THE AMERICAN UNIVERSITY IN CAIRO

100 YEARS

A Review on Landfill Gas Production, Treatment Techniques, and its Effect on Circular Economy

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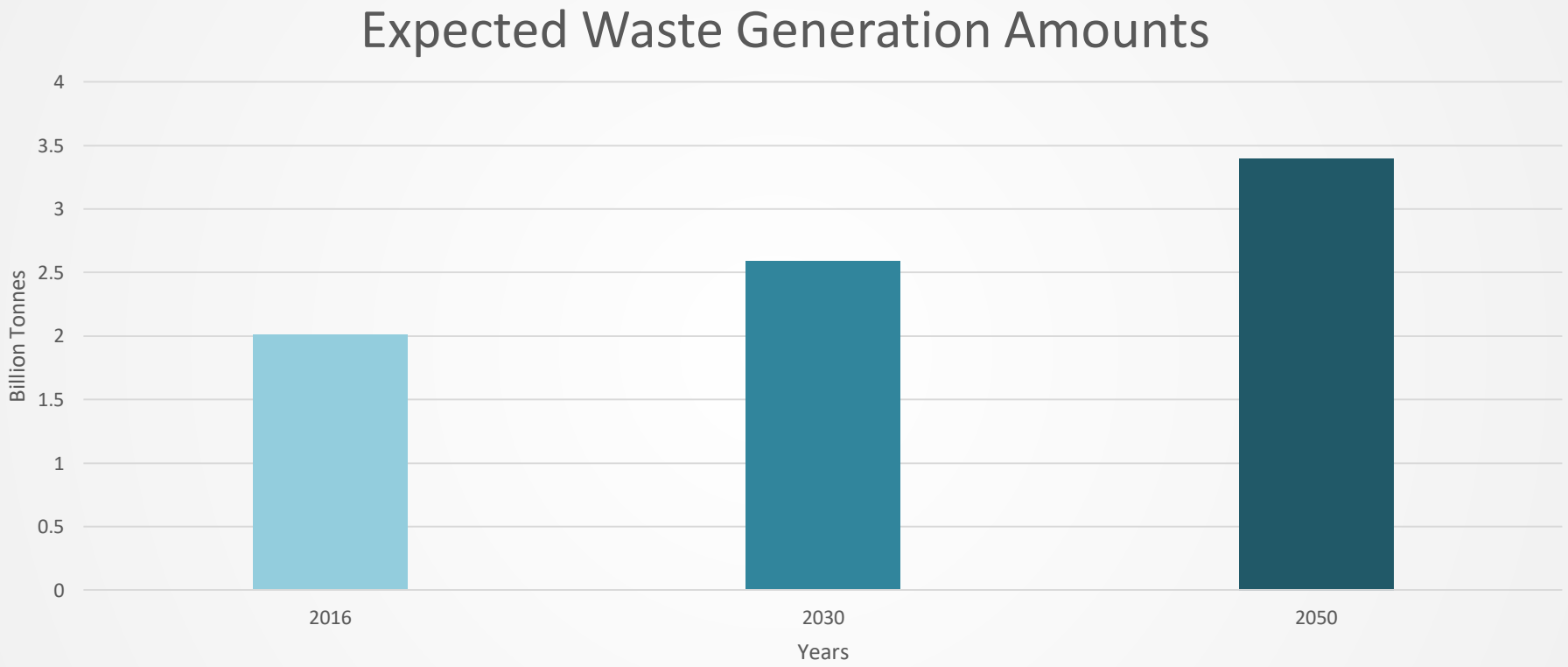
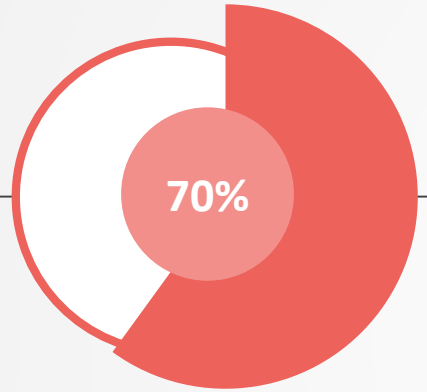
Outline

