



## Lean Gas To Power



Green Power Generation

# Overview

- Suitable for all lean gas from landfill CH<sub>4</sub> as low as 1.5%.
- 130 kWe production (with only 50 Sm<sup>3</sup>/h of methane diluted in about 4000 Sm<sup>3</sup> of stream).
- 340 kWt production @ 240°C.
- Proprietary advanced oxidized catalyst, requiring no regeneration for 8000 hr.
- Standard 40 feet container layout.
- Off-gas can be oxidized to reduce methane slip.

## Main Features

- Turn waste into a resource while preventing GHG emissions.
- Enhance the value of low-methane concentration landfills.
- Obtain dual benefits by exploiting wastes: removing pollutants and energy generation.

## Benefits



Eliminate a greenhouse gas (after oxidation, the CH<sub>4</sub> content is < 0.2%).

Avoid any combustion by-products (NO<sub>x</sub>, SO<sub>x</sub>) due to low temperature oxidation.



Save cost and footprint vs. biofilters (several times larger than our 40-ft container footprint).

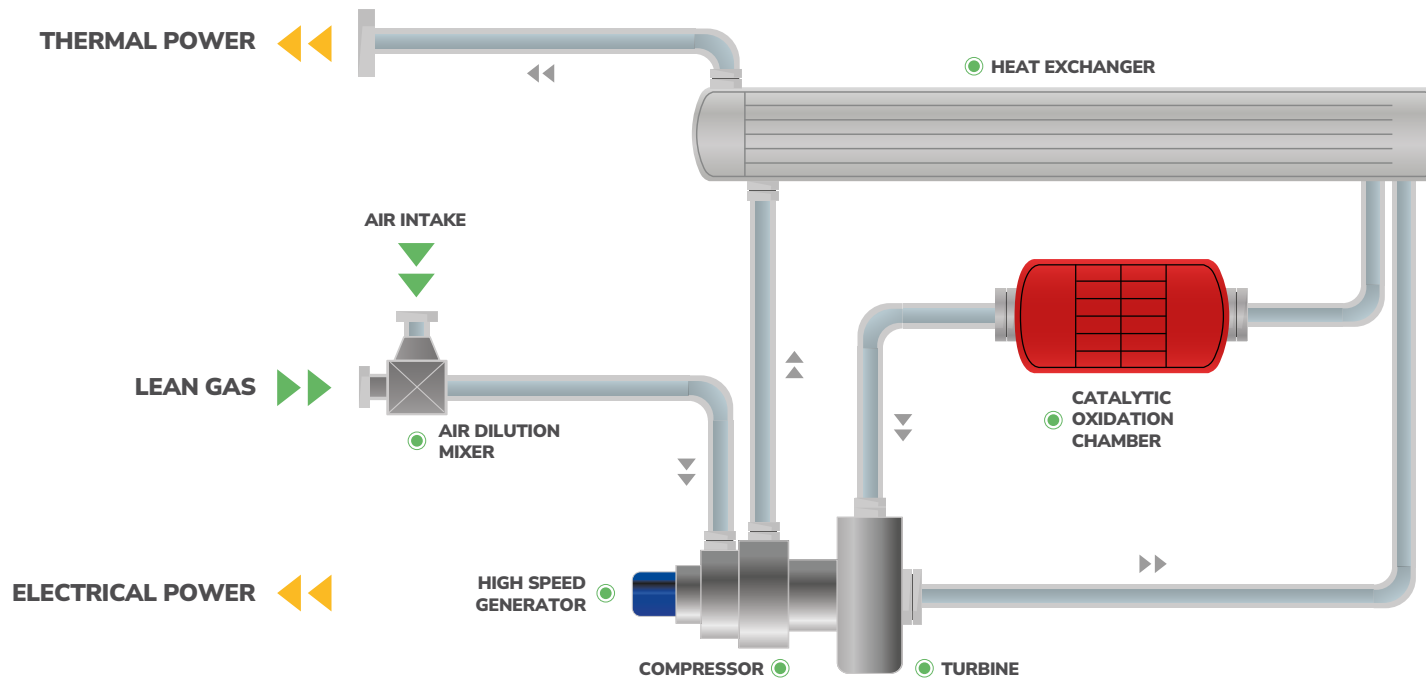
Recover from landfill all possible gas by suction.



