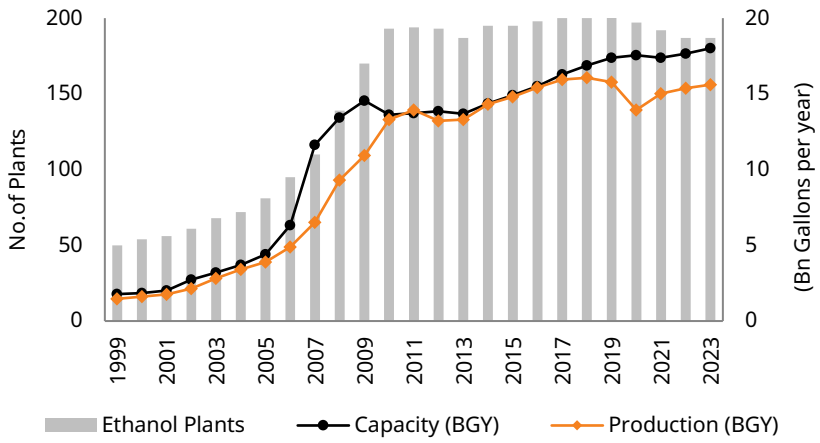
Source: Praj Industries Presentation

The US Ethanol Market

There are about 200 ethanol biorefineries across 25 states, with a significant concentration in the Midwest Corn Belt. Corn is the primary feedstock for US bioethanol, accounting for over 95% of production. The ethanol industry uses about 35% of the US corn crop. Most of the ethanol produced is used domestically. In 2022, about 14.2 billion gallons were blended into gasoline, primarily as E10 (10% ethanol blend). The US accounts for about 55% of global bioethanol production, followed by Brazil at about 30%.

United States has an installed ethanol production capacity of approximately 17.7 billion gallons per year, making it the world's largest producer of bioethanol. The US bioethanol market was valued at approximately $35 billion as of 2024. Although the US bio-ethanol market is huge there have been no new ethanol plants in USA.

Exhibit 34. No new Ethanol plant in US in last 10 years



Source: https://www.eia.gov/

From 2021 there's a push for year-round sales of E15 (15% ethanol blend) to increase ethanol use in USA. With the IATA commitments and new SAF mandate, USA would require converting its existing plants into Low Carbon Intensity Ethanol plants to support the upcoming SAF demand.

Competition in USA - ICM, Inc. is one of the leading ethanol plants & biotech providers in USA. ICM provides rotary and steam tube dryers, turbines, ethanol recovery, and oil separation systems, and gasification technological services to its clients. To date, the company has designed 110+ ethanol plants, 30+ plants have been retrofitted, 48 patents have been granted to the company, and $ 4.5 bn revenue have been generated so far. Most of the U.S. ethanol plants use ICM separation technologies. Discover processing equipment and services for creating biofuel and feed products.

Challenges for the Ethanol Story

Feedstock Availability: Sourcing enough appropriate biomass feedstocks can be difficult. While many agricultural residues and dedicated energy crops can be used, demand from alternative uses are facing challenges. Some reports say the maize-based industry has demanded immediate imports of 5 million tonnes of duty-free imports to tide over the supply crunch. Not only that, but even grain-based ethanol makers are feeling the pressure of a spike in maize prices as their ethanol procurement price of ~72 per litre was fixed when maize MSP (minimum support price) was ~2,090 per quintal. The current maize MSP for the 2024-25 kharif season is ~2,225 per quintal.

Pretreatment and Processing: The lignocellulosic structure of 2G feedstocks makes them resistant to degradation. Effective pretreatment methods are needed to break down the complex carbohydrates into fermentable sugars, which can be cost-prohibitive and energy-intensive. The efficiency of converting pretreated biomass into sugars largely depends on the effectiveness of enzymes. The development and cost of these enzymes can impact overall production economics.

Economic Viability of 2G Ethanol: The overall economics of 2G ethanol production often relies on government incentives and subsidies. Without sufficient financial support, production may not be competitive with fossil fuels or 1G ethanol.

Global competitors of Praj Industries

Praj Industries stands out in the biofuels sector owing to its specialization and technological innovations. In contrast, the other companies provide a broader range of services and focus on multiple industries, including energy, infrastructure, and environmental solutions. Each company has its strengths, but Praj's focused expertise in ethanol production positions it well within its niche market.

Exhibit 35. Global competitors of Praj Industries

Company	Operational Focus	Technological Expertise	Geographic Reach
Veolia	Focuses on resource mgmt. and environmental services, including biofuels.	Innovative waste-to-energy technologies and treatment solutions.	Global presence across various sectors.
Babcock & Wilcox	Offers energy generation technologies and services.	Specialized in biomass and renewable energy solutions.	Global, with a strong foothold in North America.
KBR, Inc.	Provides engineering solutions across industries	Advanced biofuel production technologies and engineering services.	Global presence, strong in oil and gas as well.
Black & Veatch	Focuses on sustainable infra and energy projects.	Known for its integrated solutions for renewable energy projects.	Global reach in various sectors.
Burns & McDonnell	Engineering and consulting services for infrastructure and energy.	Comprehensive environmental and renewable energy projects.	Global presence with strong U.S. operations.
Dahlman Energy	Specialized biofuels engineering services.	Focuses on biofuel production and processing technologies.	Mainly U.S. focused.
Tetra Tech	Engineering and consulting for environmental projects.	Strong emphasis on water sector projects, including biofuels.	Global reach in environmental sectors.

Source: MACM Research

Technological Collaborations of Praj Industries

Gevo Ltd (USA) - On 4th April 2019, Praj Industries signed an agreement with Gevo Inc, USA to commercialize technology to produce Isobutanol using sugary-based feedstocks, such as juice, syrup and molasses. Pursuant to the agreement, Praj will provide EPC services to 3rd parties using a process design package developed by Praj which uses Gevo's proprietary Isobutanol biocatalyst on sugary-based feedstock. Isobutanol derived from said proprietary process is high energy renewable intermediate product that finds application in Aviation and Racing cars.

DVO Inc (USA) - Praj Industries has incorporated unique dual plug flow digestor design, in collaboration with DVO Inc of USA. This patented design technology has several advantages including higher efficiency, lower energy consumption and near zero maintenance. RenGasTM technology yields are considerably higher compared to conventional biogas processes.

Celluniti collaboration for 2G Ethanol - The company capitalizes on the Celluniti technology—an exclusive, IP-protected innovation that allows to produce biofuels and chemical products from biomass, made possible through its partnership with Sekab Group. This technology facilitates the conversion of cellulose into sustainable sugars and bioethanol. Sekab contributes expertise, patented processes, and proprietary technology for producing bioethanol from lignocellulosic biomass.

Celluniti is a collaborative initiative between Praj Industries, an Indian company specializing in biofuels and process solutions, and SEKAB, a Swedish company focused on developing sustainable solutions for the bio-based economy, especially in the field of bioethanol and other biofuels. The primary goal of the Celluniti collaboration is to develop integrated solutions to produce advanced biofuels, emphasizing the utilization of lignocellulosic biomass (non-edible plant material) to create sustainable ethanol and other bio-based products.

