

Modular Deep Biogas Processing Plant “Bio-REFINE Cryo”

Modern biogas upgrading methods (amines, membranes, adsorbents) turn inherently profitable biogas plants into “consumables-driven” facilities. Continuous expenditures on chemicals procurement, disposal of spent toxic media, and equipment downtime for replacement can erode up to 30% of operating margin.

Conventional systems are characterized by process instability, unpredictable OPEX, and dependency on reagent suppliers, making the business vulnerable. They also carry a constant risk of environmental contamination and performance degradation of membranes/sorbents with even minor fluctuations in feed gas composition.

Our Solution (Technological Disruption)

A transition from chemistry to thermodynamics: a fully autonomous cryogenic system.

We eliminate the “weak link” — chemical consumables. Our technology is based on controlled cryogenic separation (phase-transition physics) combined with vibrational freezing, enabling fractionation of gas mixtures within a single closed-loop system.

This represents a complete replacement of consumables with cyclic physical separation, making the plant independent from external reagent supply chains.

Key Differentiator. A fully integrated purification cycle within a single sealed cryostat.

Core Asset. The technology is protected by an international patent application (priority established).

From Purification to Deep Processing

We transform gas upgrading into feedstock refining.

The system operates as a miniature refinery, producing three commercial products:

1. **Bio-LNG (Liquefied Biomethane).** High-value fuel with premium market pricing.
2. **LCO₂ (Food-Grade CO₂).** 99.9% purity product compliant with E290 standard, in demand across the food industry.
3. **Elemental Sulfur (S⁰).** Derived from H₂S removal. What was previously waste becomes a valuable secondary raw material.



Operational Reliability and Maintainability

- CIP System (Cleaning In Place). Maintenance without shutdown or depressurization. Automatic methanol flushing removes deposits, enabling continuous operation without downtime.

- **Adaptability.** The proprietary vibrational freezing system allows real-time adaptation to any gas composition. Changes in feedstock are handled automatically by the process control system (APCS).
- **Safety.** Emergency protection system with nitrogen purging, ensuring safe shutdown even under power loss and preventing internal freezing damage.

Scalability (Market Potential)

Modular architecture. Designed as a “gantry-ready” solution (rack-mounted / elevated installation), suitable from small farms to large industrial plants.

























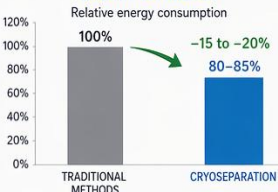
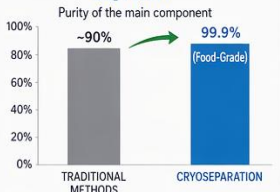







- **Low CAPEX.** Fast installation and commissioning. No need for full-scale plant construction — simply deploy and connect the module.
- **Scalable capacity.** Throughput is increased by adding standardized modules. You scale your business in parallel with feedstock growth, avoiding upfront overinvestment.

CryoSeparation vs Traditional Technologies — A New Efficiency Standard

Conventional biogas upgrading methods (amine scrubbing, membrane separation, adsorption) force a trade-off between product quality and operating costs.

Our cryogenic technology eliminates this compromise, converting upgrading into a self-sustained, high-margin production cycle.

COMPARISON OF TRADITIONAL METHODS AND CRYOGENIC PLANT CRYOSEPARATION

COMPARISON CRITERIA	TRADITIONAL METHODS (AMINES / MEMBRANES)	CRYOGENIC PLANT CRYOSEPARATION	ECONOMIC AND TECHNICAL BENEFITS
 Reagents used	 Chemical sorbents, amines, membranes (require regular replacement/regeneration)	 0 reagents. Only physical phase transitions are used	 Complete elimination of OPEX for consumables and reagents
 Waste utilization	 Formation of toxic waste from used sorbents and membranes	 Zero-Waste. All by-products (H ₂ S, H ₂ O) are processed into marketable products	 Elimination of costs for environmental waste collection and disposal
 CO ₂ purity (end product)	 Low. Requires additional expensive purification to food grade quality	 99.9% (Food-Grade). Liquid CO ₂ production meets E290 standard	 Creation of an additional revenue stream (sale of LCO ₂)
 Energy efficiency	 High energy consumption for amine regeneration or compression (for membranes)	 15–20% more efficient thanks to cold recovery and energy expansion	 Direct reduction of production costs of Bio-LNG
 Sensitivity to feedstock	 High. Risk of sorbent/membrane poisoning by hydrogen sulfide	 Low. The system adapts to any gas composition via APS	 Stable operation and protection against emergency shutdowns
 Business model	 Biogas upgrading (cost center)	 Production plant for valuable products (Bio-LNG + LCO ₂ + S ⁰)	 Maximum profitability from 1 m ³ of raw material
<div style="display: flex; justify-content: space-between;"> <div style="width: 24%;"> <p>ENERGY EFFICIENCY Relative energy consumption</p>  </div> <div style="width: 24%;"> <p>CO₂ PURITY Purity of the main component</p>  </div> <div style="width: 24%;"> <p>OPERATIONAL COSTS (OPEX) Relative operational costs</p>  </div> <div style="width: 24%;"> <p>CRYOSEPARATION PRODUCTS</p>  <p>Bio-LNG (biomethane in liquefied form) LCO₂ (E290) food grade CO₂ S⁰ (sulfur) elemental sulfur</p> </div> </div>			
<p> CRYOSEPARATION – EFFICIENT. CLEAN. PROFITABLE.  No Reagents  Zero-Waste  High Efficiency  Maximum Profit</p>			

Economic Impact

- **15–20% reduction in energy consumption.** Achieved via integrated energy recovery (expander-generator)
- **Zero-Waste.** Complete utilization of toxic by-products
- **Result.** Your margin per 1 m³ of feed gas is 20–40% higher compared to amine-based systems