1.Introduction

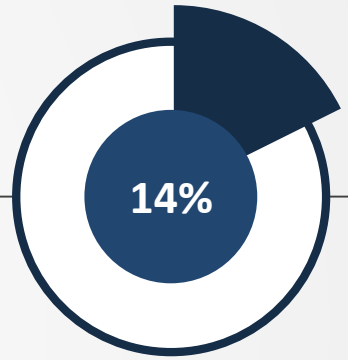


World Bank Organization, "What a Waste 2.0 : A Global Snapshot of Solid Waste Management to 2050. Urban Development;. Washington, DC: World Bank.

Current Waste Disposal



To Landfills

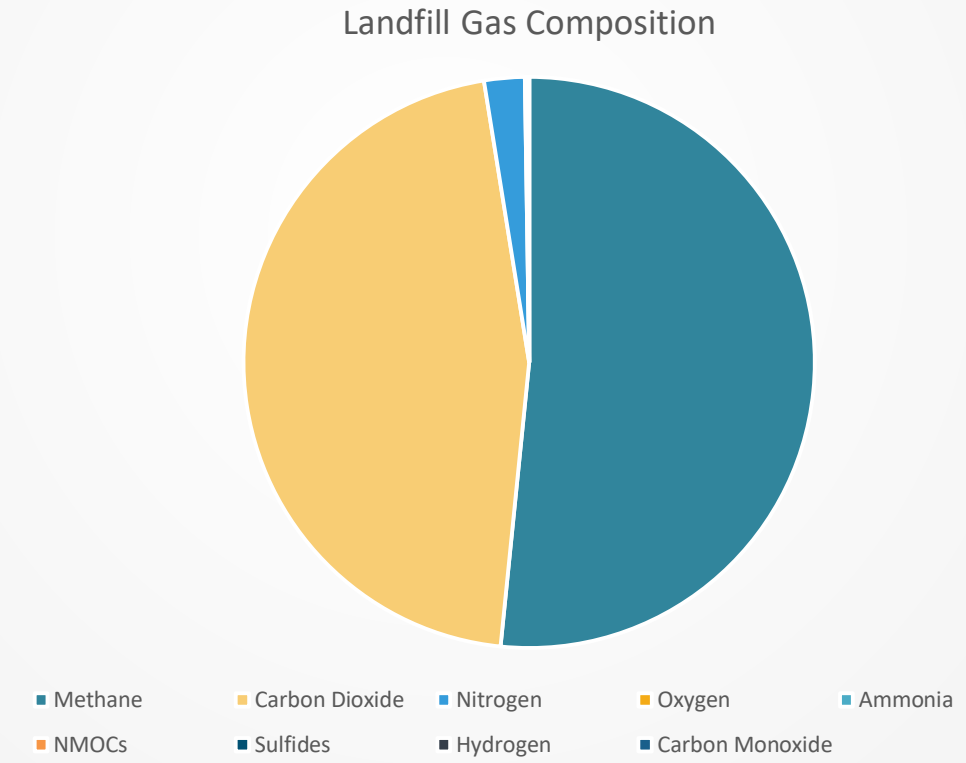


Recycled

Kurniawan, T. A., Liang, X., Singh, D., Othman, M. D., Goh, H. H., Gikas, P., Kern, A. O., Kusworo, T. D., And Shoqeir, J. A. , "Harnessing landfill gas (LFG) for electricity: A strategy to mitigate greenhouse gas (GHG) emissions in Jakarta (Indonesia)," *Journal of Environmental Management* , no. 301, (2022).