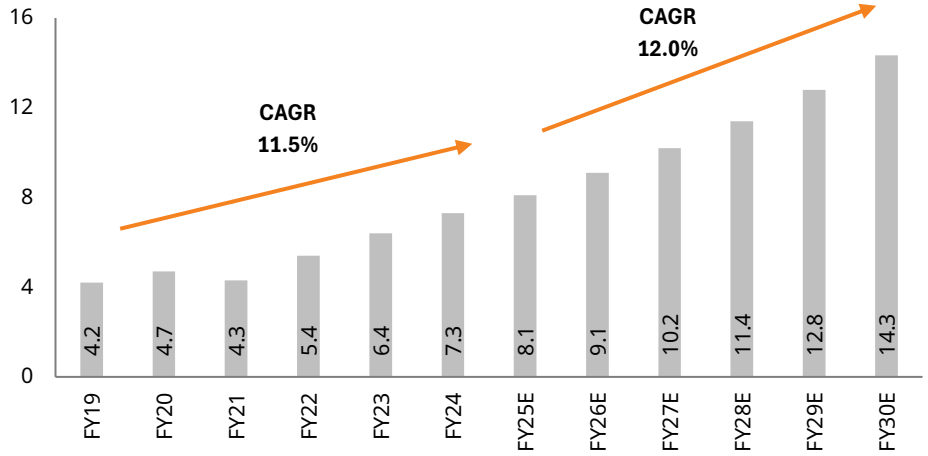
ARAI (India) - In 2020, Praj Industries and Automotive Research Association of India (ARAI) entered MoU to jointly drive application development of advanced biofuels that will find usage in industry and transportation.

Conclusion – The market for 1G Ethanol is only going to grow from here with increasing adoption of cleaner biofuels by various countries. Also, increased demand for higher blending requirements and SAF production would continue to scale demand in countries with existing 1G Ethanol infrastructure. Although it is very difficult to put a number on how fast and how big this market would grow due to sheer complexity of 100s of non-numerical factors, we remain confident on the long term growth story of 1G Ethanol on global scale.

ZLD / ETP Business - Waste-water treatment solutions

Zero Liquid Discharge (ZLD) business provides solutions that enable industrial facilities to treat and reuse their wastewater, ultimately eliminating liquid discharge into the environment

Exhibit 36. Indian Water & Wastewater treatment market size

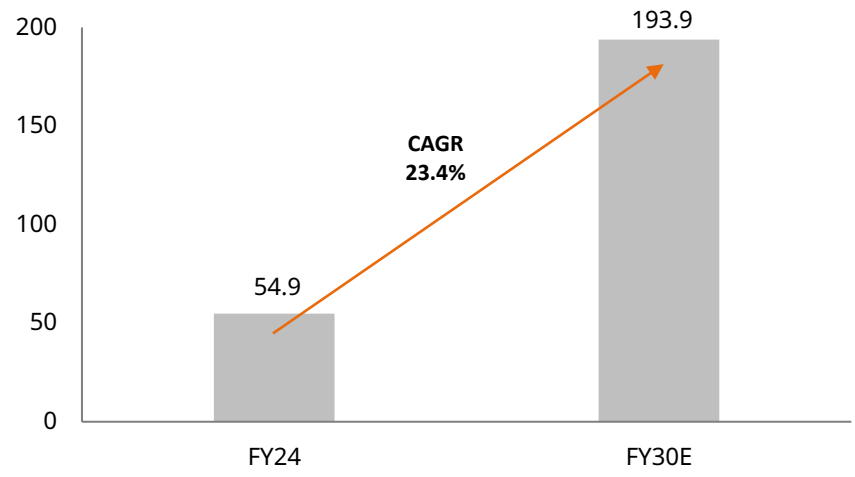


Source: Concord Enviro DRHP

Penetration of ZLD market in India

Zero Liquid Discharge (ZLD) technology is progressively penetrating industrial plants in India, driven by stringent environmental regulations and water scarcity issues. Currently, ZLD technology has been adopted by up to 23.4% of industrial plants, representing a market value of approximately $ 54.9mn (INR 4,593 mn) in FY24.

Exhibit 37. ZLD market size in India ($ mn)



Source: Concord Enviro DRHP

Zero Liquid Discharge (ZLD) systems offer significant environmental benefits by minimizing wastewater discharge, they typically come with a higher initial capital expenditure compared to conventional wastewater treatment methods. ZLD systems can achieve water recovery rates of over 95%, potentially saving millions of liters of water per year for a large industrial facility by coupling with the technology of High pH RO.

Key Drivers for ZLD business

Environmental Regulations: Increasingly strict regulations on industrial wastewater discharge are pushing companies to adopt ZLD solutions. In India, National Green Tribunal has mandated ZLD for several industries, particularly in critically polluted areas. The Central Pollution Control Board has issued guidelines for water consumption and wastewater generation for various industries, promoting ZLD adoption.

Technological Advancements: Improvements in ZLD technology have made it more accessible and efficient. Innovations have led to more affordable ZLD systems, making them viable for a broader range of industries. Advanced technologies have increased water recovery rates, making ZLD more attractive economically.

International Pressure: Global companies operating in India or sourcing from Indian suppliers often require adherence to international environmental standards, driving ZLD adoption.

Conclusion - Praj's unique proposition over here is its modularized solutions which are finding increasing acceptance from their customers. Praj is leveraging its core competence in Industrial biotechnology and microbiology to develop specialized microbes for processing difficult to treat industrial effluent. This along with the modularization of the ZLD plants creates a super convenient solution for Praj client as it reduces the downtime and manufacturing activity related hassles at their plant locations.

Praj received a contract for modularized system in Indonesia. Company completed the ZLD installation of the IOCL Dumad project which was one of the largest ZLD projects in India.

ZLD solutions are particularly relevant for water-intensive industries or those producing complex wastewater streams, including Power Generation Oil & Gas, Chemical Manufacturing, Mining & Metallurgy. The company continues to find strong market traction in the Metals, Oil & gas sector, with strong track record of repeat order wins from multiple clients which shows its technological supremacy and strong client relationship.

Praj's Bio Prism Portfolio

Renewable Chemicals & Materials (RCM) Opportunities !

The concept of Bio-Prism which consists of **Renewable Chemicals & Materials (RCM)** is pivotal in advancing the circular bioeconomy, particularly through the development of bioplastics. As the world shifts from fossil-based feedstocks to bio-based alternatives for various materials which are used at present, bioplastics emerge as one of the most sustainable solutions to replace single-use plastics, which is one of the biggest environmental concerns. Bio-Prism focuses on creating green products that contribute to sustainable development while reducing waste and carbon emissions. Praj Industries is developing sustainable solutions in the form of Renewable Chemicals and Materials (RCM). The company has developed technology to produce bioplastics, such as Polylactic Acid (PLA), as part of its Bio-Prism portfolio.

