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Tapping the Potential of Landfill Gas

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> From a renewable energy standpoint, landfill gas is one of the most effective sources of renewable energy. According to IRENA's World Energy Transitions Outlook (June 2021), there is consensus that an energy transition grounded in renewables and efficient technologies is the only way to give us a fighting chance of limiting global warming to 1.5°C by 2050.

Landfill gas (LFG) is a natural byproduct of the decomposition of organic material in landfills. LFG is composed of roughly 50% methane (the primary component of natural gas), 50% carbon dioxide (CO_2), and a small amount of non-methane organic compounds. Methane is a potent greenhouse gas 28 to 36 times more effective than CO_2 at trapping heat in the atmosphere over a 100-year period, according to the latest Intergovernmental Panel on Climate Change (IPCC) assessment report (AR5).

In the United States, municipal solid waste (MSW) landfills are the third-largest human-generated source of methane emissions, releasing an estimated 99.4 million metric tons of carbon dioxide (CO_2) equivalent ($MMTCO_2e$) to the atmosphere in 2019 alone. With a global warming potential greater than CO_2, and a short (12-year) atmospheric life, methane is a key contributor to global climate change. In addition, methane contributes to background tropospheric ozone levels as an ozone precursor.[1] As a result, reducing methane emissions from MSW landfills is one of the best ways to achieve a near-term beneficial impact in mitigating global climate change.

From a renewable energy standpoint, landfill gas is one of the most effective sources of renewable energy. According to IRENA's World Energy Transitions Outlook (June 2021), there is consensus that an energy transition grounded in renewables and efficient technologies is the only way to give us a fighting chance of limiting global warming to 1.5°C by 2050. Therefore, the next decade will be decisive to achieve the Paris and Sustainable Development goals. Any delay will drive us in the direction of further warming, with profound irreversible economic and humanitarian consequences.

[1] https://www.epa.gov/lmop/basic-information-about-landfill-gas
[2] https://www.irena.org/publications/2021/Jun/World-Energy-

