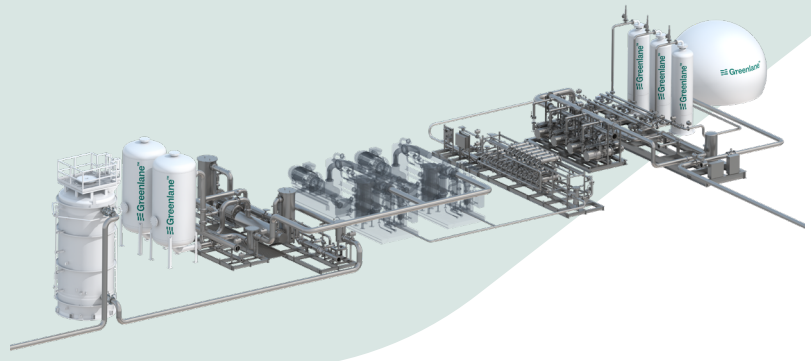


Cascade LF

Next-Generation

Landfill Gas Upgrading



Higher Performance at a Lower Cost

Every 1% improvement in methane recovery results in 1% increase in project revenue.



Designed to achieve lowest possible capital and operating cost with up to 99% methane recovery per nitrogen removal stage.



Proven, reliable and established technology elements integrated in patent-pending process.

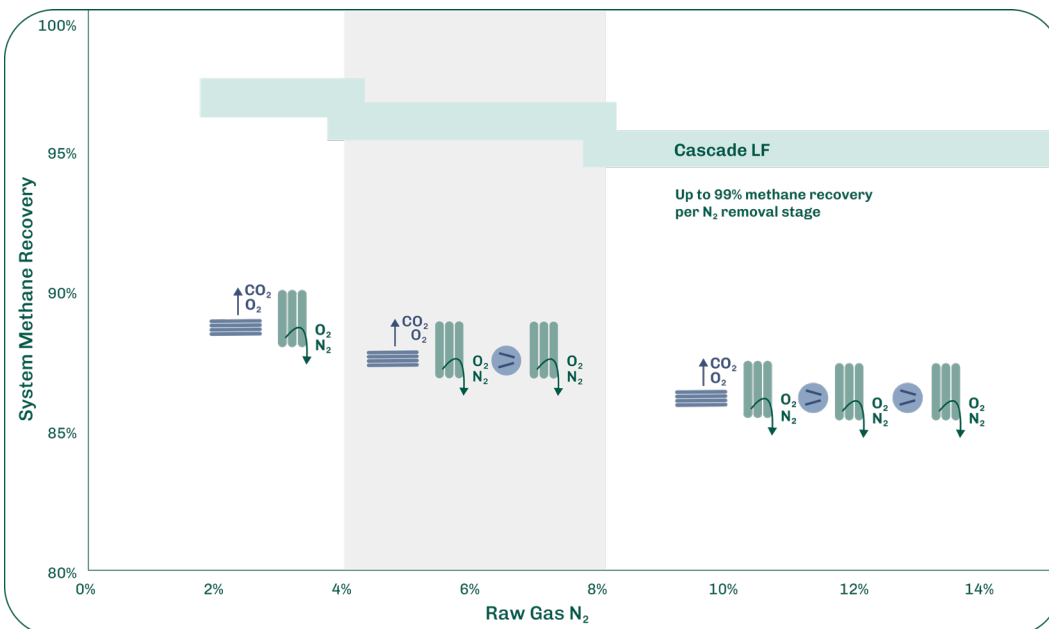


Modular system design that is configurable and adapts to rapidly changing inlet gas flow and composition.