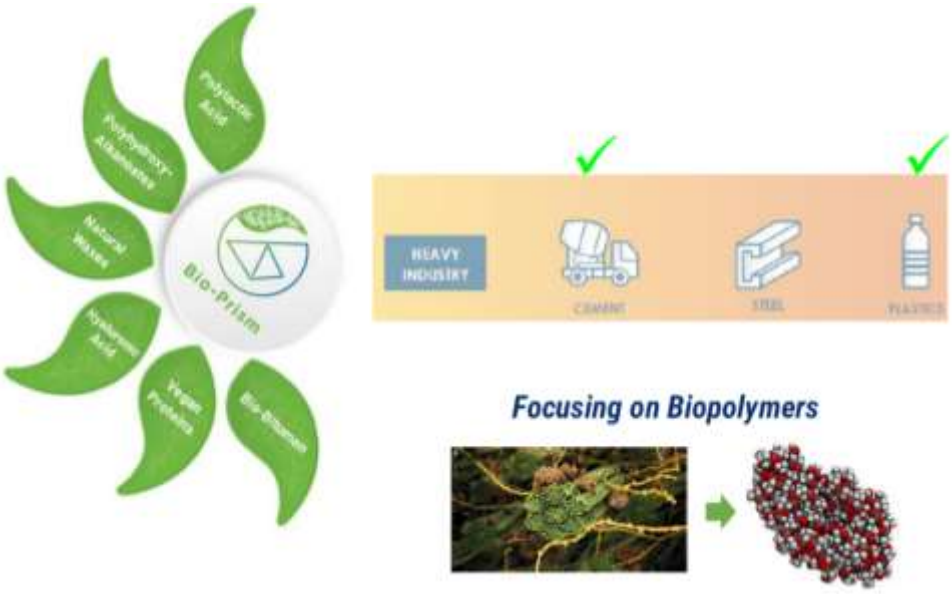


Exhibit 38. Praj RCM Offerings/Product Segmentation

BIO-REFINERY CO-PRODUCTS	BIO-BASED POLYMERS	BIO-BASED SP. PRODUCTS
Bio-Bitumen	Polylactic Acid (PLA)	Natural Waxes
Lignosulfonates	Polyhydroxyalkanoates (PHA)	Hyaluronic Acid
Vegan Proteins	Bio-Butadiene	Ectoine & Hydrxyectoine

Source: Company data, MACM Research

Bio Plastic (PLA/PHA)

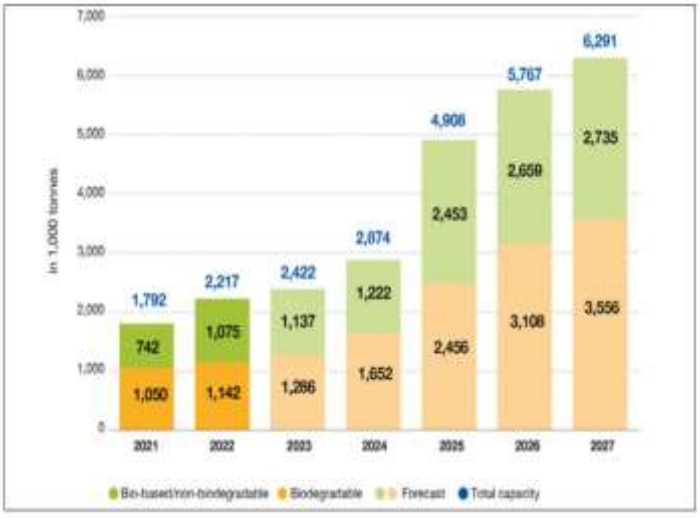
Bioplastics, such as polylactic acid (PLA) and polyhydroxyalkanoates (PHA), are derived from renewable resources and can be utilized across various application sectors. These materials not only serve as viable substitutes for conventional plastics but also align with the principles of a circular economy by being biodegradable and compostable. The transition to bioplastics is essential for mitigating the environmental impact of plastic pollution and fostering a more sustainable future.

The company also boasts expertise in the design and construction of small to medium-scale biopolymer plants, facilitating the demonstration of technology at appropriate capacities. This integrated pilot plant, located in Pune, has a capacity for producing lactic acid and serves as a crucial step in showcasing the potential of biopolymers.

Bioplastics – Scope / Market Potential - India's Plastic Industry was valued at ~$40-45 billion as of 2023. The plastics industry is currently home to about 50,000 industries, most of which are micro, small, and medium-sized enterprises (MSMEs). These enterprises contribute INR 3.5 lakh crore (US$ 42.89 billion) to India's economy and employ more than 50,000 people. The Indian plastics industry has been growing at a steady pace, with a CAGR of about 8-10% in recent years. This growth is driven by factors such as urbanization, increasing disposable incomes, and demand from various end-user industries like packaging, automotive, electronics, agriculture, and healthcare.

India's per capita plastic consumption is relatively lower compared to global averages but is gradually increasing. It was estimated to be around 11-13 kg per person per year, compared to the global average of over 30 kg. India Production Capacity - India is one of the largest producers of plastics in the world, with a production capacity of over 15 million metric tons per annum. The packaging industry is the largest consumer of plastic, contributing 40-45% of demand followed by Infra & Construction at 20-25%. Agriculture at 10-15% - Automotive at 8-10% - Electronics at 5-7% - Others: 10-15%

India's annual plastic production is around 22 million tonnes (as of 2022). The conventional plastics market in India has been growing at a CAGR of 8-10% in recent years. India Bio Plastics Market size was valued at USD 447.25 Mn in 2023 and is expected to reach USD 1809.51 Mn by 2030, at a CAGR of 22.1 % over the forecast period. Thus, the current small size of the bioplastics market and potential for growth is huge, especially given the increasing focus on sustainable alternatives and government initiatives to reduce conventional plastic usage creates a compelling case for investments in capacity.



Praj Industries invested in pilot scale Polylactic Acid (PLA) facility for Bioplastics manufacturing at Jejuri, Maharashtra in Feb 2023.

Praj has developed a proprietary technology called RenewablePlast™ to produce bioplastics. This technology focuses on producing biodegradable and compostable bioplastics. Praj's bioplastics are produced using renewable feedstocks such as sugars (bagasse) , lignocellulosic biomass, and organic waste. This approach aligns with their commitment to sustainability and circular economy principles. The bioplastics developed by Praj can be used in various applications, including Packaging materials Disposable cutlery, Agricultural films, etc

Praj has developed bio-degradable bioplastic at demo scale in its R&D facility, Praj Matrix at Pune. With this proof of concept, company invested in pilot scale plant at Jejuri, which is 100 kms from Pune. As of Q1FY25, Praj successfully produced the first batch Lactic Acid 90%, a building block for bioplastic, at its State-of-the-art demonstration plant for Biopolymers. Praj captures the Entire Value Chain & had been able to successfully manufacture the PLA with a feedstock Agnostic Multiproduct Technology. The Jejuri plant has been developed using sugar bagasse as raw material.

Exhibit 39. A typical conversion value chain for bio-plastic via organic route FTP – Carb to Plastic using biological enzymes

Source: Company data, MACM Research

Other promising products from the RCM 

Bio-bitumen is a bio-based binder derived from renewable sources such as vegetable oils, crop stubble, algae, lignin (a component of wood) or animal manure. Bio-bitumen production via fermentation route has been developed as an alternative to petroleum bitumen, thereby reducing environmental impact. It can be used in the construction of roads and roofs. It is used as a direct replacement, modifier, and rejuvenator. The main uses of bio-bitumen are in airtight structures, such as waterproof binder for road construction (asphalt floors), buildings, and marine structures. Due to its high adhesive and waterproof quality.

