

# Detail Report: Ark Bio Energies, Ballari 2G Ethanol Plant

## 1.0 Executive Summary

Ark Bio Energies Pvt. Ltd. presents a compelling investment opportunity to pioneer sustainable, second-generation (2G) ethanol production in Ballari, Karnataka. The project is a solo-founder led startup focused on converting agricultural waste, specifically rice straw and husk, into high-purity ethanol that directly supports India's successful and accelerating Ethanol Blended Petrol (EBP) Programme.

The project seeks to establish a 10 KLPD (kilo liters per day) plant that will produce 3.3 million liters of ethanol annually, addressing the national demand-supply gap and contributing to India's energy security. The investment is strategically de-risked by a favorable policy environment, government-mandated off-take agreements with Oil Marketing Companies (OMCs), and a robust, commercial-scale technology stack.

### Key Highlights

- **Project Capacity:** 10 KLPD, scalable to 20 KLPD in a planned Phase 2 expansion.
- **Location:** Ballari, Karnataka, leveraging a vast local surplus of rice straw and husk (80% surplus).<sup>1</sup>
- **Technology:** Proven enzymatic hydrolysis and fermentation process, licensed from Praj Industries, with enzymes supplied by global leader Novozymes.<sup>1</sup>
- **Investment Ask:** ₹20 Crore in equity for a 40% stake, based on a ₹100 Crore pre-money valuation.<sup>1</sup>
- **Financial Projections:** Projected Internal Rate of Return (IRR) of 23-25% and a payback period of 3.5-4 years.<sup>1</sup>
- **ESG Impact:** The plant is projected to reduce carbon emissions by 30,000 tons annually, mitigate local air pollution by preventing stubble burning, empower 5,000 farmers, and create 100 direct jobs in a rural economy.<sup>1</sup>

This project aligns with India's National Biofuel Policy, which has resulted in significant savings of foreign exchange by reducing crude oil imports.<sup>2</sup> The combination of guaranteed demand,

proven technology, and a secured feedstock supply positions Ark Bio Energies for sustainable, scalable, and profitable growth.

## **1.1 The De-Risked Investment Opportunity**

This investment offers a unique combination of high growth potential and mitigated risk, a rare confluence in the renewable energy sector. The foundational pillar of this de-risked profile is the Indian government's demonstrated, unwavering commitment to its Ethanol Blending Programme (EBP). While many biofuel programs globally rely on soft targets, India's EBP has proven to be a hard mandate with a clear, accelerating trajectory. The nation has successfully achieved its ambitious 20% ethanol blending target in 2025, five years ahead of the original 2030 schedule.<sup>2</sup> This milestone, which saw the average blending rate for the Ethanol Supply Year (ESY) 2024-25 reach 19.1% and monthly rates nearing 20%<sup>4</sup>, fundamentally changes the market from one of speculative policy to one of proven, government-backed demand. The government's actions have effectively transformed regulatory risk into a robust policy tailwind.

Beyond policy, the project is further de-risked on both the technical and operational fronts. The chosen technology, licensed from Praj Industries, is not a pilot-scale experiment but a commercially validated process. Praj's technology is the foundation of the 100 KLPD plant operated by Indian Oil Corporation (IOCL) in Panipat, Haryana, a major national project.<sup>1</sup> This real-world validation eliminates the primary technical risk associated with advanced biofuel projects.

On the operational side, the project addresses the critical challenge of feedstock supply, a known bottleneck for 2G facilities.<sup>7</sup> By strategically locating the plant in Ballari, a region with a substantial agricultural surplus, and securing a supply chain through long-term Memoranda of Understanding (MoUs) with local farmer cooperatives, Ark Bio Energies has proactively mitigated this supply risk. The offer of a premium on straw buy-back provides a strong economic incentive for farmers, ensuring a consistent and reliable supply of raw material.<sup>1</sup> This proactive approach to on-the-ground challenges sets the project apart and solidifies its viability.

## **2.0 The Indian Biofuel Imperative**

India's biofuel sector is a cornerstone of its national energy strategy, driven by a dual objective of enhancing energy security and achieving climate goals. As the world's

third-largest energy consumer, India's economic growth has historically been tied to a heavy reliance on imported crude oil, which accounts for over 53% of the country's total energy consumption.<sup>9</sup> The Ethanol Blended Petrol (EBP) Programme is a strategic and cost-effective lever to reduce this dependency and its associated foreign exchange outlays.

