Landfill Gas Generation by First-Order Decay

Methane and landfill gas generated in a year from a landfill taking constant waste for some years, by first-order decay (LandGEM form), with energy.

Method: First-order decay Q = kL₀M e^(−kt); US EPA LandGEM user's manual (2005)

Input parameters

Unit system: SI

Parameter	Value	Unit
Waste accepted per year (t)	50,000	
Years of acceptance	20.000	
Year of interest (from opening)	25.000	
Decay rate (per year)	0.050000	
Methane potential (m³/t)	100.00	
Methane fraction of landfill gas	50.000	%

Calculated results

Parameter	Value	Unit
Methane generation	280.80	m³/h
Landfill gas generation	561.60	m³/h
Methane energy (LHV 35.8 MJ/m³)	2.7924	MW

Notes for this case

• Q = kL₀M e^(−k(t − τ)) integrated over the years of acceptance (the continuous form of US EPA LandGEM). Default k = 0.05/yr and L₀ = 100 m³/t follow LandGEM's conventional values; wet tropical sites decay faster (k up to 0.2). Only 50–85 % of gas is usually collected.

Formula and method

$$Q_{CH_4}(t) = L_0 M \left[e^{-k(t-n)} - e^{-kt}\right] \ \ (t > n), \quad L_0 M (1 - e^{-kt}) \ \ (t \le n)$$

Variables

M	Waste accepted per year (t)	-
n	Years of acceptance	-
t	Year of interest (from opening)	-
k	Decay rate (per year)	-
L_0	Methane potential (m³/t)	-
f_{CH_4}	Methane fraction of landfill gas	-
Q_{CH_4}	Methane generation	m³/s
Q_{LFG}	Landfill gas generation	m³/s
P	Methane energy (LHV 35.8 MJ/m³)	W

Method and standards

First-order decay.

Assumptions and limits

- Constant acceptance; single decay rate. The continuous form differs slightly from LandGEM's 0.1-year discrete summation; M and n are used as entered (n may be fractional).
- L₀ and the methane flow are taken at the reference state of the 35.8 MJ/m³ heating value (0 °C, 1 atm); if L₀ is quoted at LandGEM's 25 °C reference, the energy here is about 9 % high.

References

- First-order decay Q = kL_oM e^(−kt)
- US EPA LandGEM user's manual (2005)

Report details

Report reference	FCC-D22G-WP6A (the same inputs always give the same reference)
Generated	17 November 2026, 19:50 UTC
Calculator	Landfill Gas Generation by First-Order Decay
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/environmental/carbon-energy/landfill-gas-first-order

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.