SFO°C
Solutions for Our Climate

Buried But Not Hidden

Addressing Methane Emissions from Korea's Regional Landfills

1 Status of Landfills in South Korea

Policy Limitations of Waste Management in Regional Landfills

Landfill Facilities in South Korea, 2023

Category	Number of Landfills	Accumulated Landfill Waste (m^3)
Public Landfills (Government managed)	210	451,335,870
Public + Private-owned Landfills	306	641,082,438

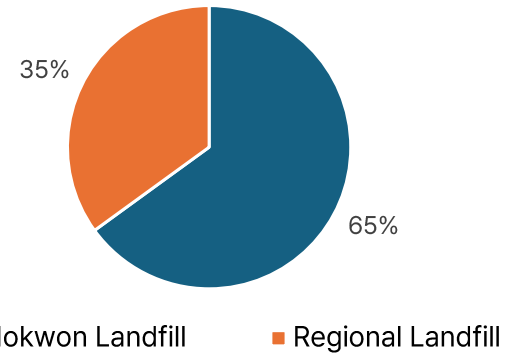
Source: Ministry of Environment(2024), Status of Waste Generation and Disposal in 2023

- **Sudokwon Landfill** (responsible for Seoul Metropolitan Region) accounts for more than half of the capacity of public landfills in South Korea.

- To reduce greenhouse gas emissions from waste, the government is pursuing policies to reduce landfilling, starting from the Sudokwon Landfill*.

* Sudokwon Landfill: Landfilling ban on Construction Waste (2025), Landfilling ban on Household Waste (2026)

Proportion Based on Accumulated Waste Volume



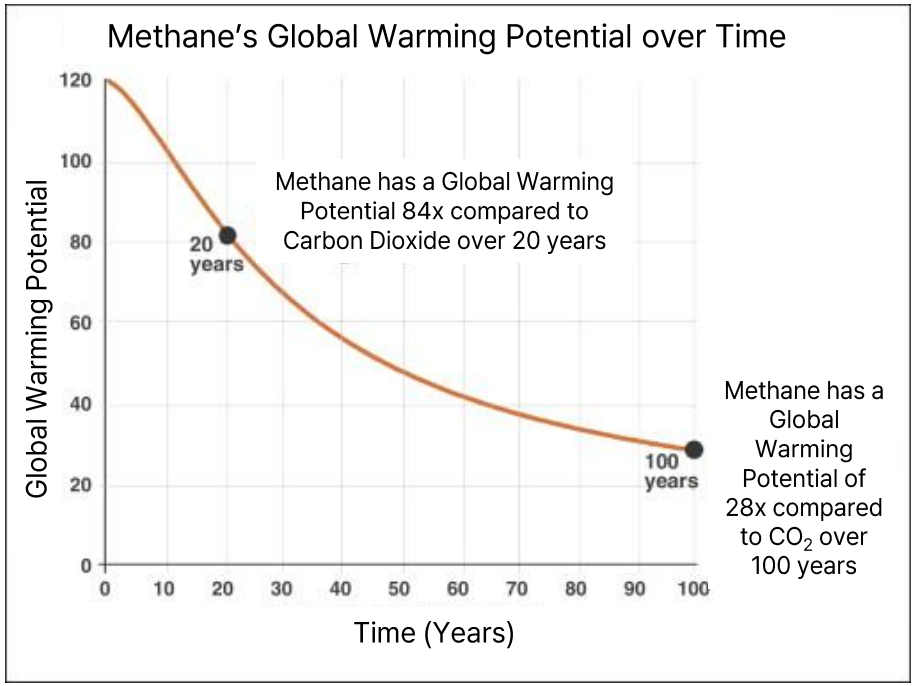
Source: Joint Ministries (2025), Measures to Advance Waste Landfill Management Via Enhancing the Stability and Efficiency of Waste Treatment

- Regional landfills (Excluding Sudokwon Landfill) managed by local governments account for 35% of landfilled waste.