The program has already demonstrated its effectiveness. Between 2014 and June 2025, ethanol blending in petrol surged from 1.5% to 20%, saving approximately ₹1.36 lakh crore in foreign exchange and cutting carbon dioxide emissions by 698 lakh tonnes.<sup>2</sup> The government has also advanced its target of 20% blending from 2030 to 2025, a clear signal of its commitment and the program's success.<sup>3</sup> The strategic pivot towards biofuels from non-food agricultural waste, such as rice straw, directly addresses the food-versus-fuel debate that has historically constrained first-generation (1G) ethanol production.<sup>1</sup>

## 2.1 National Biofuel Policy & Mandates (Up-to-Date)

The policy landscape supporting the 2G ethanol sector is exceptionally robust and has been continuously refined to de-risk investments. The National Policy on Biofuels (2022) has been the key driver, introducing and bolstering several critical mechanisms. As of September 2025, the EBP Programme has successfully achieved its 20% blending target, a significant accomplishment years ahead of schedule.<sup>2</sup> Recent data from the Petroleum Planning & Analysis Cell (PPAC) indicates that the average blending rate for the ESY 2024-25 was 19.1%, with a peak of 19.8% in August 2025 and 19.93% in July 2025, confirming the program's rapid acceleration and widespread implementation.<sup>4</sup> The government is now considering new blending targets beyond 20%.<sup>10</sup>

A crucial de-risking element is the government's administered price mechanism and the use of Long-Term Off-take Agreements (LTOAs). These legally binding agreements, signed with OMCs, provide a guaranteed market and a fixed price of ₹65 per liter for 2G ethanol, ensuring revenue stability for producers.<sup>1</sup> To date, 131 LTOAs have been signed, securing a total off-take assurance of 4.3 billion liters per annum, which validates the government's long-term procurement strategy.<sup>3</sup>

In addition to market security, a comprehensive suite of financial incentives is in place. These include:

- **Pradhan Mantri JI-VAN Yojana:** This scheme provides financial assistance for advanced biofuel projects. Ark Bio Energies' project is eligible for a viability gap funding grant of up to ₹10 Crore.<sup>1</sup> The ongoing nature of this scheme is underscored by the recent extension of its RFS-V submission deadline to August 6, 2025.<sup>12</sup>
- **Interest Subvention Schemes:** These programs provide a 6% interest subvention on

loans for setting up ethanol plants, effectively reducing the cost of capital.<sup>1</sup>

- **Tax Benefits:** The GST rate on ethanol for the EBP program has been lowered to 5%, and carbon credits are available under the Clean Development Mechanism (CDM), further enhancing project economics.<sup>1</sup>

## 2.2 Market Dynamics & The 2G Ethanol Landscape

The Indian ethanol market is in a phase of hyper-growth, with a significant demand-supply gap that provides a clear entry opportunity for new producers. The total ethanol market is estimated to be valued at ₹27,224 Crore in 2025, with projections showing it will reach ₹77,273 Crore by 2032, a compound annual growth rate (CAGR) of 16.1%.<sup>1</sup> This growth is fueled by a demand for over 10.16 billion liters of ethanol in 2025 against an available supply of only 8 billion liters, leaving a gap of over 2 billion liters.<sup>1</sup>

The 2G ethanol segment, in particular, is poised for rapid expansion. It is a ₹4,399 Crore market in 2025, exhibiting a higher CAGR of 20.1%.<sup>1</sup> This sub-sector is graduating from a demonstration phase to a commercialization phase, as evidenced by a growing number of large-scale projects. The operational landscape includes:

- **Indian Oil Corporation (IOCL):** The company's 100 KLPD plant in Panipat, Haryana, is a flagship project that uses rice straw as a feedstock and validates the commercial viability of this technology at scale.<sup>1</sup>
- **Numaligarh Refinery Limited (NRL):** India's first bamboo-based 2G ethanol plant was recently inaugurated by the Prime Minister in Assam in September 2025. This ₹5,000 Crore facility underscores the government and corporate commitment to diversifying 2G feedstock and scaling advanced biofuel production.<sup>17</sup>

This broader context is highly favorable for a project like Ark Bio Energies. The entry of major players like IOCL and NRL into commercial 2G production confirms that the technology is mature and the market is real, providing a significant confidence boost for private investors. Ark's 10 KLPD capacity is perfectly sized to capture a portion of the market's demand-supply gap while benefiting from the technological and policy validation established by these larger projects.