TOTAL MITIGATION IN 2050

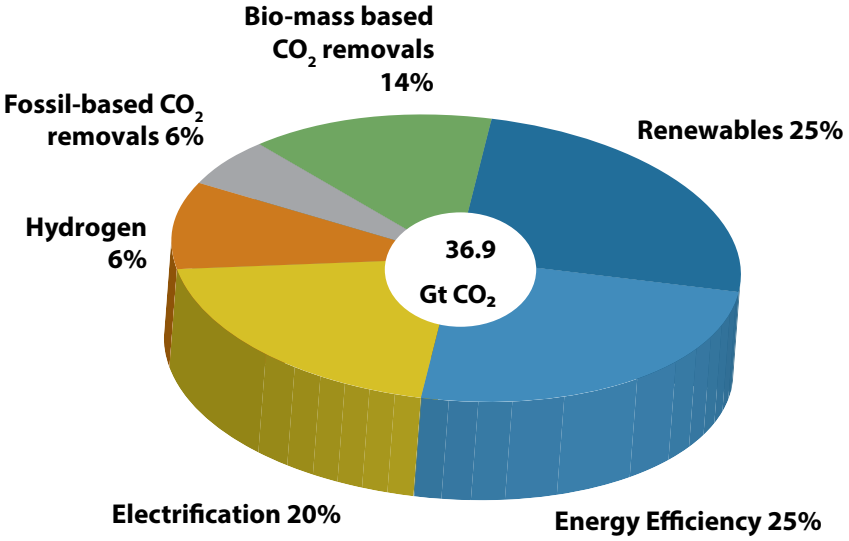


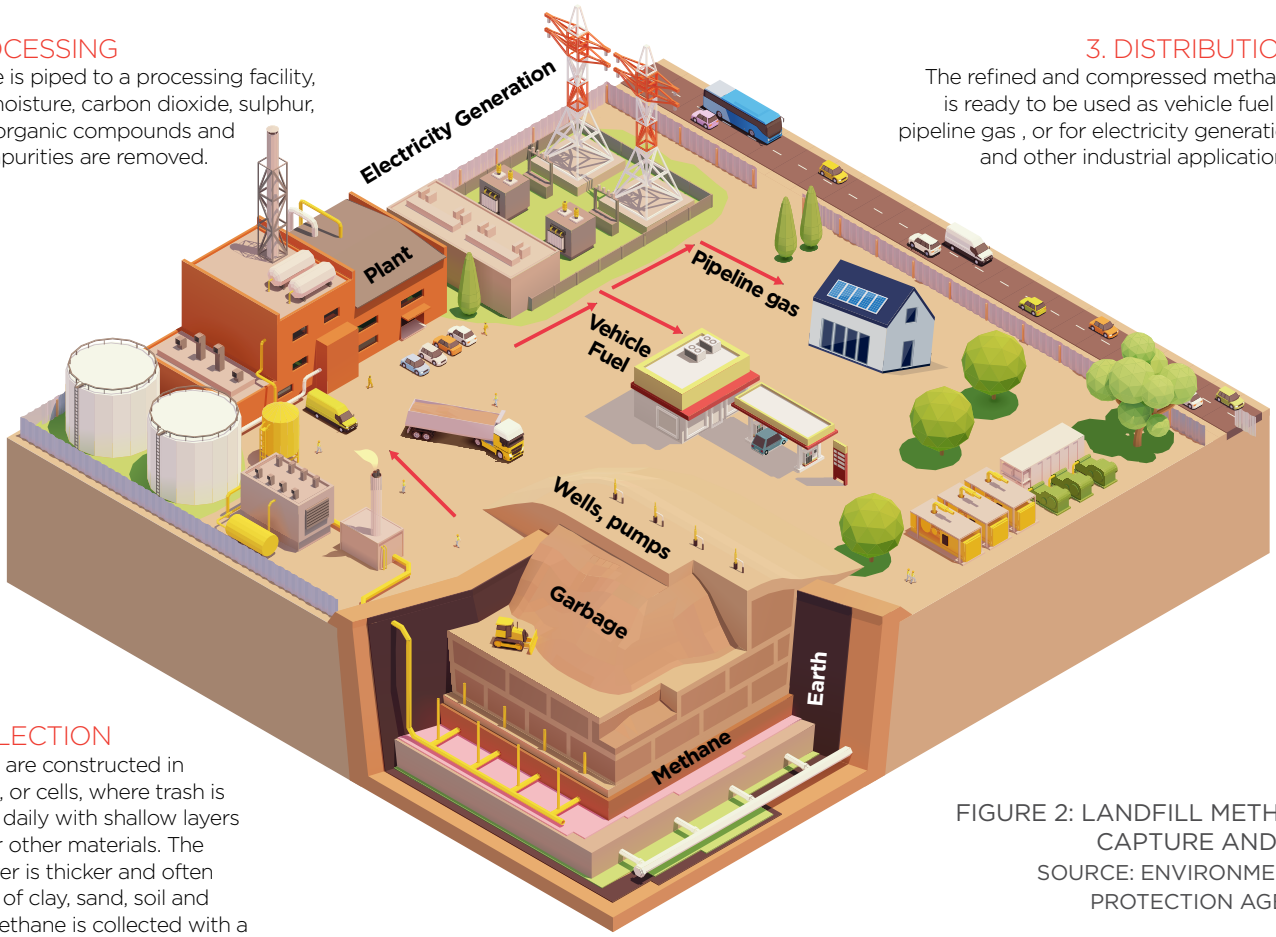
FIGURE 1: SIX COMPONENTS OF THE ENERGY TRANSITION STRATEGY[2]
SOURCE: IRENA WORLD ENERGY TRANSITIONS OUTLOOK (2021)

2. PROCESSING

Methane is piped to a processing facility, where moisture, carbon dioxide, sulphur, volatile organic compounds and other impurities are removed.

3. DISTRIBUTION

The refined and compressed methane is ready to be used as vehicle fuel or pipeline gas , or for electricity generation and other industrial applications.