- Meanwhile, the ban on household waste landfilling in regional landfills are postponed until 2030.
  - ❖ Reasons for Postponement: Difficulty securing waste incineration facilities, difficulty on waste recycling expansion.

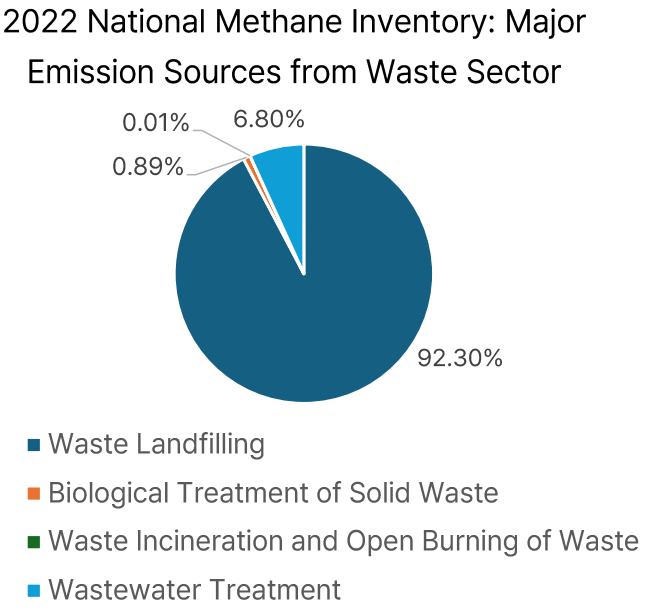
1 Status of Landfills in South Korea

Emissions from Landfills Account for the Most Waste Methane Emissions



Source: David Allen (2014), Current Opinions in Chemical Engineering

Methane has an average lifespan of about **12 years** in the atmosphere – making the actual Global Warming Potential to be about **84 times** that of Carbon Dioxide.

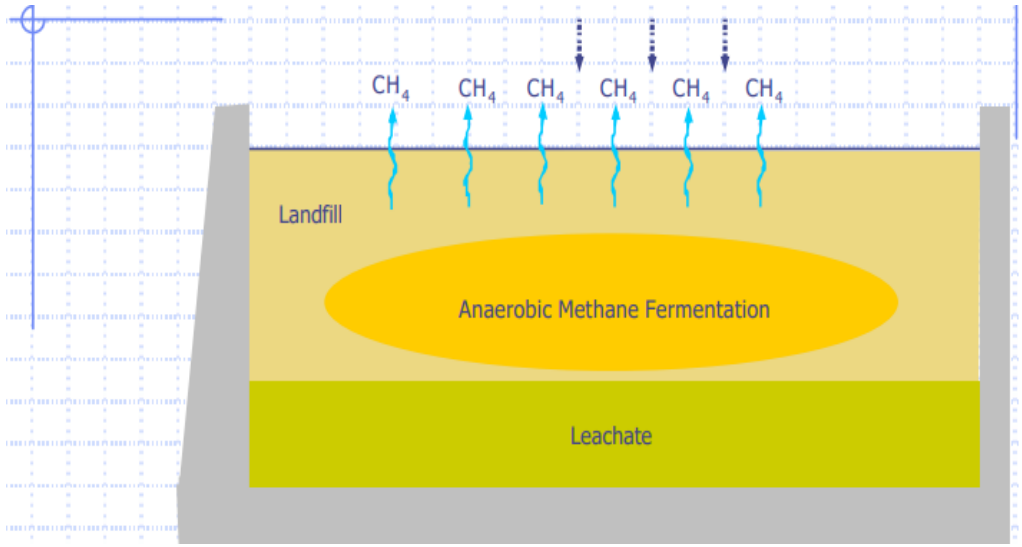


Source: Greenhouse Gas Inventory and Research Center of Korea, National Greenhouse Gas Inventory (1990-2022)

Landfill Emissions account for most (92.3%) of the waste sector methane emissions.