## 3.0 Project Overview: Ark Bio Energies, Ballari

The Ark Bio Energies plant is a meticulously planned project designed to be efficient, sustainable, and scalable. The initial phase will establish a 10 KLPD plant, producing 3.3 million liters of high-purity ethanol annually by operating for 330 days per year.<sup>1</sup> The project has a clear roadmap for future growth, with plans to double capacity to 20 KLPD in a Phase 2 expansion by 2030, which will require an additional investment of ₹30 Crore. This planned scalability demonstrates a long-term vision and offers a capital-efficient pathway for investors to participate in future growth by leveraging the initial infrastructure.<sup>1</sup>

### **3.1 Location Rationale & Feedstock Security**

The selection of Ballari, Karnataka, as the project site is a critical strategic advantage that addresses the single largest operational challenge for 2G ethanol production: consistent feedstock supply. Known as the "Rice Bowl" of Karnataka, the district produces 2.36 lakh hectares of paddy annually, with a corresponding generation of 4.72 lakh tons of rice straw.<sup>1</sup> A significant portion of this biomass, estimated to be an 80% surplus post-farm use, is available for conversion.<sup>1</sup> The Ark plant's annual requirement of 50,000 tons represents only a small fraction of this local surplus, ensuring a robust and reliable supply chain within a 50-kilometer radius.<sup>1</sup>

The project's approach to feedstock acquisition directly mitigates the common industry risk of an unreliable supply chain. Research indicates that a lack of assured economic returns for farmers and infrastructure gaps in collection are major hurdles for biomass utilization.<sup>8</sup> Ark Bio Energies' strategy directly counters these issues by establishing partnerships with 10 local farmer cooperatives and executing MoUs for long-term supply.<sup>1</sup> This model, which includes a buy-back at a premium of ₹1,000 per ton, provides a powerful and consistent economic incentive for farmers, which is often a missing link in other biomass projects. This proactive, community-based strategy not only secures the raw material but also fosters a mutually beneficial relationship, addressing the social component of the business model.

### **3.2 Technology & Process Innovation**

The technological backbone of the Ark Bio Energies plant is a commercial-scale, enzymatic hydrolysis process licensed from Praj Industries, with key enzyme blends sourced from Novozymes.<sup>1</sup> This partnership brings together a leading engineering and technology provider with a global leader in enzyme solutions.<sup>16</sup> Praj's technology is a cornerstone of India's 2G ethanol push, having been successfully deployed at the commercial-scale IOCL plant in

Panipat, providing a tangible example of its effectiveness and reliability.<sup>6</sup>

The process flow is designed to optimize the conversion of rice straw, a particularly challenging feedstock. Key technical challenges with rice straw include its fibrous nature, high gelatinization temperature, and low protein content, all of which can hinder fermentation efficiency.<sup>21</sup> The chosen technology stack is specifically engineered to overcome these issues. The process involves an advanced pre-treatment step (steam explosion) to break down the complex lignin barrier, followed by enzymatic hydrolysis using Novozymes' Cellic® blends, which are designed for robust and efficient conversion of cellulose to simple sugars.<sup>1</sup> This methodical approach ensures a high yield of 300 liters of ethanol per ton of rice straw, significantly higher than earlier pilot-scale projects.<sup>1</sup> The project's claim of proprietary pre-treatment tweaks for rice straw further highlights its focus on optimizing the process for this specific feedstock, a mark of technical sophistication.<sup>1</sup>

### 3.3 Products & Revenue Streams

The project's revenue model is designed for resilience by leveraging a multi-product approach. While ethanol sales constitute the primary revenue stream, the value of co-products significantly enhances the project's overall economics and financial stability.

- **Ethanol:** This is the core product, with 100% of the plant's output guaranteed for off-take by OMCs at a fixed price of ₹65 per liter through a 5-year LTOA.<sup>1</sup> Ethanol is projected to account for approximately 70% of total revenue.<sup>1</sup>
- **By-products:** The production process generates valuable co-products that contribute to both revenue and operational efficiency. Lignin, a key residue of the enzymatic process, will be utilized as boiler fuel, enabling the plant to achieve 20% energy self-sufficiency and thereby lowering its operational expenditure.<sup>1</sup> Additionally, the process yields high-purity (99%) carbon dioxide (CO<sub>2</sub>), which can be sold to industrial users, providing a secondary revenue stream that is projected to contribute 25% of total revenue.<sup>1</sup>
- **Carbon & ESG Credits:** The project's significant environmental impact in reducing CO<sub>2</sub> emissions by 30,000 tons annually allows it to generate carbon credits and other ESG-related incentives. These credits can be sold in domestic and international markets, creating a third revenue stream that further bolsters profitability.<sup>1</sup>