Landfill Gas (LFG)

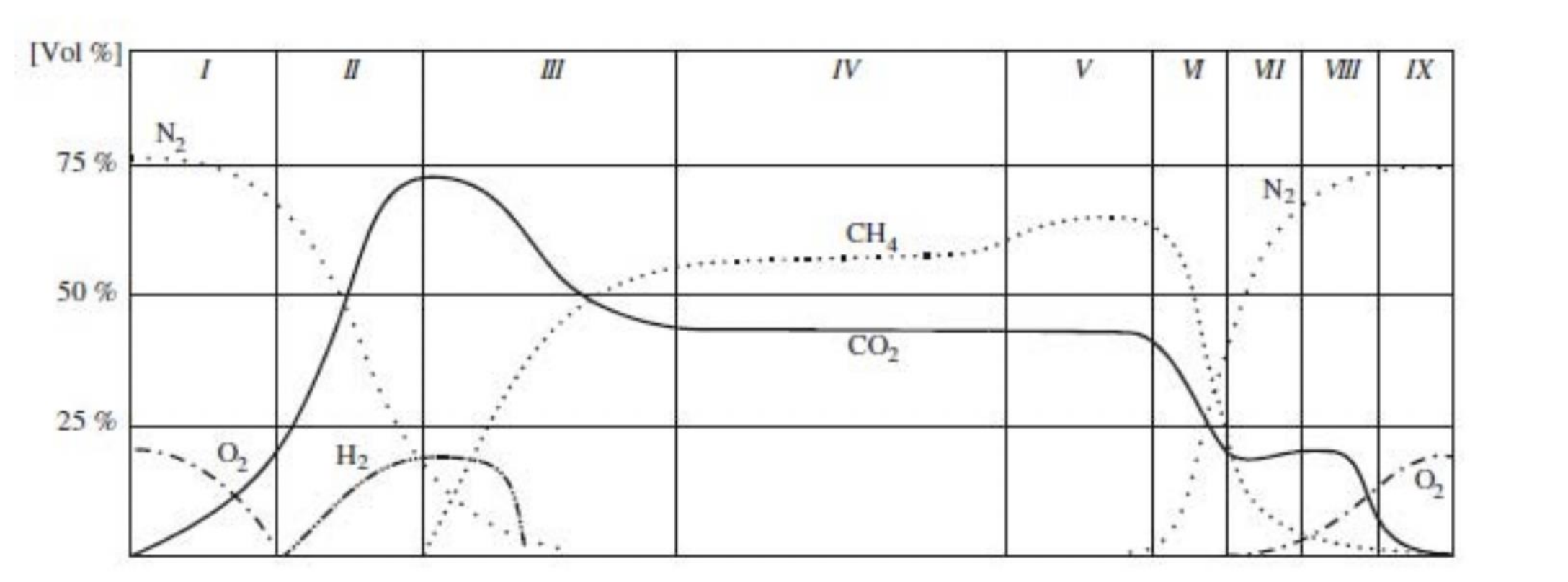
Due to the anaerobic biodegradation of municipal solid waste, landfill gas (LFG) is produced which is a greenhouse gas (GHG) composed mainly of methane and carbon dioxide.



ATSDR, Landfill Gas Basics, https://www.atsdr.cdc.gov/hac/landfill/html/ch2.html. (2001).

Production Methods

1. Bacterial Decomposition



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2. Volatalization

organic compounds undergo a phase change from liquid/ solid to vapor.