2 How is Methane Emitted from Landfills?

Methane Emission Processes from Anaerobic Landfills



Source: Takeo Tashiro, Solid Waste Management and Global Warming

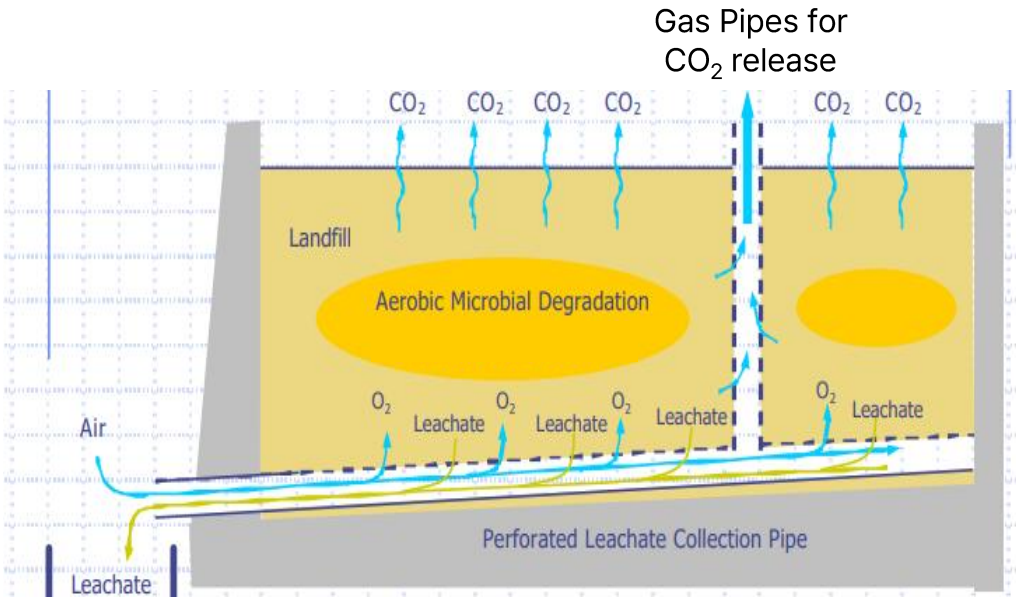
- Anaerobic Landfill: Happens when Microorganisms decompose Organic Waste (Food residue, Wood, Paper etc.) in an oxygen-free environment.

- When microorganisms decompose organic waste under anaerobic conditions, landfill gas (mainly composed of methane and carbon dioxide) is generated.

- In South Korea, direct landfilling of food waste has been banned since 2005, but methane is still released due to landfilled organic waste such as wood and paper.
  - ❖ The composition of landfilled waste comprises of 27% Organic waste and 73% Inorganic waste. (Based on 2022 National Statistics)

2 How is Methane Emitted from Landfills?

Semi-aerobic Landfill: Alternatives to Lower Greenhouse Gas Emissions



Source: Takeo Tashiro, Solid Waste Management and Global Warming

- Semi-aerobic landfill: oxygen (air) is injected into the landfill. Microorganisms aerobically decompose waste, leading to stabilization of waste and reduction of methane emissions.

- Leachate collection pipe openings are placed outside the landfill to remove leachate effectively and facilitate injection of air.

- Decomposition of waste through semi-aerobic methods contribute to Greenhouse gas emission reductions.
  - ❖ South Korean Study (2024): approximately 96% of greenhouse gas emission reductions were achieved by injecting air into the anaerobically operated landfill in Yeoju, South Korea.

- Semi-aerobic landfills were first developed in the 1970s in Fukuoka, Japan. Certain regions in the Sudokwon Landfill are operating under the semi-aerobic model.

3 Greenhouse Gas Management: Sudokwon Landfill vs. Regional Landfills

Sudokwon Landfill

Methane Leakage Prevention

Image Source: NewsPim (Article), Sudokwon Landfill Co. completes Construction of Area 3-1 ... Landfill to be operational for 7 years

- Installation of leachate collection and drainage pipes expand semi-aerobic landfill capacities and prevent methane leakage.