This diversified revenue model, a trend seen in advanced biofuel projects globally, provides a hedge against potential price volatility and feedstock cost fluctuations, strengthening the project's financial foundation.<sup>7</sup>

## 4.0 Financial Projections & Viability

The financial model for Ark Bio Energies is built on realistic projections that account for the specific dynamics of the 2G ethanol market. The total capital expenditure (CAPEX) is estimated at ₹50 Crore, which includes the cost of the plant, land, construction, and working capital.<sup>1</sup> This higher CAPEX, compared to a first-generation corn-based plant (which can be as low as ₹14.2 Crore for a 10 KLPD facility)<sup>24</sup>, is a known characteristic of advanced biofuel projects due to the need for complex pre-treatment and hydrolysis equipment.<sup>25</sup> This increased initial investment is effectively mitigated by the availability of government grants and subsidies.<sup>1</sup>

### 4.1 Capital & Operational Expenditure

The total project cost of ₹50 Crore is structured to ensure efficient allocation of funds. Post-subsidies, the net CAPEX is expected to be ₹40 Crore. The investment ask of ₹20 Crore in equity is earmarked for the project's most critical components: 60% for plant construction and equipment, 30% for feedstock and working capital, and 10% for initial operations and other expenses.<sup>1</sup> The operational expenditure (OPEX) is projected at ₹15 Crore in Year 1, with feedstock accounting for a significant portion.<sup>1</sup>

### 4.2 Revenue & Profitability Projections

Based on a phased ramp-up and a conservative pricing model, the project's profitability is projected to be robust. Revenue is expected to reach ₹20 Crore in Year 1, growing to ₹27 Crore in Year 3 and ₹50 Crore by Year 10.<sup>1</sup> The EBITDA margin is projected to stabilize at approximately 44%, a strong indicator of the project's operational efficiency.<sup>1</sup> The following table provides a detailed overview of the projected financial performance over the first decade.

Year	Revenue (₹ Cr)	OPEX (₹ Cr)	EBITDA (₹ Cr)	PAT (₹ Cr)
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1	20	12	8	2.25
3	27	15	12	5.25
5	35	19	16	8.25
10	50	26.5	23.5	13.875

### 4.3 Returns & Sensitivity Analysis

The project's financial returns are attractive, with a base case IRR of 23% and a rapid payback period of 3.5 years.<sup>1</sup> A comprehensive sensitivity analysis has been performed to demonstrate the project's resilience to external market fluctuations, a key concern for investors. The analysis shows that even under a conservative scenario, with a 15% reduction in ethanol price and a 50% increase in feedstock cost, the project maintains a viable 15% IRR and a payback period of 4.5 years.<sup>1</sup> This level of resilience underscores the project's fundamental strength and its ability to withstand market pressures.

Case	Ethanol Price	Feedstock Cost	IRR	Payback
Base	₹65/L	₹8/kg	23%	3.5 years
Conservative	₹55/L	₹12/kg	15%	4.5 years
Aggressive	₹75/L	₹6/kg	28%	2.5 years

## 5.0 Environmental, Social, and Governance (ESG) Impact

The Ark Bio Energies project is a prime example of a business model that creates both



financial value and significant, measurable ESG returns. The project's alignment with national and global sustainability goals is a core part of its investment thesis.

## 5.1 Environmental Impact

The plant’s primary environmental benefit is its contribution to climate action. By utilizing agricultural waste for biofuel production, it directly displaces fossil fuels, leading to a projected reduction of 30,000 tons of carbon dioxide (CO2) emissions annually.<sup>1</sup> This figure is highly credible, as cellulosic ethanol has the potential to cut greenhouse gas emissions by up to 86% compared to gasoline.<sup>26</sup> Furthermore, the project directly addresses the widespread issue of agricultural waste burning, which is a major source of air pollution. By creating a commercial use for rice straw, the plant provides a sustainable alternative to stubble burning, contributing to a 70% reduction in PM2.5 particulate matter.<sup>1</sup>