New Technology Without Adding New Technology Risk

Greenlane's patent filings leverage decades of gas upgrading experience. Key insights include: 1) removing CO₂ from CH₄ is easier than removing N₂; and 2) equilibrium pressure swing adsorption (PSA) has the most promise for N₂ removal, but internal gas recycling, which is wasteful in terms of OPEX and methane recovery, can be eliminated. Greenlane's patent-pending process uses established technology to first remove virtually all of the CO₂, then our innovative Linear Nitrogen Rejection Unit (NRU), based on equilibrium PSA principles, reduces N₂ to the level required for product gas compliance in a simplified step-wise gas enrichment process using fewer and smaller adsorption beds. The result is lower CAPEX and OPEX and higher methane recovery. For landfill gas with high N₂ levels, Greenlane's modular design uses additional adsorption beds and compression in a staged configuration, maintaining the linear approach and high methane recovery over the range. Optimal results occur when Cascade LF is paired with landfill wellfield real-time monitoring and controls to limit N₂ and maximize CH₄ flow from the landfill.

High Performance with Cascade LF



Performance trend depends on O₂ level and product gas requirements.

Cascade LF Operating Range

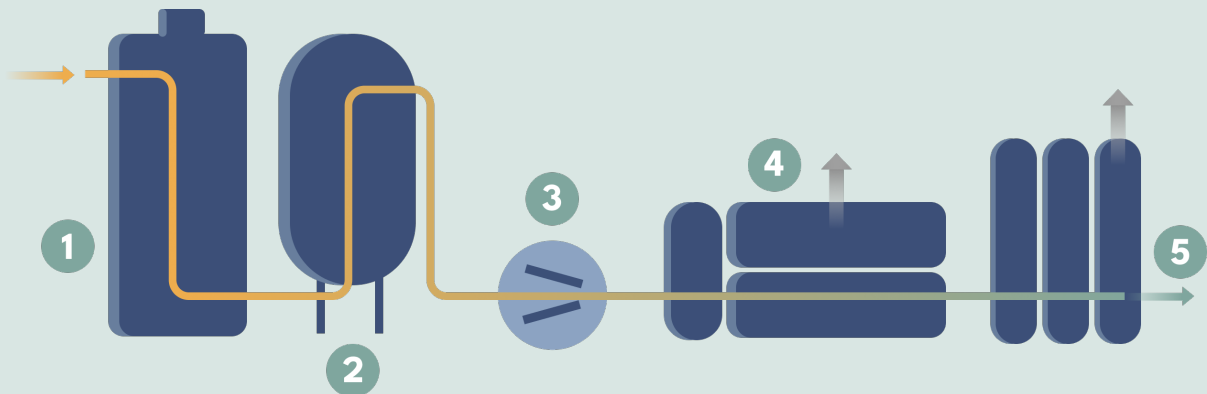
Inlet Flows (scfm)	Inlet Flows (Nm ³ /h)	Typical nitrogen levels
900 - 3,100*	1,400-5,000*	up to 15%

i Please contact us to size your system. Modular packages available.

*Higher flow rates can be accommodated with multiple trains.

How Cascade LF Works

1. Raw landfill gas passes through activated carbon pre-treatment removing Hydrogen Sulfide (H₂S).
2. Subsequent pre-treatment removes VOCs and Siloxanes using formulated activated carbon. For high levels of contaminants, a proprietary regenerative temperature swing adsorption (TSA) module is used.
3. Pre-treated gas is compressed, dewatered and temperature-controlled.
4. Upgrading process using membrane separation effectively eliminates CO₂ and most of the O₂. Elimination of CO₂, O₂ and H₂O creates the conditions for optimal subsequent N₂ removal. The separated CO₂ can be captured for other value-add purposes.
5. In the final upgrading step, O₂ and N₂ are removed to the level needed to meet the final biomethane / RNG product gas specification using Greenlane's proprietary Linear NRU technology. For landfill gas containing increasingly higher levels of N₂, additional adsorption beds plus compression are employed.



The Greenlane Advantage

Solving the industry's most challenging problems for over 35 years with more than 500 systems sold into 32 countries.

- + 24/7/365 expert technical support
- + Remote monitoring and management
- + Priority spare parts incl. warehousing/logistics
- + Proprietary software and equipment upgrades
- + Commissioning, training & performance optimization
- + Service contract options

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