Methane Capture and Utilization

Image Source: Global Eco News (Article), Gas Collection Facilities Installed in Sudokwon Landfill Area 3

- Some methane gas from landfills are released to the atmosphere.
- Installed methane gas capture facilities reduces emissions from Sudokwon Landfill.

Image Source: HKBC (Article), 50MW Power Plant in Sudokwon Landfill

- Methane gas captured from Sudokwon landfill is sent to a 50MW power plant within the overall landfill site.
- Landfill gas is converted to energy, which is then used for operations within the landfill site.

3 Greenhouse Gas Management: Sudokwon Landfill vs. Regional Landfills

Some Regional Landfills Lack the Capacity to Capture or Utilize Landfill Gas

Regional Landfills – Select Cases

City	Name of Facility	Does this facility utilize landfill gas?
Daejeon	Geumgo Environment Resource Facility Center	Yes
Wonju	Wonju City Landfill Facility	Yes
Changwon	Deokdong Landfill	Yes
Yeosu	Manheung Landfill	No
Jinju	Jinju Metropolitan Landfill	No
Gunsan	Gunsan City Waste Landfill	No

Source: Ministry of Environment, Site Survey and Survey Criteria for Waste Landfills

- Only a select number of regional landfills utilize landfill gas to resource (e.g., energy).
- Landfill gas (Methane) that is not captured and used as energy sources is released to the atmosphere.
- This is a key factor for relatively high greenhouse gas emissions in regional landfills, which are anaerobically operated.

3 Greenhouse Gas Management: Sudokwon Landfill vs. Regional Landfills

Some Regional Landfills Show Gaps Between Site Design and Actual Operations

- Some regional landfills are designed to be operated semi-aerobically.
  (Source: Information Request by National Assembly Member Park Jeong Hyeon to Gyeonggi Subnational Government)

- However, these regional landfills operate anaerobically because leachate levels are too high at the landfill site. This prevents the injection of air (oxygen) in leachate pipes for semi-aerobic operations.
  (Source: Feasibility Study on Infrastructure Installations on Waste Treatment Facilities)

- Therefore, there is a presumption that greenhouse gas emissions are significantly higher because landfill facilities do not operate according to the semi-aerobic design.

3 Greenhouse Gas Management: Sudokwon Landfill vs. Regional Landfills

Emissions from Regional Landfills are Derived Using Anaerobic Operation Emission Factors

7.2.1 관리형 매립 (5.A.1.) 7.2.1 Managed Landfills (5.A.1)

7.2.1.1 배출원 개요 7.2.1.1 Emission Pollutants

2022년 기준	산정온실가스	방법론	배출계수	활동자료
	CH_4	Tier 2	CS, D	폐기물 매립처리량
2022	Greenhouse Gas: CH_4	Methodology: Tier 2	Emission Factor: CS,D	Data Used: Amount of Landfilled Waste

3) 국내 매립지는 위생매립지와 비위생매립지로 분류하고 있으며, 위생매립지는 2006 IPCC GL의 관리형 매립지, 비위생매립지는 비관리형 매립지에 해당함

3) South Korean Landfills are classified by Sanitary and Unsanitary Landfills. Sanitary Landfills are classified according to 2006 IPCC Guidelines "Managed Landfills," while Unsanitary Landfills are classified as "Unmanaged landfills."

A managed landfill is defined as a landfill designed in accordance with relevant plans: such as landfill cell layouts, mechanical compaction and leveling, is equipped with landfill gas collection and treatment facilities, floor reclamation facilities, and leachate treatment systems. Waste disposed in managed landfills emits CH_4 under anaerobic conditions. As there are no semi-aerobic or aerobic landfills in Korea, these categories are reported as "NO." The amount of landfill gas recovered from the emitted CH_4 is either incinerated or utilized for power generation and heat energy. Therefore, this is deducted from the landfill sector emissions; the corresponding emissions are accounted under the energy sector.