Turn waste into a valuable resource instead of paying for its disposal.

Support the sustainability of the landfill and help the environment with an effective decarbonization.

# How It Works



# 1

Gas is collected by suction from the landfill, avoiding any leakage of greenhouse gas and exploiting all the methane available thanks to vacuum.

# 2

The compressed stream is sent into the catalytic chamber for oxidation (750/800 °C - negligible NO<sub>x</sub>/SO<sub>x</sub>).

# 3

The re-heated flow passes through a turbine directly connected with the high-speed generator to produce power.

# 4

The exhaust gas is sent to a heat exchanger to generate thermal power.

# Mass Balance

Typical composition of a lean gas ( $\text{CH}_4 < 10\%$ ). Other compositions can be treated.

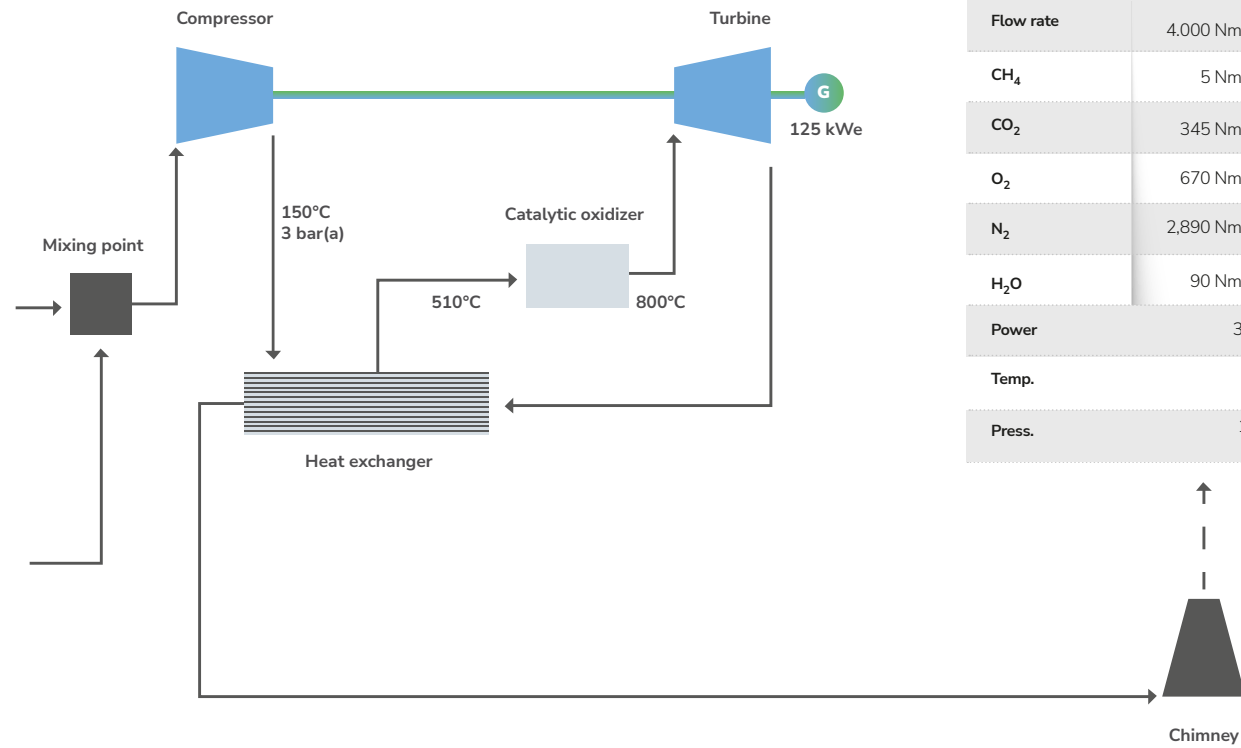
## Off-Gas / Lean Gas

Flow rate	500 Nm <sup>3</sup> /h	100,0%
CH <sub>4</sub>	50 Nm <sup>3</sup> /h *	10,0%
CO <sub>2</sub>	300 Nm <sup>3</sup> /h	60,0%
O <sub>2</sub>	25 Nm <sup>3</sup> /h	5,0%
N <sub>2</sub>	125 Nm <sup>3</sup> /h	25,0%
Temp.	20°C	
Press.	1 bar(a)	