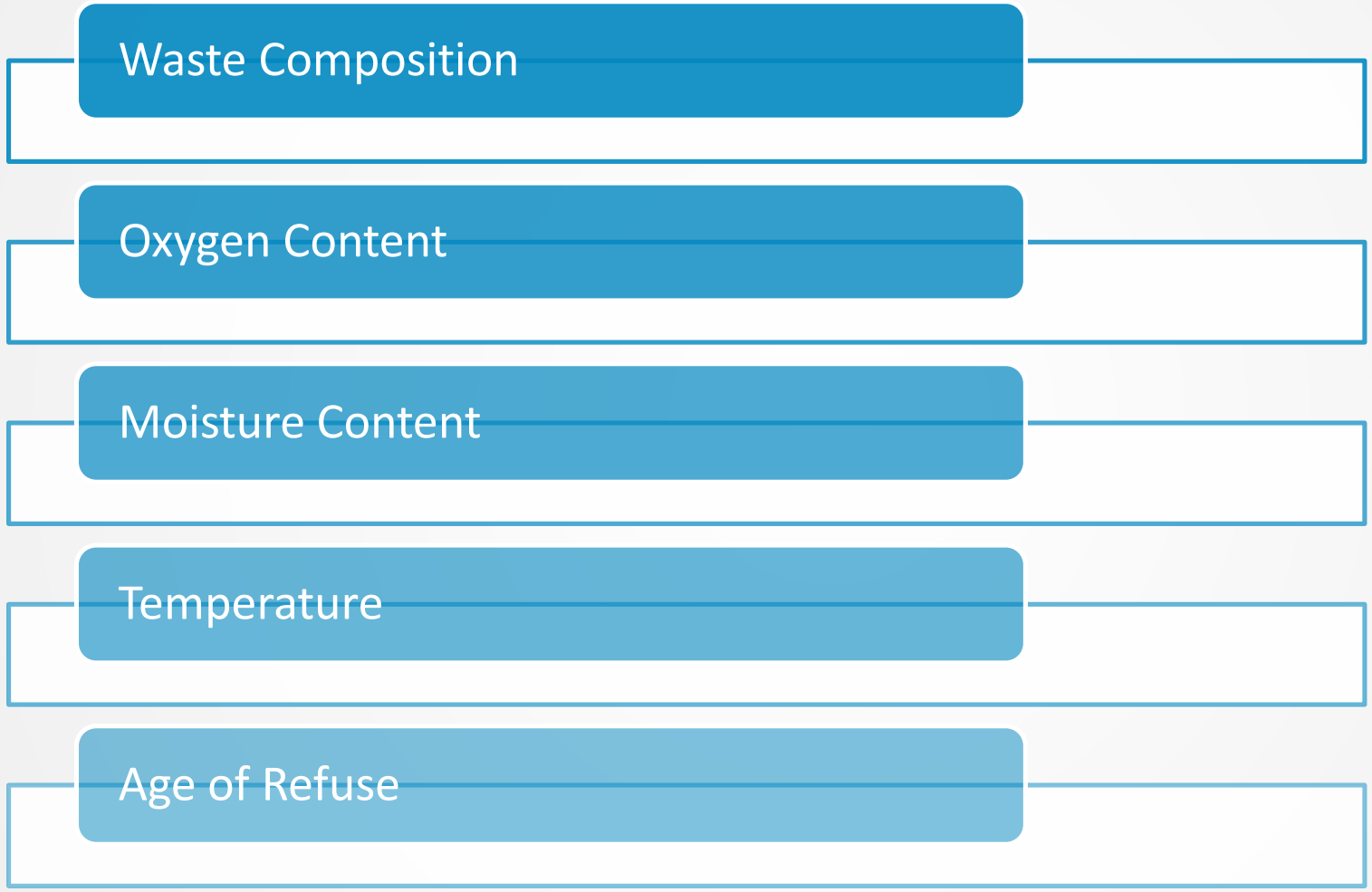
3. Chemical Reactions

landfill gas can also be produced as a result of certain chemical reactions between some chemicals in the waste.

4. Novel Techniques

Leachate biodegradation

Production Controlling Parameters



2.Environmental Impacts

- MSW landfills comes in **3rd** place for human related methane gas emissions in the United States.