Praj's Hyaluronic Acid, branded as Hyaferm™, is a cutting-edge product derived from a proprietary non-GMO strain through a plant-based fermentation process. It offers three variants: Hyaferm-P, Hyaferm-C, and Hyaferm-F. Praj is open to technology licensing and production partnerships, highlighting its commitment to innovation and collaboration in the industry. Global Market Size - $ 10 bn

Vegan Protein – from grain based distillers. Praj is pioneering the development of rice protein, a unique vegan protein source, through advanced extraction and texturization technologies. The process begins with rice, where pre-processing and enzyme hydrolysis yield protein isolates, concentrates, and hydrolysates. Global Market Size - $ 792 mn

Praj's Ectoine and Hydroxyectoine are innovative products derived from the fermentation of sugars using extremophilic bacteria. These compounds provide osmotic protection to macromolecules, cells, and tissues, enhancing their stability and functionality. Praj employs a proprietary purification process to yield both ectoine and Hydroxyectoine from a single microbial strain, allowing for efficient production. Global Market Size - $ 65 mn (Ectoine)

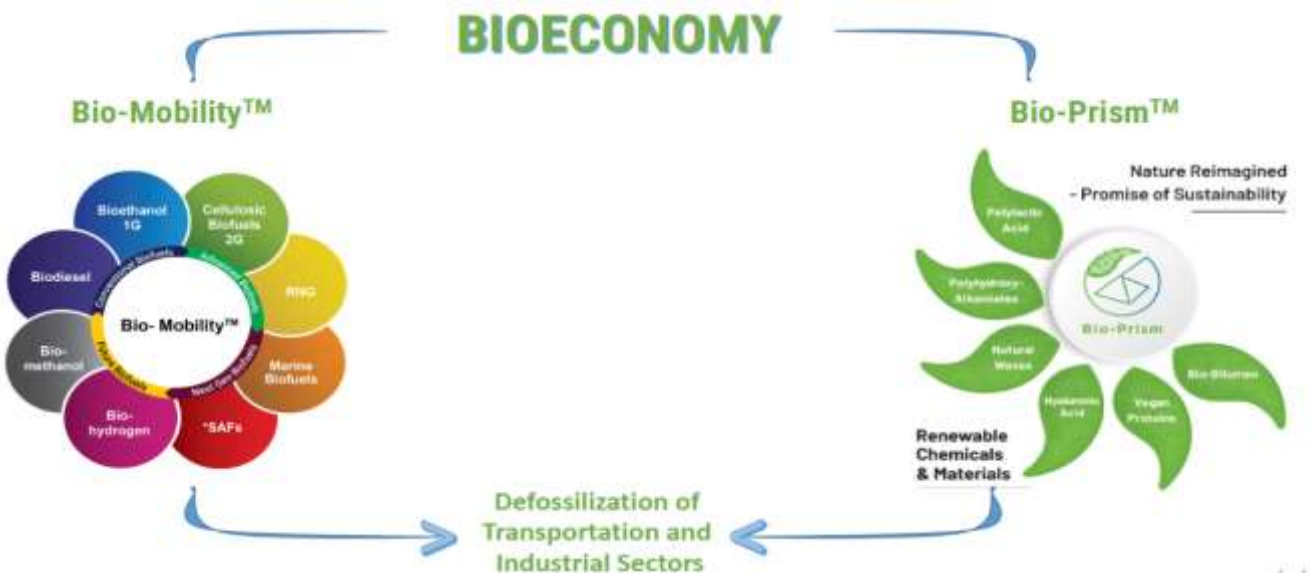
Praj rice bran wax products, Oriwax-R, Oriwax-P, and Oriwax-HP, suitable for various applications in personal care, pharmaceuticals, confectioneries, and coatings. This wax is abundantly available and approved by the US FDA as a food ingredient, known for its exceptional oil gelling properties even at low concentrations. Global Market - $ 680 mn

Praj Industries - Company Background

Praj Industries (PRJ) is a process and project engineering company established in 1983 by Mr. Pramod Chaudhari, and is headquartered in Pune, Maharashtra. Over the last 40 years company has amassed more than 1000+ customers reference across 100+ countries across all 6 continents. With a team of 1800+ employees, 90+ research scientists, 400+ patents filings, and 24 Indian and 60 international patents being granted.

Praj industries has four world class manufacturing facilities located in Maharashtra, Gujarat and Karnataka, which are near ports and supported by a multi-disciplinary engineering team. The company has Global Offices located in Thailand and Philippines in South East Asia and in Houston, Texas, USA. Kandla SEZ & Mangalore SEZ are two of the companies' latest manufacturing facilities. The Kandla plant has production installations for Stainless steel, Alloy & carbon steel products and Modular skids with total area: 50,900 sqm The Manglore facility is the latest facility developed by Praj with the focus of catering to the promising ETCA segment. It's a • State of the art manufacturing facility based on Industry 5.0 principles. With the total area 128,671 sqm (Covered) & potential area to expand another 58,064 sqm in future.

Praj Industries has a core business framework which is based on bio-economy, emphasizing sustainable practices leading to decarbonsisation in transportation and Industrial sectors. This framework is segmented in two key components:



Bio-Mobility focuses on innovative transportation solutions utilizing biofuels and sustainable practices. Bio-Prism represents the production of renewable chemicals and materials, promoting sustainability. The overarching theme is driving climate action through bio-economy initiatives, showcasing a commitment to reducing carbon emissions and fostering environmentally friendly practices.

Bio-Prism focuses on developing technologies for production of bio-based Renewable Chemicals and Materials (RCM). Sugary, starchy and cellulosic agri-based feedstocks along with gases like biogas, methane and various non-edible oils are the starting materials for RCM. For conversion of these feedstocks to the final molecule of interest, it is exploring Bio-catalytic, Chemo-catalytic & Thermo-chemical routes. Within the bio-industrial ambit, a spectrum of bio plastics remains a priority, along with cellulose-lignin refinery products and specialty products.

The core of the company is based on its state-of-art R&D center located in Pune named PRAJ Matrix

This R&D center is built on 5-acre land plot with an invested capital of ~US$25mn) having experienced workforce conducting research in area of Bioenergy, Bio-Chemicals, Health & Wellness. The center provides customized research and services solutions to customers. Over years of constant R&D, PRAJ has been able to obtain 84 patents against its name in various areas of biofuels.

PRAJ Matrix company's Centre of Excellence (COE) over the years has collected, processed and categorized samples of 7000 different types of Plant Sugars, 2000 variety of starches, 1200 variety of different cellulose, 300 types of Gases & 300 types of Oils. This Database is one of the true strengths of Praj which gives it ability to service customers across the globe in different geographies.

Exhibit 40. The Praj Matrix Center R&D Capabilities

Biotechnology Laboratory

Bioprocess Development

Chemical Process Development

Analytical Facility

2nd Generation Ethanol Pilot Plant

Multipurpose Pilot Plant

Catalysis lab @Praj Matrix R&D center

Source: Company data, MACM Research

Management Team – Right People, Right Place, Right Time!!!

Mr. Shishir Joshipura, CEO & Managing Director

Shishir Sir is a Mechanical Engineer from BITS Pilani and an Advanced Management Graduate from Harvard Business School. He has over 35 years of rich experience in varied fields of engineering. He co-chairs the CII Innovation Council for Western Region and is a Member of the CII National Committee on Capital goods, Smart Manufacturing, Trades and Fairs.

He joined Praj Industries Ltd in 2018 as Managing Director and CEO. Praj's revenue has grown from INR 9,170 mn in 2018 to INR 34,660 mn during his tenor. We believe his past connections in his prior role at SKF would be extremely beneficial to Praj as it scales its ETCA segment in coming years.

Professional Experience

During his tenure at Thermax Ltd (2002-2009), Mr. Joshipura was initially heading the Process Heat Division, got promoted as EVP and became the head of Global business for cooling and heating business. During his stint at Thermax, the revenue of the company grew from INR 152 mn to INR 32,643 mn. The energy segment during the period grew from a revenue of INR 152 mn to INR 25,173 mn.

At SKF India Ltd, Mr. Joshipura joined as the Managing Director in 2009. From 2009 to 2018, the company reported a revenue growth CAGR of 6.5% from INR 16,647 mn to INR 27,500 mn. Mr. Joshipura has taken several initiatives to focus on energy efficiency and productivity improvement across diverse sectors such as paper, chemical, power, Textile.