1. COLLECTION

Landfills are constructed in sections, or cells, where trash is covered daily with shallow layers of soil or other materials. The final cover is thicker and often consists of clay, sand, soil and grass. Methane is collected with a network of wells, pipes and pumps.

FIGURE 2: LANDFILL METHANE CAPTURE AND USE
SOURCE: ENVIRONMENTAL PROTECTION AGENCY

By reducing methane emissions, we can quickly reduce the atmospheric warming effect, and according to Jeff Chanton, Climate Scientist at Florida State University, targeting landfills is a great place to start. Landfills help keep our communities clean, but they also pose serious threats to the health of our environment. The most pressing environmental concern regarding landfills is their release of methane.[3] At the same time, methane emissions from MSW landfills represent a lost opportunity to capture and use a significant energy resource.

Utilising landfill gas as a renewable energy source helps to meet energy needs, improves environmental and health concerns, and provides economic benefits such as revenue generation, job creation, and market development. By capturing methane from landfills, various forms of energy can be produced, such as electricity, boiler fuel, steam, alternative vehicle fuel, and pipeline gas.[4]

In the United States, approximately 70% of currently operational LFG energy projects generate electricity, by utilising a variety of technologies, including reciprocating internal combustion engines, turbines, microturbines, and fuel cells, to generate electricity for on-site use or sale to the grid.

Additionally, the direct use of LFG can offset the use of another fuel, for example, natural gas or fuel oil. Current industries using LFG include auto manufacturing, chemical production, food and beverage processing, pharmaceuticals, cement and brick manufacturing, wastewater treatment, consumer electronics and products, paper and steel production, and prisons and hospitals.

LFG can also be upgraded to renewable natural gas (RNG), a high-Btu gas, through treatment processes by increasing its methane content and, conversely, reducing its CO_2, nitrogen, and oxygen contents. RNG can be used in place of fossil natural gas, as pipeline-quality gas, compressed natural gas (CNG), or liquefied natural gas (LNG). Options for the use of RNG include thermal applications to generate electricity or as fuel for vehicles. The RNG can be used locally at the site where the gas is produced or can be injected into the natural gas transmission or distribution pipelines for delivery to another location.[5]

Transitions-Outlook

[3] https://www.colorado.edu/ecenter/2021/04/15/hidden-damage-landfills

[4] http://large.stanford.edu/courses/2014/ph240/thorne2/

[5] https://www.epa.gov/lmop/basic-information-about-landfill-gas

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Landfill Gas-to-Energy in Latin America and the Caribbean

Over the past several decades, health and environmental concerns associated with LFG have been mounting in urgency, particularly in the context of small island developing states (SIDS), such as in the Caribbean, which are constrained by space, limited resources, and fragile ecosystems.

In 2006, the Landfill Gas-to-Energy (LFGTE) Initiative in Latin America and the Caribbean was published with the objective of:[6]

- Contributing to the maximisation of methane emissions reductions and the development of carbon trading opportunities
- Promoting LFGTE investment in Latin America and the Caribbean to improve solid waste management practices in the region
- Creating awareness of LFGTE opportunities
- Documenting and disseminating LFGTE experience and
- Establishing knowledge sharing mechanisms to increase cooperation

Consequently, in the last ten years, governments have closed some of the most polluted landfills in the region, including sprawling facilities in Brazil, Mexico, and Nicaragua. The drive is part of an effort by countries to cut down on pollution and stem the flood of greenhouse gases.

According to the United Nations Environmental Programme (2020), currently, dumpsites receive 40% of the world's waste, particularly in developing countries. In Latin America and the Caribbean, approximately 145,000 tonnes of garbage arrive at dumpsites every day, where the decomposition and burning of waste generate powerful gases that pollute the atmosphere, make people sick, and contribute to climate change.

