



Biogas Upgrading Solutions for landfills

Greenlane™ **Cascade PSA LF** product solutions deliver high quality RNG from landfills with varying biogas quality, contaminants and flow rates.



Improving landfill gas management and value creation

Landfills represent a valuable source of biogas, that is produced through the decomposition of organic waste.

Landfills are the world's third-largest source of emissions from methane, a potent greenhouse gas that traps 30 times more heat in the atmosphere than carbon dioxide. While most landfill sites have gas collection systems to minimize emissions and reduce site odour, many systems are ineffective at managing nitrogen and oxygen levels. Additionally, landfill gas contains varying levels of contaminants like siloxanes, volatile organic compounds, and hydrogen sulfide.

Biogas upgrading systems utilizing pressure swing adsorption (PSA) technology cleanse the impurities in landfill gases by removing the carbon dioxide, nitrogen, oxygen, and water in a dependable and adjustable process that results in the creation of clean, high-purity, low-carbon fuel: biomethane or renewable natural gas.

Cascade PSA LF important benefits

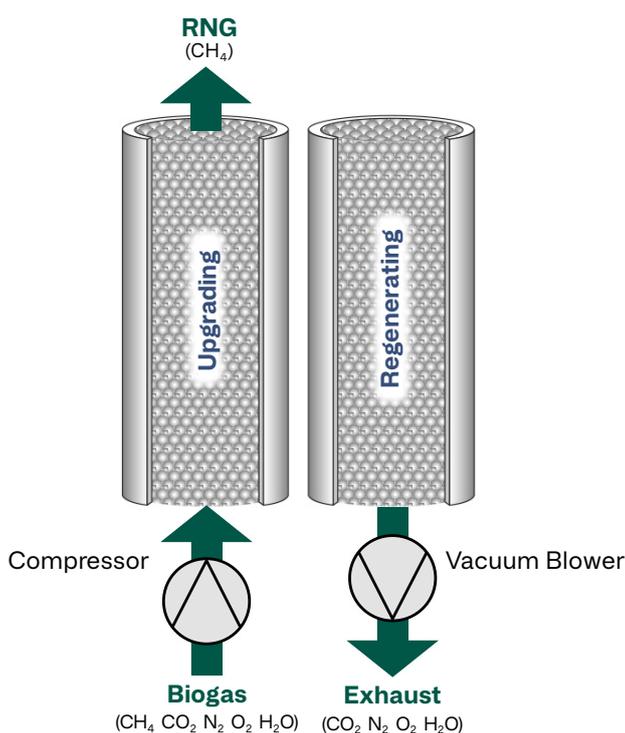
- **Reduces risk in landfill gas management:** helps landfill operators better manage variability in contaminants, methane levels, and gas quality.
- **Helps meet stringent pipeline quality requirements:** delivers end-to-end, standardized landfill-gas upgrading solutions that meet most oxygen and nitrogen requirements without the need for additional equipment.

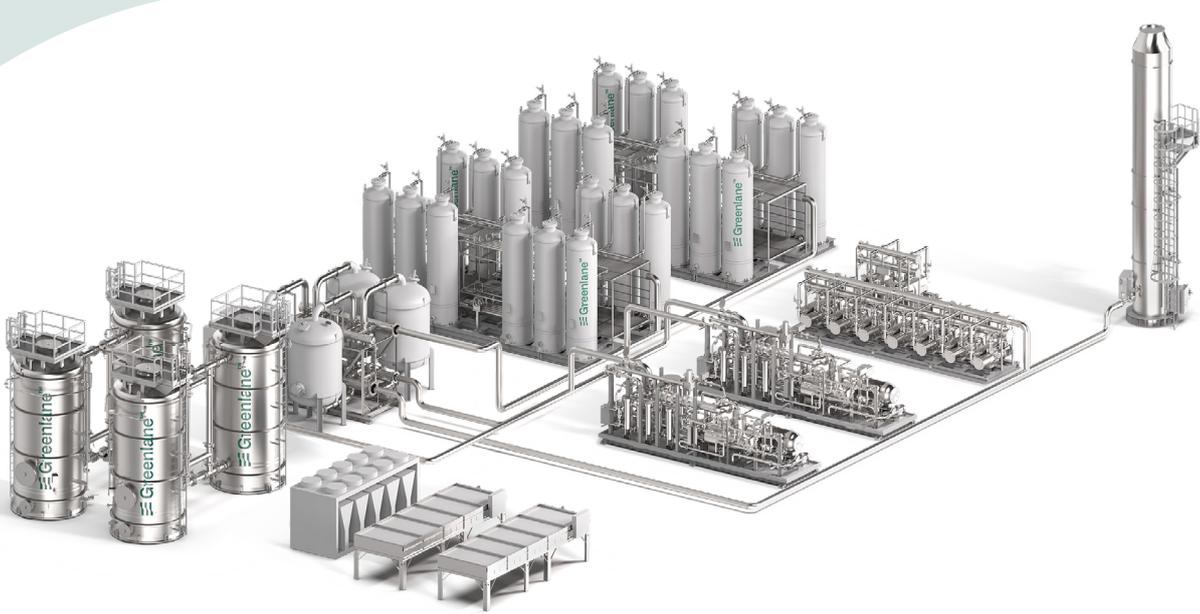
→ How Pressure Swing Adsorption Technology works