관리형 매립지는 매립구획 등 제반 계획에 따라 설계되고, 기계적 압축과 평탄 작업이 이루어지며, 매립가스 포집과 처리시설, 바닥 차수시설과 침출수 처리시설을 갖춘 매립지로 정의하고 있다. 관리형 매립지에서 매립된 폐기물은 혐기성 상태에서 CH_4로 배출되고, 국내에는 준호기성 및 호기성 매립지는 존재하지 않아 "NO"로 보고하였다. 배출된 CH_4 중 매립가스가 회수된 양은 소각 처리되거나 발전 및 열 에너지원으로 이용되어 매립 부문 배출량에서는 차감되고, 해당 배출량은 에너지 분야에서 산정한다.

Source: Greenhouse Gas Inventory and Research Center (2025), 2024 National Greenhouse Gas Inventory Report(1990-2022)

- Emission factors for anaerobic landfills are applied to **all South Korean landfills**
  - ❖ When calculating for the National Emissions Inventory, the Methane Correction Factor for anaerobic landfills is twice that of semi-aerobic landfills.
  - ❖ Methane Correction Factor from IPCC Guidelines: Anaerobic landfills 1.0, Semi-aerobic landfills: 0.5

- The Greenhouse Gas Inventory and Research Center (subsidiary to the Ministry of Climate, Energy and Environment) states that all landfills operate anaerobically, regardless of how the landfills were originally designed.

(Source: Information Request by National Assembly Member Park Jeong Hyeon to Greenhouse Gas Inventory and Research Center)

3 Greenhouse Gas Management: Sudokwon Landfill vs. Regional Landfills

Legal/Administrative/Economic Factors Limiting the Management of Emissions in Regional Landfills

Legal Limitations

- The Waste Controls Act and the Enforcement Decrees/Rules are focused on the operational conditions of the landfill. On the contrary, there is no legal basis for managing greenhouse gas emissions from landfills.
  - ❖ The Waste Controls Act does not define how landfills must operate, especially on the management of landfill gas.

On-Site Limitations

- Failure in practice to properly comply with landfill management measures as defined by the Waste Controls Act.
  - ❖ Leachate Levels: In some regional landfills, leachate levels exceed the legal standard of 5 meters, due to lack of capacity to manage landfills.
  - ❖ In this case, it is difficult to inject air (oxygen) through the leachate pipe to the landfill.

Economic Limitations

- Regional landfills lack the economic incentives to promote gas-to-energy systems because of the small amounts of landfill gas that could be captured.
- Lack of subnational government budget poses challenges to shift anaerobically operated landfills to semi-aerobic methods.

