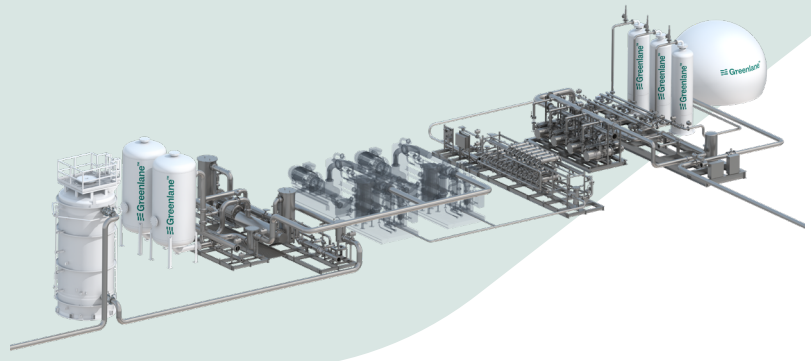


## Cascade LF

Next-Generation

Landfill Gas Upgrading



### Higher Performance at a Lower Cost

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



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.

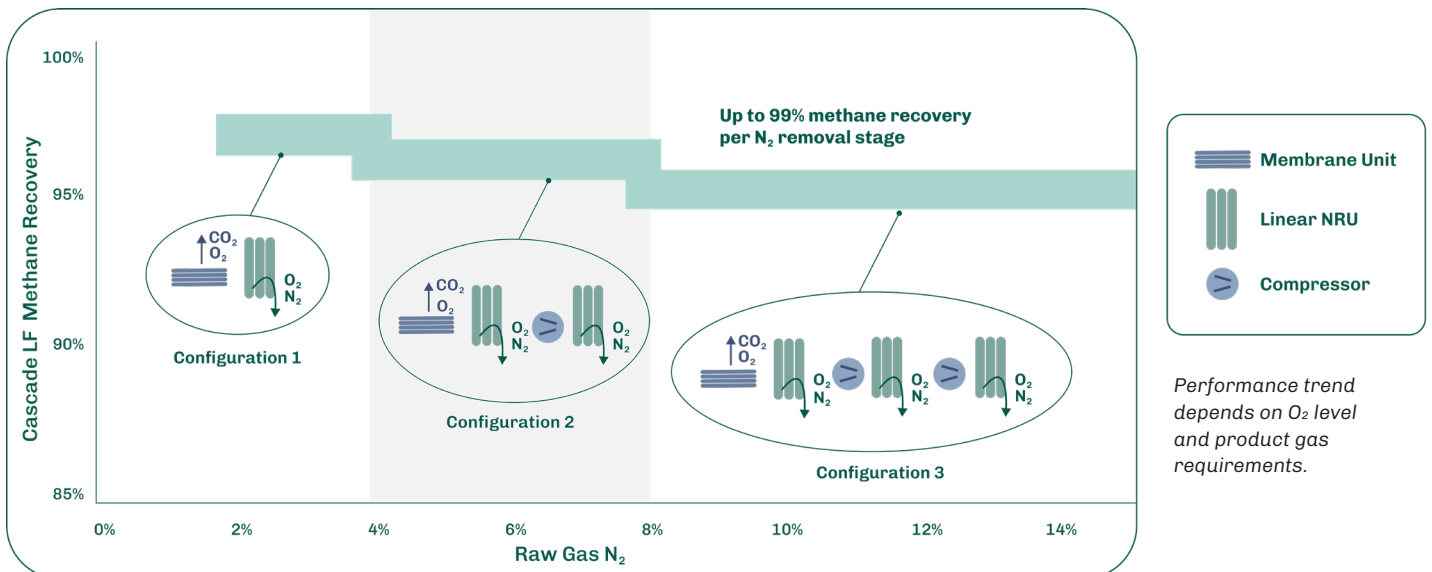


Modular system design that is configurable and adapts to rapidly changing inlet gas flow and composition.

### New Technology Without Adding New Technology Risk

Greenlane's patent filings leverage decades of gas upgrading experience. Key insights include: 1) removing CO<sub>2</sub> from CH<sub>4</sub> is easier than removing N<sub>2</sub>; and 2) equilibrium pressure swing adsorption (PSA) has the most promise for N<sub>2</sub> 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 CO<sub>2</sub>, then our innovative Linear Nitrogen Rejection Unit (NRU), based on equilibrium PSA principles, reduces N<sub>2</sub> 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 N<sub>2</sub> 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 N<sub>2</sub> and maximize CH<sub>4</sub> flow from the landfill.

### High Methane Recovery with Cascade LF



**i** Configuration is dependent on the N<sub>2</sub> level in the landfill gas. Lower N<sub>2</sub> levels enables fewer adsorption beds and less compression.

# Cascade LF Operating Range

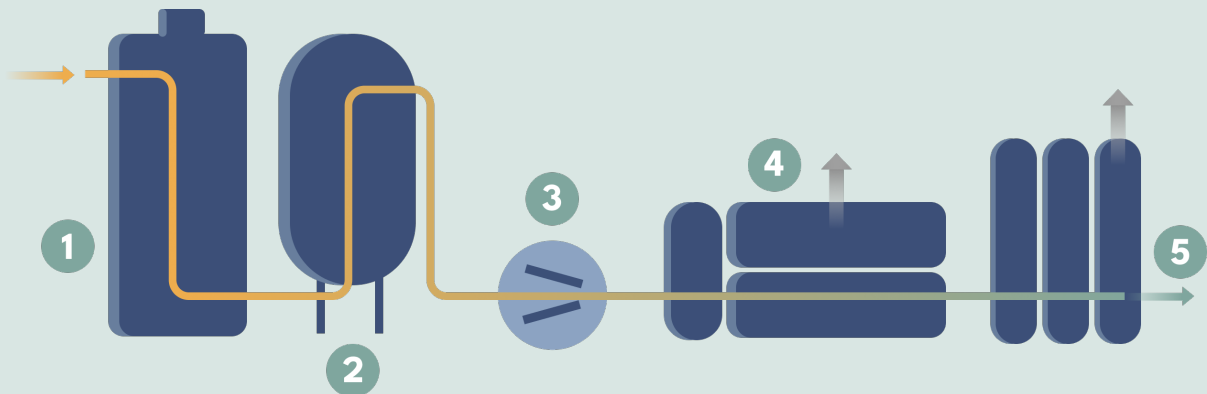
Inlet Flows (scfm)	Inlet Flows (Nm <sup>3</sup> /h)	Typical nitrogen levels
900 - 3,100*	1,400-5,000*	up to 15%

**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 (H<sub>2</sub>S).
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 CO<sub>2</sub> and most of the O<sub>2</sub>. Elimination of CO<sub>2</sub>, O<sub>2</sub> and H<sub>2</sub>O creates the conditions for optimal subsequent N<sub>2</sub> removal. The separated CO<sub>2</sub> can be captured for other value-add purposes.
5. In the final upgrading step, O<sub>2</sub> and N<sub>2</sub> 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 N<sub>2</sub>, 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

## Contact us

For North America:  
[salesna@greenlanerenewables.com](mailto:salesna@greenlanerenewables.com)

For Brazil and Latin America:  
[vendasbr@greenlanerenewables.com](mailto:vendasbr@greenlanerenewables.com)