Mr. Sachin Raole, CFO & Director

Sachin Sir is a Cost Accountant and Chartered Accountant with 27 years of experience in varied fields of finance and accounts. He has worked in the areas of divestment, mergers & acquisitions, financial restructuring, treasury, accounts and taxation. He has very rich experience in the wide spectrum of finance across industries; manufacturing, project, financial services and pharmaceuticals.

He joined Praj Industries in 2016 and has been handling the finance, commercial and resources since then. Under his leadership, the company has continued to grow, managing its working capital judiciously even in Co-VID times without any significant strain on balance sheet. This top management duo makes very good professional power packed combination with both having strong industry / domain expertise and

Professional Experience

During his tenure at RPG Lifesciences (2018-2016), Mr. Raole was heading the Finance, Secretarial & legal, IT, Procurement and HR. He joined the company as the CFO and helped the company increase its revenue from INR 1,890 mn to INR 2,790 mn with wise investment decisions.

At KEC International Ltd, Mr. Raole joined DCM Finance in 2004. During his tenure in KEC, Mr. Raole was looking after the finance and accounts of RPG Cables Division and M&A activity of KEC

Mr. Atul Mulay, Head of Bio Energy

Mr. Atul Mulay is working as President and Strategic Business Unit Head for Bio Energy Division and heads Global operations. He is Director on Praj Engineering and Infra Limited Board and a Trustee of Praj Foundation. He has been associated with Praj Group since inception of the group. He is a qualified Mechanical and Production Engineer and has also done his post-graduation in Marketing Management from Pune. He has to his credit Fulbright Scholarship from United States of America and completed his Global Leadership Management Tepper School of Business, Carnegie Mellon University.

Mr. Pramod Kumbhar, Chief Technology Officer, Praj Matrix

Dr. Pramod Kumbhar works as President and Chief Technology Officer of Praj matrix - R&D Center. He is focused on driving innovations in industrial biotechnology to make biofuels and bio chemicals. He has a Ph.D. in Chemical Engineering from ICT, Mumbai and Postdoctoral stints at CNRS laboratories in Montpelier and Institute of Catalysis, Lyon in France. He is Fellow of Maharashtra Academy of Sciences. Prior, he has worked at General Electric R&D Centre in Bangalore and SI Group (Schenectady Chemicals, USA) in various positions including last assignment as R&D director for Asia Pacific.

Mr. Vasudeo Joshi, (Head of Advanced Biofuels)

Mr. Vasudeo Joshi is working as Vice President and Business Unit Head for Advance Biofuels and he is a Chemical Engineer and has over 33 years of experience in the field of Biofuels, Dairy & Food Processing Industry. He has been working with Praj for over 24 years with Multidiscipline experience in the Business Development, Proposals & Cost estimations, Engineering and Execution of Biofuel Projects in Domestic and Overseas markets. He was leading the Praj team in successful demonstration of Praj's

Mr. Abhijit Dani, (Chief Business Officer and WTD of Praj GenX Ltd)

Mr. Abhijit Dani is a Vice President and Business Unit Head of Process Equipment and Modularisation, and Water Treatment. He is a Mechanical Engineer and MBA in Marketing and Finance. He was selected for prestigious Fulbright Scholarship from Carnegie Mellon University, USA. In 2009, he joined Praj and over last 12 years, under his leadership, this Business Unit has created many milestones in Process Equipment and Modularisation offerings in Hydrocarbon, Industrial Biotech and Chemical Industry. He is also the Vice Chairman of Process Plant & Machinery Association of India (PPMAI) and he is also on the Central Advisory Board of Chemtech foundation.

Mr. Mihir Mehta, (Wholetime Director at Praj HiPurity Systems)

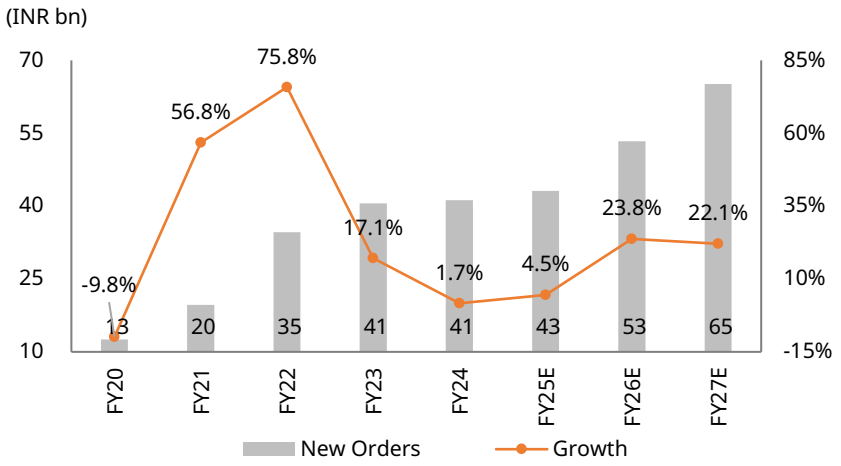
Mr. Mihir Mehta is BU Head & Vice President at PRAJ HiPurity Systems Ltd. and heads global business unit and operations of HiPurity systems. He is a qualified mechanical engineering graduate from Mumbai University has earned repute for himself in the Indian Pharmaceutical Industry. He has to his credit more than 550 water plants and more than 200 critical process plants installed in India and abroad. He is a Fulbright scholar from Carnegie Mellon University, USA.

Financial Outlook

New Orderbook Buildup Momentum to continue

We expect orderbook to grow at 11% CAGR over FY24-27E. We expect the SAF related 1G Ethanol demand and domestic CBG market to present the near-term kickers, followed by ETCA segment scaling up gradually over coming two years, the Engineering order book would also continue to grow in mid-teens on account of ZLD / ETP business and traditional CPS/CPES business.

Exhibit 41. New Orders (INR bn)

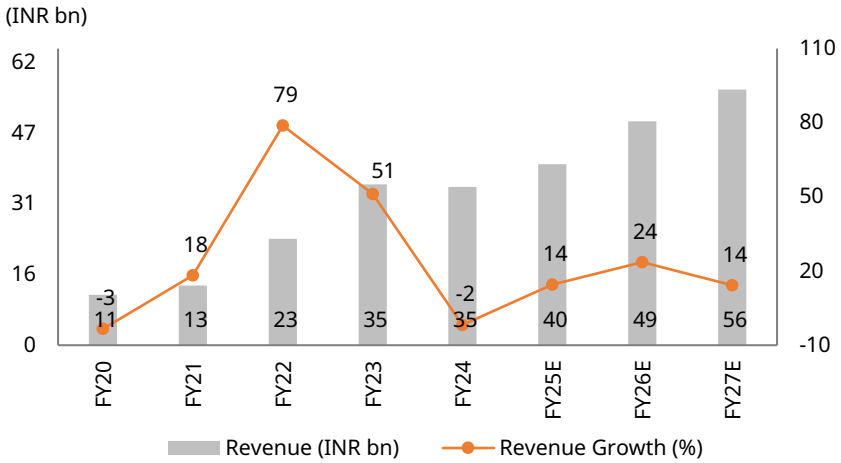


Source: Company data, MACM Research

Which shall drive Revenue to grow at ~17% CAGR over FY24-27E

The company's consolidated revenue clocked 24% CAGR over FY19-24 led by strong growth in its Bio-energy segment (35% CAGR) largely driven built up of Sugar based capacities from H2FY22 to FY23, which slowly started to transit into built up of Grain-based capacities. We estimate PRAJ to report 17% revenue CAGR over FY24-27E. Revenue CAGR on back CBG capacity build, rekindled demand for the 1G ethanol from maize based capacities & slow and steady ramp up of Engineering segment driven by ETCA and traditional ZLD/ETP demand. We expect revenues of Bio-energy segment to grow at 11% CAGR and Engineering to grow at 46% CAGR as the new Mangalore capacity ramps up.