4 Methane Leakages of Korean Landfills Detected by Satellite

Carbon Mapper Satellite Imagery of Methane Leakage from Korean Landfill

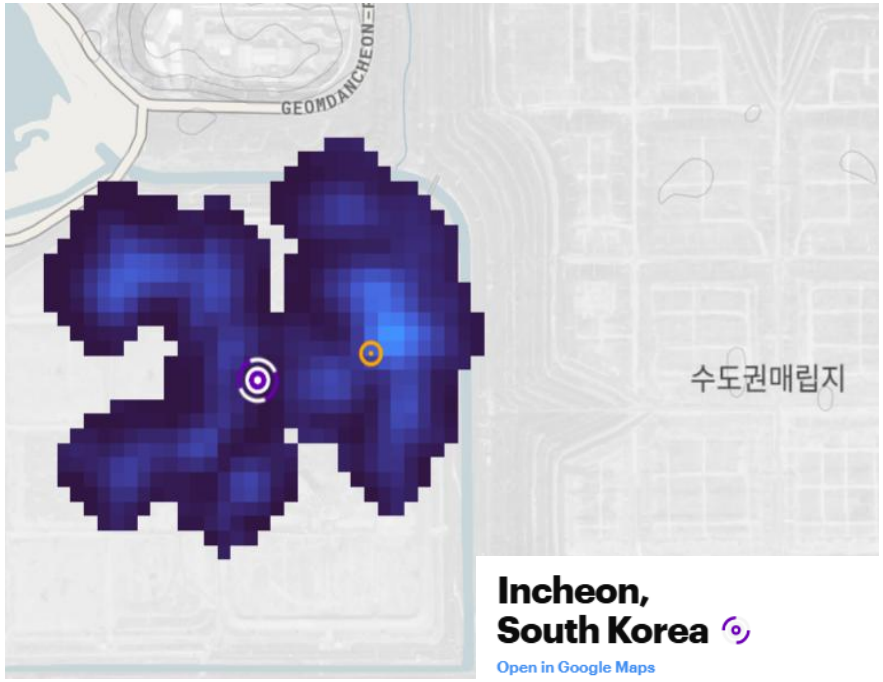


Image Source: Carbon Mapper Data Portal

- The Carbon Mapper Tanager-1 satellite detects carbon dioxide and methane emitted to the atmosphere. Ever since its launch into orbit in August 2024, Tanager-1 captures super-emitting cases of greenhouse gases worldwide.
- The satellite reports on methane emissions of at least 100kg per hour, and reports all observed cases on its data portal.
- In the case of South Korea: Sudokwon Landfill, Gwangju Metropolitan Sanitary Landfill, Busan Saenggok Landfill, Daegu City Sanitary Landfill are some of the major sites that have been identified by the Tanager-1 satellite.

4 Methane Leakages of Korean Landfills Detected by Satellite

Methane Leakage is Relatively Higher in Regional Landfills Compared to Sudokwon Landfill

Comparison of Methane Leakages from Korean Landfills Observed By Tanager-1 Satellite

Sudokwon Landfill		Gwangju Landfill		Busan Landfill	
Cumulative Volume Landfilled: 164 million m^3		Cumulative Volume Landfilled: 4.1 million m^3		Cumulative Volume Landfilled: 19.3 million m^3	
Date	**Fugitive Emissions (kg/hour)**	**Date**	**Fugitive Emissions (kg/hour)**	**Date**	**Fugitive Emissions (kg/hour)**
2025.04.06	763	2025.02.14	1,468	2025.08.22	772
2025.06.22	410	2025.05.30	895	2025.11.05	1,121
2025.08.24	514	2025.07.27	562	-	
Average Emissions	**562**	**975**		**946.5**	

Data Source: (Cumulative Landfill Volume) Ministry of Environment, Site Survey and Survey Criteria for Waste Landfills (Emissions) Adapted from Carbon Mapper Tanager-1 Data Portal

- Higher amounts of accumulated waste methane emissions often yield to higher methane emissions.
- However, the largest amount of methane emissions were detected from the Gwangju Metropolitan Landfill, despite having the least amount of cumulative volume of landfilled waste compared to Sudokwon and Busan Landfills.
- This suggests that emissions from regional landfills are not as well controlled compared to Sudokwon Landfill.

5 On-site Methane Measurements on Regional Landfills

On-site Measurement Project

- **(Background)** To check the emissions coming from the landfills in Gyeonggi province, on-site measurement projects were carried out at two landfills (Landfill Sites A and B) in the region for about 4 months, from June to September 2025.

- **(Purpose)** Monitor methane emissions from regional landfills to establish a foundation and basis for enhanced emissions monitoring measures.

- **(Method)** Compare landfill site emissions derived from First-Order Decay Model* (IPCC Guidelines) with on-site measurements.
  - ❖ IPCC First-Order Decay (FOD) Model: Model to calculate methane emissions based on decomposition of organic carbon over time from landfilled waste
  - ❖ FOD Models are used to calculate emissions from Korean landfill facilities: emissions statistics are used in the National Greenhouse Gas Inventory Report and Emission Trading Scheme (ETS).