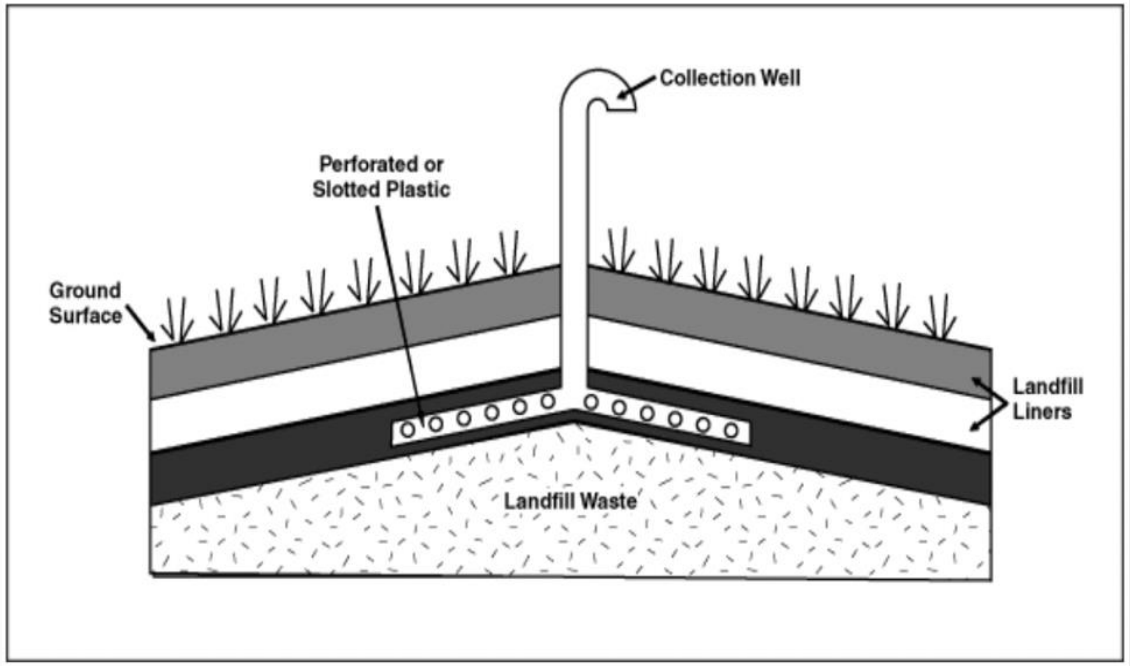
- In 2019, methane emissions from these landfills were equivalent to greenhouse gases emissions from more than **21.6 million** fossil fuel driven vehicles for one year or to carbon dioxide emissions from **12 million** homes energy use per year

World Bank Organization, "What a Waste 2.0 : A Global Snapshot of Solid Waste Management to 2050. Urban Development;. Washington, DC: World Bank.

3.Collection Systems

1. Passive Collection System

- It makes use of the landfill pressure and gas concentrations variations to emit the LFG into the atmosphere or a control system.
- It can be installed in either active or closed landfill

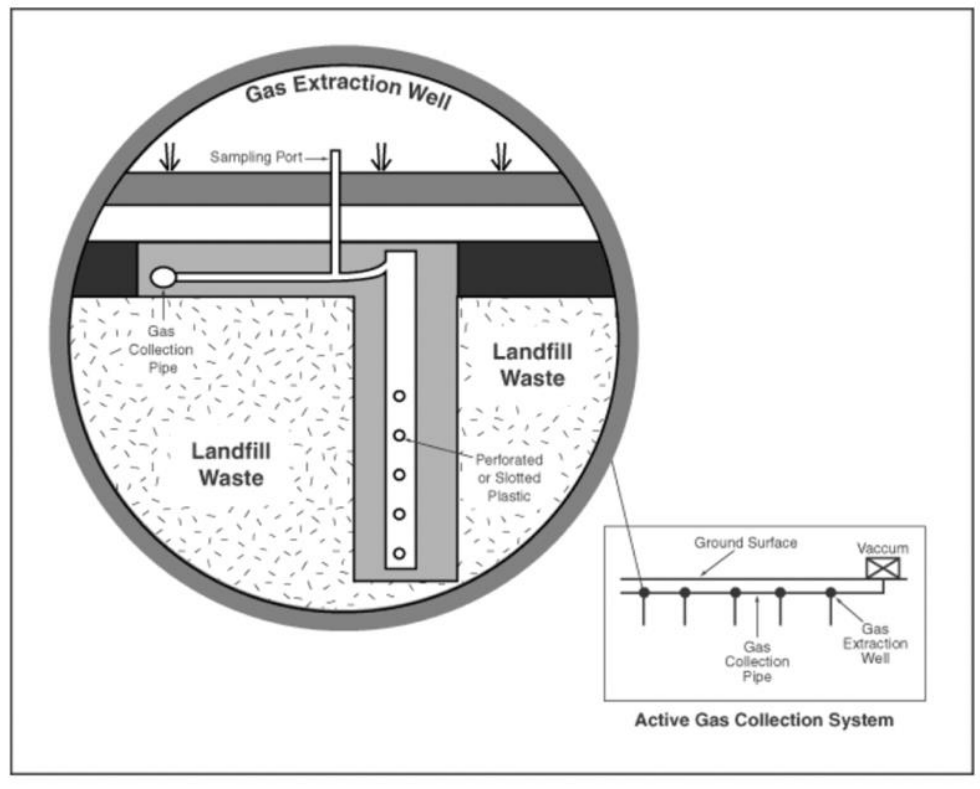


ASTDR, "Chapter 5: Landfill Gas Control Measures. https://www.atsdr.cdc.gov/HAC/landfill/html/ch5.html. (2001).

