Deep Innovation Dossier: EcoHarvest: Real-Time GHG Conversion

Product Vision & Value Proposition

The Vision: Net-Positive Operations. EcoHarvest is not just carbon capture; it is a closed-loop energy solution that transforms environmental liability into high-value fuel and power infrastructure. It redefines sustainability from a cost center to a revenue stream.

Unique Selling Points (USP):

- **Real-Time Modularity:** Proprietary capture units are adaptable to diverse assets—from tailpipes to manure lagoons—ensuring 24/7 mitigation.
- **Localized Energy Generation:** Captured GHGs are converted into synthetic fuels or biogas directly on-site or nearby, dramatically reducing energy transport costs and enhancing grid resilience.
- **Verified Carbon Credits:** The platform provides immutable data streams confirming emissions reduction, allowing enterprises to maximize their compliance and voluntary carbon market revenue.
- **Aspirational Inevitability:** Positioning GHG emitters as active participants in the circular energy economy, making sustainable operations the inevitable and profitable standard.

Consumer & Market Impact

Primary User Personas & Solved Pain Points:

1. The Fleet Manager (Commercial Transportation): Pain Point: Regulatory pressure for emissions reduction combined with rising fuel costs. Solution: EcoHarvest integrates seamlessly to mitigate tailpipe emissions and provides alternative synthetic fuel for vehicle use, solving both environmental compliance and cost volatility.

(Quote): 'Managing our emissions footprint while cutting operational costs felt impossible. EcoHarvest makes our logistics green and resilient.'

2. The Agri-Entrepreneur (Large Livestock Farming): Pain Point: Methane emissions liability (enteric fermentation/manure) and lack of reliable rural energy infrastructure. Solution: Capture systems convert livestock emissions into biogas for farm operations or grid injection, offsetting energy usage and generating income.

(Quote): 'This turns our biggest environmental headache—methane—into farm power. Feels like something from the future.'

3. The Municipal Utility Regulator (Non-Obvious Persona): Pain Point: Difficulty meeting localized renewable energy portfolio standards and managing urban air quality. Solution: EcoHarvest aggregation points become micro-power generation facilities across the municipality, leveraging existing pollutant streams as input for distributed clean energy.

(Quote): 'This provides a verifiable pathway to localized grid independence and improves public health simultaneously. This would save us years of infrastructure buildout.'

Feasibility Assessment

Technological Readiness Level (TRL) - NASA Scale

- **Current TRL: 4 - Component and/or breadboard validation in a laboratory environment.**
- Explanation: Core chemical capture processes (e.g., amine scrubbing, biological conversion) are established, but the modular, real-time integration of these technologies onto mobile assets (cars) and disparate stationary sources (farms) requires rigorous, system-level bench testing.
- **Next Stage (TRL 5):** Component and/or breadboard validation in a relevant environment. Focusing on robust, miniaturized capture units operating successfully under dynamic stress (vibration, temperature extremes) simulating real-world usage.

Business Readiness Level (BRL) - KTH Innovation Scale

- **Current BRL: 3 - Idea, market and potential customer needs validated.**
- Explanation: The core value proposition (GHG mitigation + energy production) has strong theoretical market demand driven by ESG mandates and rising energy costs. Initial customer segments (fleet operators, large agriculture) are identified, but specific business models (e.g., CapEx vs. Energy-as-a-Service, carbon credit monetization model) remain theoretical.
- **Next Stage (BRL 4):** Key assumptions validated and documented. Development of a detailed Minimum Viable Business Model (MVBM) with preliminary financial projections and identified scaling risks.

Prototyping & Testing Roadmap

Phase 1: Minimum Viable Product (MVP) Development (6-9 Months)

- Develop a stationary MVP unit for high-flow Methane capture (farm setting) demonstrating successful conversion to pipeline-grade biogas.
- Focus MVP software on robust data measurement, reporting, and verification (MRV) of captured emissions.
- Parallel Validation: Test Energy-as-a-Service subscription model viability with 3 large agricultural clients.

Phase 2: Targeted Field Trials & Iterative Refinements (9-15 Months)

- Deploy second-generation modular units on small commercial vehicle fleet (trucks/buses) in a controlled urban logistics environment.
- Collect performance data on capture efficiency under mobile conditions and refine component durability (TRL 5/6).
- Parallel Validation: Optimize the carbon credit monetization strategy based on verifiable MRV data.

Phase 3: Pre-Commercial Pilot Program (15-24 Months)

- Integrate refined capture hardware and software platform into a large-scale commercial partner operation (e.g., 50+ vehicles or one major farm facility).
- Validate system scalability, cost-of-goods-sold (COGS), and refine the full commercial offering prior to mass production planning (BRL 7).

Strategic Launch & Market Integration

Go-to-Market Strategy: Velocity through Partnership

- **Strategic Partnerships:** Target OEMs (Original Equipment Manufacturers) in commercial vehicle and heavy machinery sectors for integrated, factory-ready EcoHarvest installations.
- **Industry Incumbents:** Collaborate with major agricultural and logistics industry firms (e.g., global food processors, freight carriers) to secure high-volume, B2B anchor clients for immediate scale and system standardization.
- **Early Adopter Incentives:** Offer subsidized integration costs for partners committing to publicizing their net-positive operations via the EcoHarvest platform, driving brand reputation.

Distribution Channels: Primarily B2B Enterprise sales, utilizing specialized cleantech integrators and direct sales channels focusing on maximizing recurring revenue via the EaaS model.

Macrotrend Alignment: The Circular Economy and Digital Infrastructure. EcoHarvest capitalizes directly on the global mandate for decarbonization and the necessity of decentralized, reliable energy production. It fits into the future normal where waste streams (GHGs) are viewed as essential digital resources that fuel the energy grid, establishing infrastructure for true energy autonomy.

Next Step

Initiate a dedicated engineering sprint to finalize the TRL 4 bench-test protocol for the mobile capture unit, focusing specifically on heat dissipation and energy consumption trade-offs necessary for vehicle integration, culminating in preliminary schematics for TRL 5 validation.