## 5.2 Social Impact

The project is designed to have a transformative social impact on the local community. It provides a reliable source of income for approximately 5,000 farmers by purchasing their agricultural waste, a resource that would otherwise have little to no economic value.<sup>1</sup> The guaranteed income stream through straw buy-back at a premium provides a significant financial boost to rural livelihoods. In addition to farmer empowerment, the project is a major job creator, providing 100 direct jobs with a focus on local hiring and an estimated 500 indirect jobs throughout the supply chain.<sup>1</sup>

## 5.3 Comprehensive Risk Assessment & Mitigation

A thorough assessment of potential risks and corresponding mitigation strategies has been conducted to ensure the project's long-term viability. The following matrix summarizes the key risks and the specific measures in place to address them.

Risk	Likelihood	Impact	Mitigation Strategy
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<b>Feedstock Shortage</b>	Medium	High	<b>Structured Sourcing:</b> 3-year MoUs with farmer co-ops at a premium; strategic location in a region with an 80% surplus of rice straw; feedstock diversification to include other agri-residues like cotton stalk; maintenance of a 6-month buffer stock. <sup>1</sup>
<b>Technology Underperformance</b>	Medium	Medium	<b>Proven Technology:</b> Licensed from Praj Industries, whose technology is a cornerstone of India's 2G push and is commercially operational at the IOCL Panipat plant; proprietary pre-treatment tweaks for rice straw; and a 10% CAPEX contingency fund. <sup>1</sup>
<b>Regulatory Delay</b>	Low	High	<b>Streamlined Process:</b> Utilization of a single-window clearance portal and pre-consultation for environmental and other

			approvals; alignment with central and state government policies. <sup>1</sup>
<b>Price Volatility</b>	Medium	Medium	<b>Market &amp; Product Hedging:</b> Guaranteed off-take via fixed-price contracts with OMCs; diversified revenue streams from co-products like lignin and CO <sub>2</sub> ; ability to earn and sell carbon credits. <sup>1</sup>
<b>Environmental Non-Compliance</b>	Low	High	<b>Sustainable Operations:</b> Implementation of a Zero Liquid Discharge (ZLD) system for water management; commitment to annual third-party audits and compliance with all environmental regulations. <sup>1</sup>

## 6.0 Leadership & Governance

### 6.1 Leadership & Execution Roadmap

The success of Ark Bio Energies is underpinned by the deep domain expertise of its leadership. The founder and CEO is a solo founder with over 15 years of experience in the renewable energy sector, including a distinguished tenure at Praj Industries.<sup>1</sup> This background not only provides a comprehensive understanding of the biofuel value chain but also establishes a pre-existing relationship with the project's key technology partner, a significant advantage. The leadership is supported by a well-rounded advisory board, including a representative from a venture capital firm, an OMC executive, and an agricultural expert, ensuring a balanced perspective across finance, market, and operations.<sup>1</sup>

The project has a clear and aggressive execution roadmap:

- **Q4 2025:** Finalize the Detailed Project Report (DPR), secure equity funding, and acquire land in the designated Special Economic Zone (SEZ).<sup>1</sup>
- **Q1 2026:** Obtain all necessary regulatory approvals, including environmental clearance (EC) and excise permissions.<sup>1</sup>
- **Q2-Q3 2026:** Initiate construction with a robust Engineering, Procurement, and Construction (EPC) tender process.<sup>1</sup>
- **Q1 2027:** Commence trial runs and plant commissioning.<sup>1</sup>
- **Q2 2027:** Achieve full Commercial Operation Date (COD) and ramp up to 90% utilization.<sup>1</sup>

## 6.2 Investment Opportunity & Exit Strategy

Ark Bio Energies seeks ₹20 Crore in equity for a 40% stake, with a pre-money valuation of ₹100 Crore.<sup>1</sup> The project is strategically positioned to provide investors with a clear and attractive path to liquidity. Potential exit options include:

- **Strategic Sale:** As the market matures and consolidates, a strategic sale to an Oil Marketing Company (OMC) or a larger biofuel conglomerate is a highly probable exit, given the government's push for integration within the energy sector.
- **Initial Public Offering (IPO):** As the company scales, a public listing on the BSE Green Segment could be pursued, targeting a 2030 timeframe.
- **Secondary Sale:** A sale of the stake to private equity funds specializing in renewable energy is a viable option by Year 7, offering a timely return on investment.

This investment offers a rare opportunity to enter a high-growth, de-risked market with strong government backing and a clear path to profitability.

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