Collection Systems

2. Active Collection System

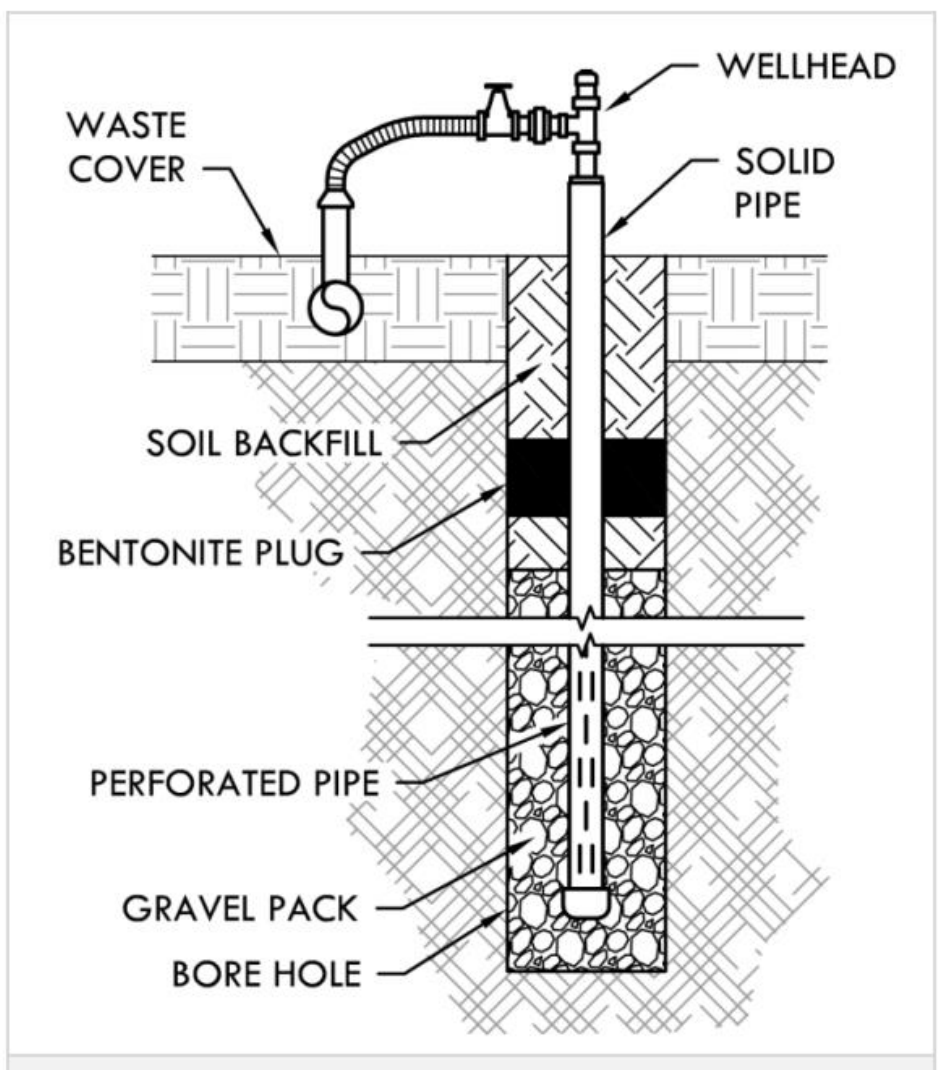
- More Effective than the passive system.
- They are installed with valves to be able to control the gas flow rate and determine its composition and pressure.
- They also have pumps to be able to vent the gas by creating low pressure inside the collection wells and hence provide a pathway for the gas to move .