1. Landfill gas is pretreated, compressed, filtered, and conditioned for upgrading
2. gas flows through a system of two PSA stages
3. first stage cleans the gas, removing the majority of carbon dioxide, nitrogen, and oxygen
4. second stage polishes the gas, removing nitrogen, oxygen, and trace carbon dioxide to meet pipeline specifications

Each stage comprises a series of vessels which contain specialized adsorptive media. The carbon dioxide, nitrogen, oxygen, and water molecules adsorb to the surface of the media while the methane passes directly through the media. **This results in a continuous uninterrupted stream of high purity renewable natural gas (RNG).**

The PSA regenerates by applying a vacuum to release any contaminants. Methane recovered during regeneration is recycled back to the inlet, which ensures the highest possible recovery rate. Gas quality feedback controls further optimize methane recovery on a continuous and fully automated cycle.





Why PSA technology for landfill biogas upgrading?

Pressure Swing Adsorption technology is often the best fit for challenging raw gas qualities, particularly when nitrogen and oxygen are present.

Greenlane's Cascade PSA LF products:

- utilize a two-stage PSA process for the efficient removal of nitrogen, oxygen, and carbon dioxide
- can cycle quickly and responsively to changes in landfill-gas flow rates and quality
- integrate hydrogen sulfide pretreatment and volatile organic compound and siloxanes removal, to improve safety and extend equipment lifecycles



Cascade PSA LF installation

The Cascade PSA LF advantage

- + High methane recovery, depends on gas quality
- + Standardized plants, suited to medium and high-flow applications
- + Adsorptive media lifetime of 10+ years
- + Built for difficult upgrading applications
- + Few moving parts and low maintenance needs
- + High uptime
- + Guaranteed RNG purity and methane recovery
- + Cold Weather Packages available
- + 24/7/365 on-call technical support

Cascade PSA LF models

Models	Flow (Nm ³ /h)*	Flow (scfm)*
Medium	2500	1550
Large	5000	3100
X-Large	10 000	6200

*minimum flow is 40% of max flow

Typical gas processing capability for RNG

Parameter	Raw Gas Quality	Product Gas Quality	Cascade PSA LF
Methane (CH ₄)	45-55 %	Meets Pipeline Quality Requirements	High methane recovery
Carbon Dioxide (CO ₂)	35-40 %		
Nitrogen (N ₂)	<16 %		
Oxygen (O ₂)	<3 %		

¹ Methane recovery increases with lower Nitrogen and Oxygen in the raw gas.

² Product oxygen levels vary depending on inlet oxygen and methane recovery rates.

³ Typical biogas values shown. Actual values may vary.

⁴ Complete system solution also includes VOC, Siloxane and H₂S removal

Your trusted biogas upgrading partner



Greenlane Renewables is a leading global provider of integrated biogas upgrading systems, with more than 140 installations worldwide to date. We believe renewable natural gas is the most relevant renewable energy to support the decarbonization of commercial transportation and the natural gas grid.

Greenlane™ **Cascade suite of technologies** and products produce clean, low-carbon and carbon-negative RNG, creating value from organic waste at landfills and water recovery facilities, agricultural, food and organics. With water wash, pressure swing adsorption, membrane separation and proprietary desulfurization products available, Greenlane's commitment is to deliver exactly the right technology and level of service to meet our customers specific biogas upgrading needs and objectives.

Our services:

- 24/7 helpline
- Installation training, consulting, inspection
- Operator training and support
- Commissioning and performance testing
- Service and performance reporting
- Preventative and corrective maintenance
- Performance data analysis
- Options for service/maintenance contract
- Remote monitoring and management

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#1

in global
supplied capacity

140+

upgrading
systems deployed

35+

years
experience

19

countries
supplied