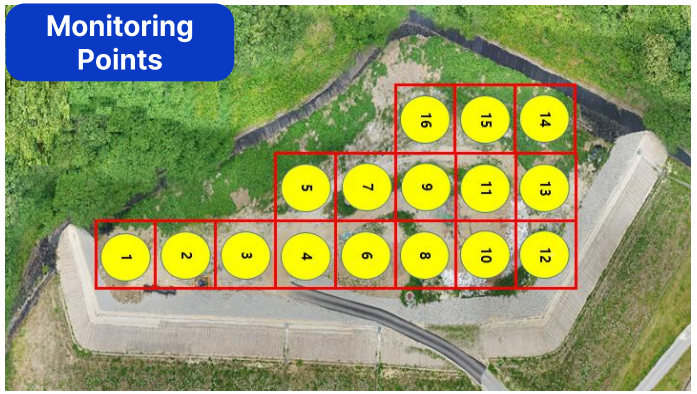
5 On-site Methane Measurements on Regional Landfills

Chamber Method (Measurement)

- Chamber Method: Measures methane emissions coming out from the landfill surface.

- Measurement of emissions: Laser detectors were installed on the chamber. The methane concentration (ppm) was measured on each monitoring point for 20-40 minutes. Then, these concentrations were converted into emission rates ($kgCH_4$/hour).

- Monitoring Points: Considering the overall area of the landfill, 25 monitoring points were considered in Landfill A, while 16 monitoring points were considered in landfill B.
  - ❖ Based on meteorological conditions, on-site measurements were conducted 6 times in Landfill A and 12 times in Landfill B.



5 On-site Methane Measurements on Regional Landfills

Current Models Underestimate Methane Emissions from Regional Landfills

Measurement Results

Landfill Site	Average Measured Emissions Units: $kgCH_4/hour$	National Emission Statistics (Based on IPCC Guidelines) Units: $kgCH_4/hour$
Landfill Site A	62.7	26.7
Landfill Site B	34.5	22.3

- Our results show that reported methane emissions from regional landfills are underestimated compared to actual measurements.
  - ❖ Landfill A: Underestimated by approximately 2.3x, Landfill B: Underestimated by approximately 1.5x

- As measures to reduce greenhouse gas emissions from regional landfills, ① On-site monitoring of emissions, ② Changing the landfill operation methods (from anaerobic to semi-aerobic) should be considered.

6 Solution: Transitioning to Semi-Aerobic Landfill Operations

Recommendations to Transition Landfills to Semi-Aerobic Operations

Conclusion

- Regional landfills should be converted and operated in semi-aerobic conditions to manage greenhouse gas emissions.

Recommendations

Identify the operation status on all South Korean landfills

① The South Korean government should conduct a full survey to check for anaerobic and semi-aerobic operations on all landfills.

→ On existing Anaerobic landfills: Check for landfill gas capture infrastructure, feasibility to transition to semi-aerobic operations.

→ Check for semi-aerobically designed landfills that are operating in anaerobic conditions.

Pilot Projects to Transition Landfills to Semi-Aerobic

② Conduct pilot projects on transitioning anaerobic landfills to semi-aerobic landfills to examine potential emission reductions and economic benefits.

Expand Semi-Aerobic Landfill Transitions Nationwide

③ Based on pilot project results, establish roadmaps and strategies to convert regional landfills to semi-aerobic conditions nationwide.

SFO°C
Solutions for Our Climate

Buried But Not Hidden

Addressing Methane Emissions from Korea's Regional Landfills

Published	February 2026
Author	Sanghyun Ma | Researcher, Methane & HFCs
Design	Nature Rhythm

Solutions for Our Climate (SFOC) is an independent nonprofit organization that works to accelerate global greenhouse gas emissions reduction and energy transition. SFOC leverages research, litigation, community organizing, and strategic communications to deliver practical climate solutions and build movements for change.