Exhibit 42. Revenue trend

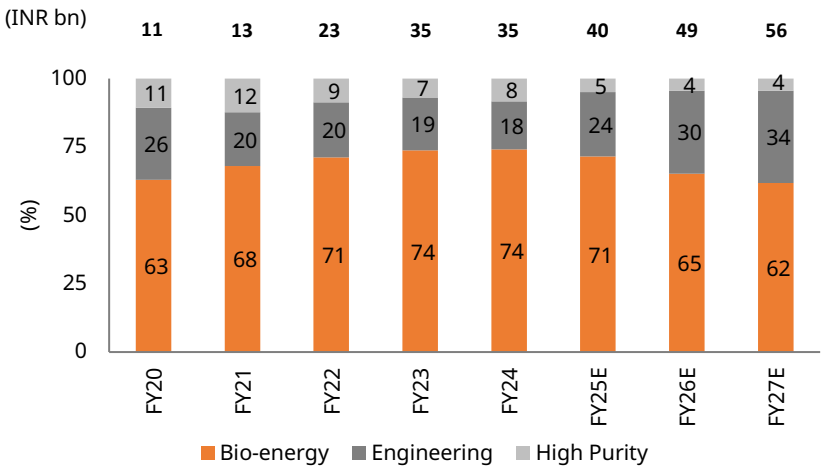


Source: Company data, MACM Research

Change in Orderbook Composition

Shift from traditionally dominated domestic Bioenergy business (largely 1G Ethanol – Sugar & Grain based) to new ETCA segment (catering to carbon capture) and ZLD/ETP business.

Exhibit 43. Segmental revenue split (%)

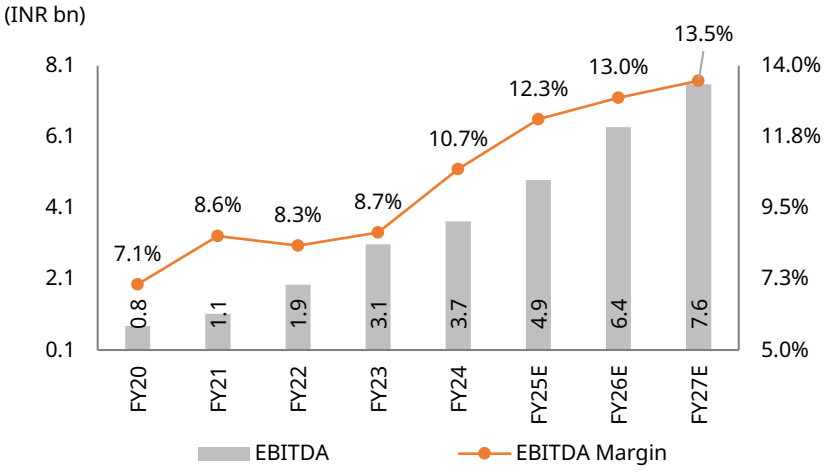


Source: Company data, MACM Research

Leading to improved margin profile, EBITDA to grow at 26% CAGR over FY24-27E

PRAJ's EBITDA growth stood at 20.8% YoY in FY24, despite a decline of 1.8% YoY in revenue. EBITDA reverted to mean with 200 bps points expansion YoY to 10.7% in FY24 as commodity prices softened, and operation expenses such as high power and logistics costs moderated. We estimate PRAJ to record 27% EBITDA CAGR over FY24-27E, aided by significant operation leverage play, improving export mix which are higher margin orders and increasing contribution of Engineering segment which are largely export orders with better margin profile. We have estimated EBITDA margin to improve by current 10.7% in FY24 to 13.5% in FY27E (v/s average of 8.4% over FY19-24).

Exhibit 44. EBITDA and EBITDA Margin

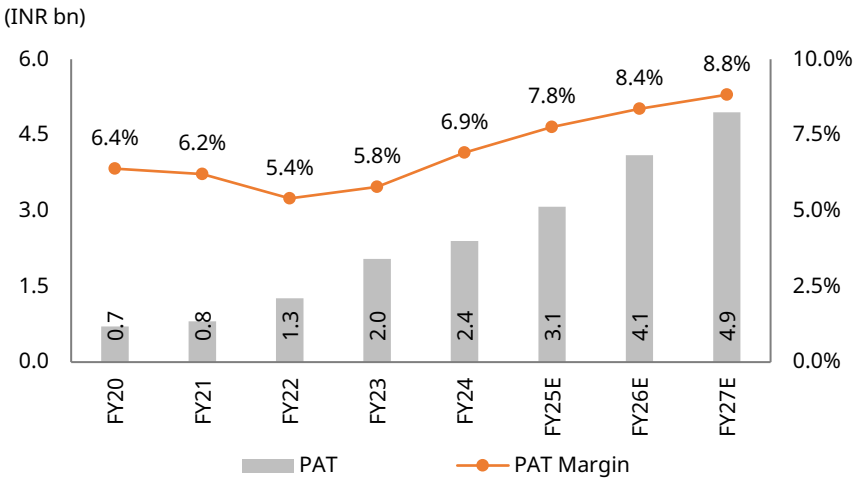


Source: Company data, MACM Research

Improving profitability

With the growing top line and improving margin profile will trickle down to 27% PAT CAGR over FY24-27E. We estimate PAT margin to improve from 6.9% in FY24 to 8.8% in FY27E (v/s average 6.1% in FY19-24).

Exhibit 45. PAT trend

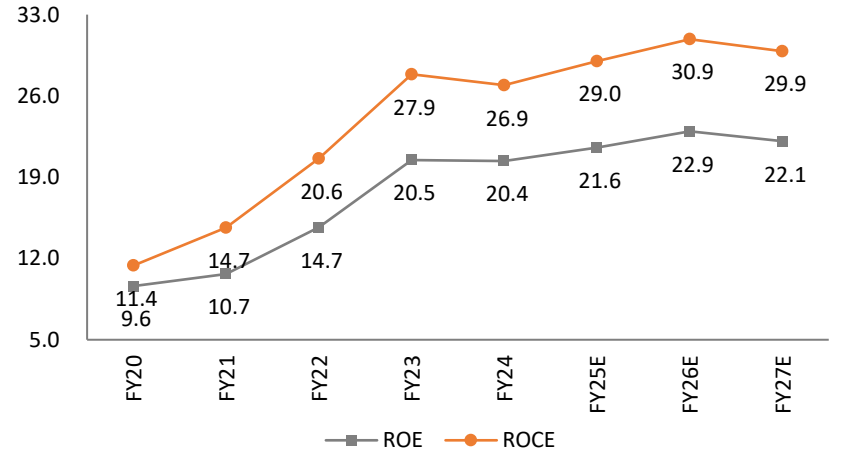


Source: Company data, MACM Research

Would lead to improving Return Ratios

We expect the ROE profile of the company to improve from 20.4% in FY24 to 22.1% in FY27 & ROCE to improve from 26.9% in FY24 to 29.9% in FY27E. This would demand the stock to trade at premium valuations in coming years as growth prospects would continue to remain strong.