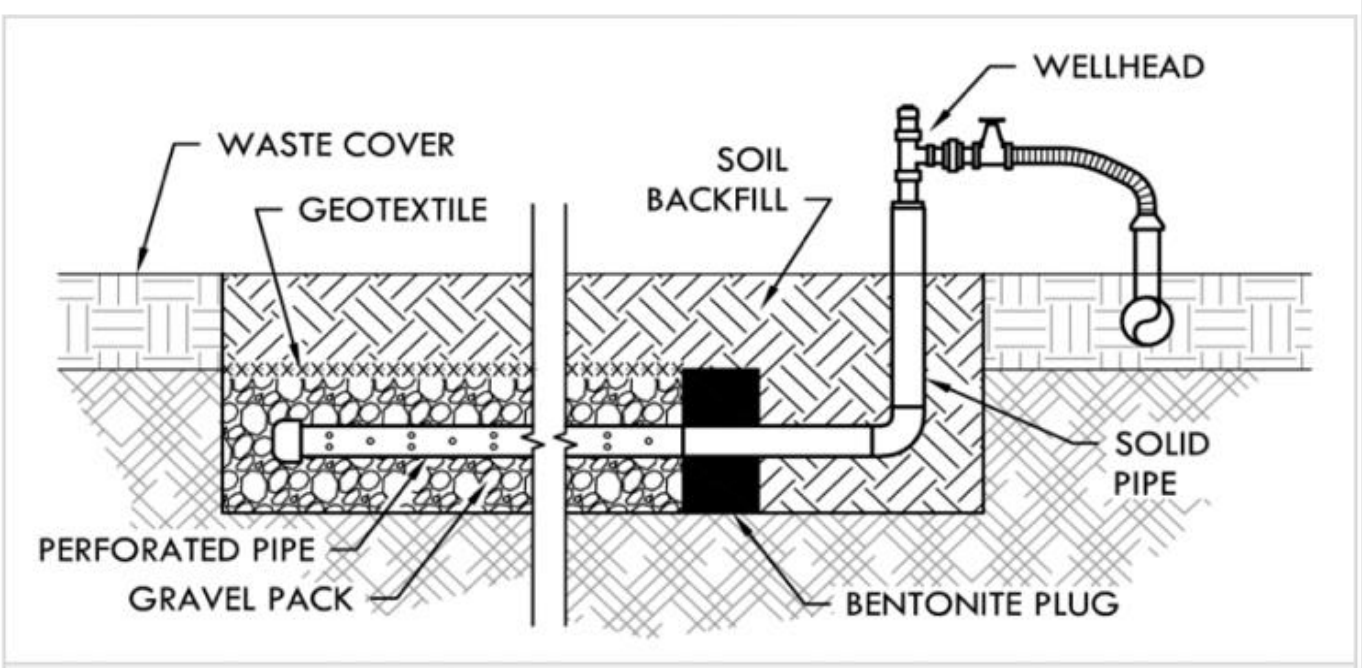


Active Gas Collection System

ASTDR, "Chapter 5: Landfill Gas Control Measures. https://www.atsdr.cdc.gov/HAC/landfill/html/ch5.html. (2001).