\* Nm<sup>3</sup>/h of CH<sub>4</sub> refers to the methane content needed to obtain the maximum electric power (125 kW). Lower CH<sub>4</sub> contents can be also treated (the power production proportionally decreases)

## Dilution Air

Flow rate	3.500 Nm <sup>3</sup> /h	100,0%
O <sub>2</sub>	735 Nm <sup>3</sup> /h	21,0%
N <sub>2</sub>	2.765 Nm <sup>3</sup> /h	79,0%
Temp.	20°C	
Press.	1 bar(a)	

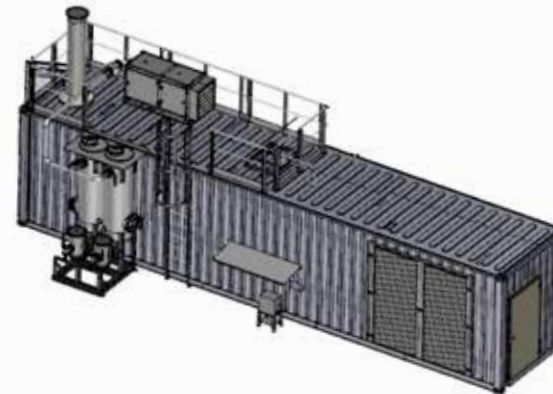
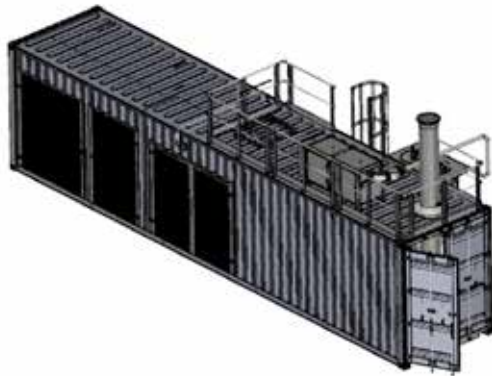


## Exhaust Gas

Flow rate	4.000 Nm <sup>3</sup> /h	100,0%
CH <sub>4</sub>	5 Nm <sup>3</sup> /h	0,12%
CO <sub>2</sub>	345 Nm <sup>3</sup> /h	8,63%
O <sub>2</sub>	670 Nm <sup>3</sup> /h	16,75%
N <sub>2</sub>	2.890 Nm <sup>3</sup> /h	72,25%
H <sub>2</sub> O	90 Nm <sup>3</sup> /h	2,25%
Power	340 kWt	
Temp.	240°C	
Press.	1 bar(a)	



# System Design



# Technology Map



## Exhaust Gas Cleaning

### Advanced DeSox

Exhaust Gas Cleaning Systems

### Catalytic Abatement

DeNO<sub>x</sub> SCR  
Diesel Oxidation Catalyst  
Methane Slip Reduction

### Filtration

Wet Electrostatic Precipitator  
Diesel Particle Filtration  
Filter Cassettes



## Carbon Capture

### Carbon Capture and Sequestration

Scrubbing with Ammine  
Scrubbing with Calcium Hydroxide  
Molten Carbonate Fuel Cells

### Liquefaction

CO<sub>2</sub> Liquefaction



## Clean Fuel

### Pre-Treatment and Upgrading

Smart Blending  
Pre-Treatment  
Biogas Upgrading

### Liquefaction

Biomethane Liquefaction  
Natural Gas Liquefaction  
Nitrogen Rejection Unit



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