Exhibit 46. RoE and RoCE trend



Source: Company data, MACM Research

Valuation

Praj Industries is part of carbon reduction engineering & bio-economy value chain which has strong structural tailwinds over the coming decade which will support the industry growth. The rising populations energy needs leading to rising emissions and depleting conventional resources will have to be managed in a sustainable way with technological innovations as the global & domestic economy grows.

Praj makes a compelling bet in this growing industry with its technological prowess in the bio-economy & carbon sustainability value chain which gives it the right to win in coming decade. This is proven by Praj's dominant market share (~66% in the Bioethanol space in India), and ability to get repeat orders in Engineering segment from large industrial private & govt players. This along with strong management, good corporate governance practices and stable technocrat promoter checks all the boxes for a good long term portfolio constituent.

Praj's unique value proposition of TEMPO (Technology, Engineering, Manufacturing, Project management, and O&M) service model makes it difficult to directly compare it with any peer, making relative valuation slightly difficult.

Exhibit 47. Peers

Particulars	CMP (INR)	MCap (INR bn)	P/E (x)			ROE (%)			ROA (%)			EV/EBITDA (x)		
			FY24	FY25E	FY26E	FY24	FY25E	FY26E	FY24	FY25E	FY26E	FY24	FY25E	FY26E
Praj Industries	**719**	**1,32,152**	**34.6**	**38.5**	**30.2**	**24%**	**24%**	**26%**	**10%**	**10%**	**10%**	**34.3**	**26.6**	**21.2**
Thermax Ltd	5,107	6,08,490	73.2	81.2	62.7	16%	16%	17%	7%	7%	9%	77.9	60.9	47.3
RITES Ltd	686	1,64,727	35.0	37.4	29.7	17%	17%	20%	8%	11%	13%	20.9	22.6	17.8
VA Tech Wabag	1,357	84,380	19.3	28.2	24.1	14%	15%	16%	6%	NA	NA	21.9	18.5	15.0

Source: Company data, MACM Research

Praj currently delivers 23% ROE & 29% ROCE, which is expected to improve further as operational leverage kicks in with growing orderbook & scale, improving margins supported by the changing orderbook composition and export mix which would lead to 200-300 bps improvement in EBITDA margins over coming 3-5 years We have factored in Praj's Revenue/EBITDA/PAT to grow at a 17%/27%/27% CAGR over the next three years FY24-FY27E. With the growth prospects continuing to remain strong as most regulatory deadlines start coming nearer, we expect company to start converting prospects into orderbook which would give revenue visibility. **We value the stock at 40xFY26E which implies a target price of INR 890 per share implying a 21% upside potential from CMP of INR 735 per share. We Initiate Coverage on Praj Industries with a BUY rating!**

Exhibit 48. 1yr Forward PE chart

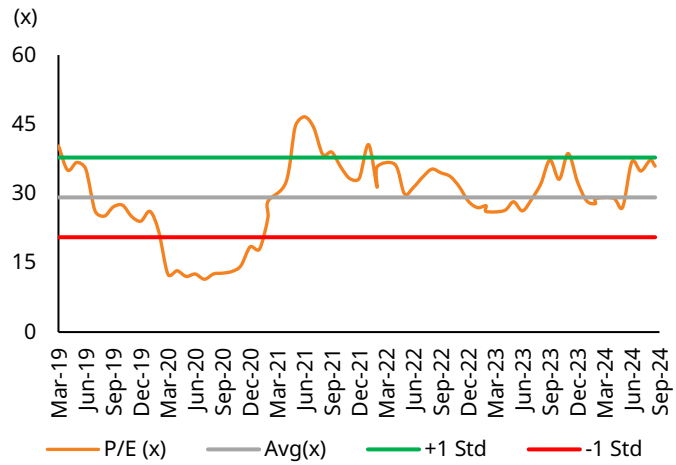
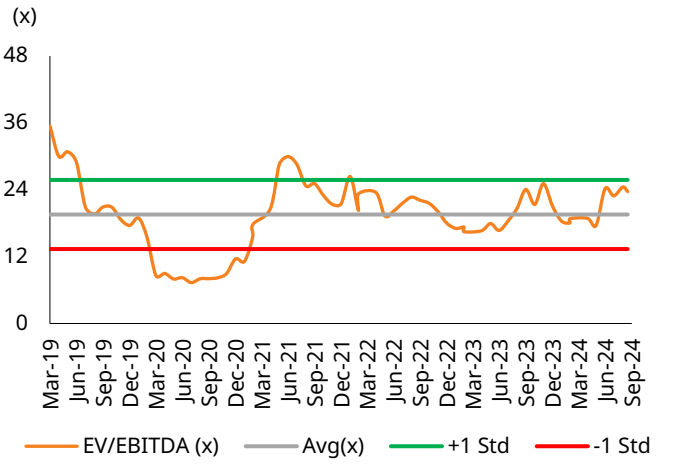


Exhibit 49. 1yr Forward EV/EBITDA chart



Source: Company data, MACM Research

Financials

Consolidated P&L Account

(INR mn)	FY23	FY24	FY25E	FY26E	FY27E
Net sales	**35,280**	**34,663**	**39,679**	**49,064**	**56,048**
Expenditure					
Total raw material cost	22,014	19,621	21,341	26,985	30,826
Employee cost	2,576	3,187	3,241	3,568	3,910
Other expenses	7,612	8,136	10,215	12,141	13,732
Total expenditure	32,202	30,944	34,797	42,694	48,468
Operating Margin	**3,078**	**3,718**	**4,882**	**6,369**	**7,579**
OP Margin (%)	**8.7%**	**10.7%**	**12.3%**	**13.0%**	**13.5%**
Other income	102	160	369	369	369
Depreciation	302	441	643	723	782
PBIT	**2,878**	**3,438**	**4,608**	**6,016**	**7,167**
Interest expenses	46	98	210	250	270
PBT	**2,831**	**3,340**	**4,398**	**5,766**	**6,897**
Tax	789	941	1037	1382	1667
Adjusted profit	**2,042**	**2,399**	**3,079**	**4,102**	**4,948**
Extra ordinary items	0	0	282	282	282
Reported PAT	**2,042**	**2,399**	**2,798**	**3,821**	**4,667**
PAT Margins	**5.4%**	**5.8%**	**6.9%**	**7.8%**	**8.4%**

Consolidated Balance sheet

(INR mn)	FY23	FY24	FY25E	FY26E	FY27E
Share Capital	367	368	368	368	368
Reserves & Surplus	10,413	12,378	15,457	19,560	24,508
Total Shareholder's Fund	**10,781**	**12,746**	**15,825**	**19,927**	**24,875**
Non-Current Liabilities					
Total borrowings	0	0	0	0	0
Other long-term liabilities	401	1,618	1,604	1,604	1,604
Current Liabilities					
Trade payables	5,050	4,968	5,087	6,432	7,348
Other current liabilities	9,955	9,624	9,624	9,624	9,624
Total liabilities	**26,187**	**28,954**	**32,140**	**37,587**	**43,451**
Fixed Assets	2,366	4,072	4,429	4,706	4,401
Current work in process	69	32	32	32	32
Intangible assets	40	448	448	448	448
Non-current investment	2,214	945	945	945	945
Other non-current assets	911	1,218	1,218	1,218	1,218
Current Assets					
Inventories	3,336	2,209	3,216	4,066	4,645
Trade receivables	5,118	7,948	8,360	9,458	11,695
Cash & Cash equivalents	1,448	2,127	2,850	4,933	8,859
Other current assets	8,336	9,087	9,544	9,544	9,544
Total assets	**26,187**	**28,954**	**32,140**	**37,587**	**43,451**