Types of wells used in the collection system





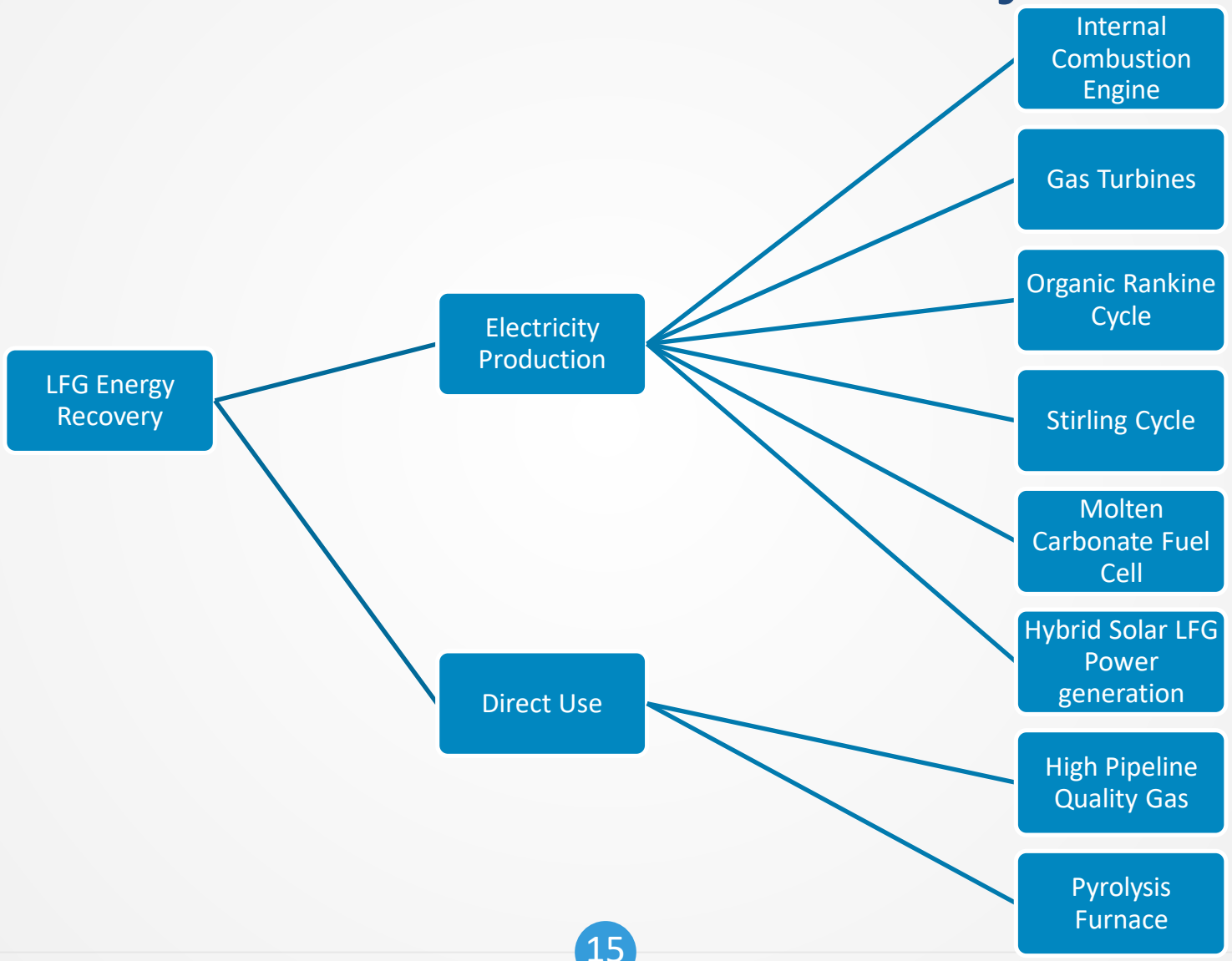
Configuration	Advantages	Disadvantages
Vertical	1. Can be installed in active landfills if extended. 2. Can be adjusted to different LFG generation rates. 3. It provides no disruption for landfill operations if installed in inactive landfills. 4. Can be accessed for maintenance.	1. It requires maintenance frequently if installed in active landfills. 2. Redrilling maybe required if any changes took place in the waste thickness. 3. It requires special equipment and hence high operational cost.
Horizontal	1. Lower cost for large LFG amount collection. 2. Can be installed in active landfills without the need of extension. 3. It does not require special equipment or drilling.	1. Hard to adjust due to its length. 2. Can be crushed easily if no proper protection was applied. 3. Can be subjected to flooding if the drainage system is not working properly. 4. If not sufficiently covered by waste, some air emissions may emit.

4.Treatment Systems

- Dehydration
- Filtration
- Hydrogen Sulfide and VOC Removal

ASTDR, "Chapter 5: Landfill Gas Control Measures. https://www.atsdr.cdc.gov/HAC/landfill/html/ch5.html. (2001).

5.LFG and Circular Economy



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Conclusion

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Questions?