Cash Flow Statement

(INR mn)	FY23	FY24	FY25E	FY26E	FY27E
Reported PBT	**2,831**	**3,340**	**4,117**	**5,484**	**6,615**
Depreciation	302	441	643	723	782
Interest Expense	46	98	210	250	270
Tax paid	-632	-1057	-1050	-1382	-1667
Working capital Change	-1407	-5	-1986	-1742	-1328
Operating Cash Flow (a)	**1,141**	**2,816**	**1,933**	**3,333**	**4,672**
Capex	-638	-2110	-1000	-1000	-477
Free Cash Flow	**504**	**706**	**933**	**2,333**	**4,195**
Investments	-192	36	0	0	0
Others	-25	-736	0	0	0
Investing Cash Flow (b)	**-855**	**-2,809**	**-1,000**	**-1,000**	**-477**
Debt Issuance	0	0	0	0	0
Interest Expense	-46	-98	-210	-250	-270
Others	-343	770	0	0	0
Financing Cash Flow (c)	**-389**	**672**	**-210**	**-250**	**-270**
Net Cash Flow (a + b + c)	**-103**	**679**	**723**	**2,083**	**3,925**
Opening Cash	**1,551**	**1,448**	**2,127**	**2,850**	**4,933**
Closing Cash	**1,448**	**2,127**	**2,850**	**4,933**	**8,859**

Key Financial ratios

	FY23	FY24	FY25E	FY26E	FY27E
EPS INR	11.1	13.1	16.8	22.3	26.9
EBIT Margin	8.7%	10.7%	12.3%	13.0%	13.5%
Net Profit Margin	5.8%	6.9%	7.8%	8.4%	8.8%
RoCE	27.9%	26.9%	29.0%	30.9%	29.9%
RoE	20.5%	20.4%	21.6%	22.9%	22.1%
Debtor (Days)	67.6	85.9	87.0	87.0	87.0
Inventory (Days)	56.3	51.6	55.0	55.0	55.0
Creditor (Days)	77.1	93.2	87.0	87.0	87.0
Debt-Equity Ratio (x)	0.0	0.0	0.0	0.0	0.0
P/E (x)	66.8	56.9	44.4	33.3	27.6
EV/EBIDTA (x)	43.6	36.1	27.5	21.1	17.7

Source: Company data, MACM Research

Consolidated P&L Account

(USD mn)	FY23	FY24	FY25E	FY26E	FY27E
Net sales	**421**	**413**	**473**	**585**	**668**
Expenditure					
Total raw material cost	263	234	254	322	368
Employee cost	31	38	39	43	47
Other expenses	91	97	122	145	164
Total expenditure	384	369	415	509	578
Operating Margin	**37**	**44**	**58**	**76**	**90**
OP Margin (%)	**8.7%**	**10.7%**	**12.3%**	**13.0%**	**13.5%**
Other income	1	2	4	4	4
Depreciation	4	5	8	9	9
PBIT	**34**	**41**	**55**	**72**	**85**
Interest expenses	1	1	3	3	3
PBT	**34**	**40**	**52**	**69**	**82**
Tax	9	11	12	16	20
Adjusted profit	**24**	**29**	**37**	**49**	**59**
Extra ordinary items	0	0	3	3	3
Reported PAT	**24**	**29**	**33**	**46**	**56**
PAT Margins	**5.4%**	**5.8%**	**6.9%**	**7.8%**	**8.4%**

Consolidated Balance sheet

(USD mn)	FY23	FY24	FY25E	FY26E	FY27E
Share Capital	4	4	4	4	4
Reserves & Surplus	124	148	184	233	292
Total Shareholder's Fund	**129**	**152**	**189**	**238**	**297**
Non-Current Liabilities					
Total borrowings	0	0	0	0	0
Other long-term liabilities	5	19	19	19	19
Current Liabilities					
Trade payables	60	59	61	77	88
Other current liabilities	119	115	115	115	115
Total liabilities	**312**	**345**	**383**	**448**	**518**
Fixed Assets	28	49	53	56	52
Current work in process	1	0	0	0	0
Intangible assets	0	5	5	5	5
Non-current investment	26	11	11	11	11
Other non-current assets	11	15	15	15	15
Current Assets					
Inventories	40	26	38	48	55
Trade receivables	61	95	100	113	139
Cash & Cash equivalents	17	25	34	59	106
Other current assets	99	108	114	114	114
Total assets	**312**	**345**	**383**	**448**	**518**

Cash Flow Statement

(USD mn)	FY23	FY24	FY25E	FY26E	FY27E
Reported PBT	**34**	**40**	**49**	**65**	**79**
Depreciation	4	5	8	9	9
Interest Expense	1	1	3	3	3
Tax paid	-8	-13	-13	-16	-20
Working capital Change	-17	0	-24	-21	-16
Operating Cash Flow (a)	**14**	**34**	**23**	**40**	**56**
Capex	-8	-25	-12	-12	-6
Free Cash Flow	**6**	**8**	**11**	**28**	**50**
Investments	-2	0	0	0	0
Others	0	-9	0	0	0
Investing Cash Flow (b)	**-10**	**-34**	**-12**	**-12**	**-6**
Debt Issuance	0	0	0	0	0
Interest Expense	-1	-1	-3	-3	-3
Others	-4	9	0	0	0
Financing Cash Flow (c)	**-5**	**8**	**-3**	**-3**	**-3**
Net Cash Flow (a + b + c)	**-1**	**8**	**9**	**25**	**47**
Opening Cash	**18**	**17**	**25**	**34**	**59**
Closing Cash	**17**	**25**	**34**	**59**	**106**

Source: Company data, MACM Research, 1 USD = INR 83.86

Appendix 1

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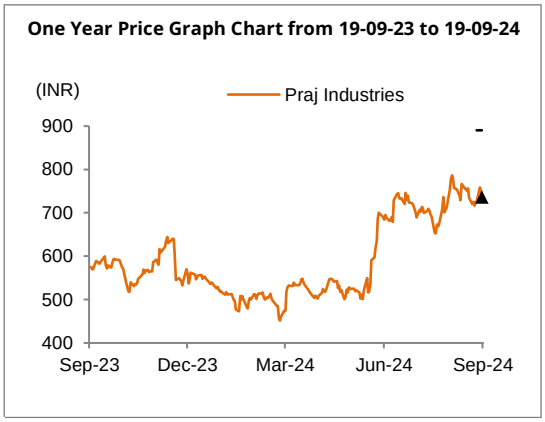
Two-year rating and TP history

Company	Date	Rating	TP (INR)
Praj Industries – Initiating Coverage	19/09/24	Buy	890



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Add	10% to <20%
Hold	5% to <10%
Sell	Below 5%

Industry ratings	
Overweight	Expected to outperform the market over 12 months
Neutral	Expected to perform in line with the market over 12 months
Underweight	Expected to underperform the market over 12 months

Rating and TP history: Share price (–), TP (▬), Not Rated (■), Buy (▲), Add (■), Hold (●), Sell (◆)
* The target price was determined by the research analyst through valuation methods discussed in this report, in part based on the analyst's estimate of future earnings.
* The achievement of the target price may be impeded by risks related to the subject securities and companies, as well as general market and economic conditions

	Buy	Add	Hold	Sell
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