[6] https://openknowledge.worldbank.org/handle/10986/17972?show=full

The COVID-19 pandemic has shown how essential it is to manage waste to minimise long-term risks to human and environmental health. In response to COVID-19, there has been a significant increase in the amount of medical waste that could be contaminated with the virus. Finding innovative solutions to reduce waste, dispose of it properly, reuse it, and recycle it under a circular economy perspective is key in post-COVID-19 recovery plans in Latin America and the Caribbean, where only about 10% of waste is recycled.[7]

Exploration of the Use of Landfill Gas for Energy in Trinidad and Tobago

In Trinidad and Tobago, most municipal solid waste is disposed of in four main landfills: Beetham Landfill, Forres Park Landfill, Guanapo Landfill and Studley Park Landfill, which are either close to capacity or are at capacity and still collecting waste. 55% of Trinidad's MSW goes to Beetham, 16% to Guanapo, and 29% to Forres Park, with 100% of Tobago's waste going to Studley Park.

According to the Waste Management Report presented before the Joint Select Committee of the Parliament in 2019, the average person in Trinidad and Tobago generates approximately 1.5 kilograms of waste per day, which amounts to approximately 2,000 tonnes of waste that reaches the landfill sites per day. This figure does not include the large quantities of waste that are improperly disposed of, polluting our streets, drains, rivers, beaches, and other environs.[8] In 2020, Trinidad and Tobago had a forecast estimate of 1.56 million tonnes of solid waste generated per annum.

When we consider that decomposition of this waste generates a potential energy source, it makes commercial and environmental sense to explore options for mobilising and utilising this resource. From another perspective, since all our landfills generate significant quantities of Green House Gas (GHG) emissions, putting LFG to productive use can also help reduce our country's growing carbon footprint.

Cognisant of the value-added potential of LFG to Trinidad and Tobago's economy, on September 13th, 2021, a Memorandum of Understanding (MOU) was signed

[7] https://www.unep.org/news-and-stories/story/latin-america-and-caribbean-closure-ageing-dumps-helping-clear-air

[8] https://www.swmcol.co.tt/index.php/education/7-waste-management-topics

FROM L-R: President, National Energy, Dr. Vernon Paltoo; President, NGC, Mr. Mark Loquan; Chairman, The NGC Group, Mr. Conrad Enill; CEO, SWMCOL, Mr. Kevin Thompson; Hon. Minister of Energy and Energy Industries, Mr. Stuart Young; Hon. Minister of Public Utilities, Mr. Marvin Gonzales; Chairman, SWMCOL, Mr. Ronald Milford; President, NGC CNG, Mr. Curtis Mohammed

among The National Gas Company of Trinidad and Tobago Limited (NGC), NGC CNG Company of Trinidad and Tobago Limited (NGC CNG), National Energy Corporation of Trinidad and Tobago Limited (National Energy), and the Trinidad and Tobago Solid Waste Management Company Limited (SWMCOL), to explore opportunities to capture and commercialise landfill gas for uses such as the provision of carbon-negative, renewable compressed natural gas.

Through this MOU, the parties will identify and quantify landfill gas emissions for existing MSW landfills, explore existing and new infrastructure requirements to facilitate transportation and commercialisation of extracted landfill gas volumes, and explore opportunities for utilisation of the derived renewable compressed natural gas as an alternative transportation fuel for vehicles. This initiative will contribute to Trinidad and Tobago's energy transition journey and create new revenue streams for the country.

As part of its Green Agenda, The NGC Group continues to explore several opportunities to reduce Trinidad and Tobago's reliance on fossil fuels and transition the country into a decarbonised, safer, and healthier environment. With its focus on reducing its corporate carbon footprint while simultaneously supporting Trinidad and Tobago in meeting its Nationally Determined Contributions (NDC) emissions reduction target, The NGC Group is committed to driving the local energy transformation to a zero-carbon energy future. This collaboration with SWMCOL is just one of several partnerships The NGC Group is embracing to address the rapidly changing energy and economic landscape and mitigate the threat of climate change.

Now more than ever, renewable energy and energy efficiency initiatives are needed if we are to create a circular economy and achieve our sustainable energy future. Therefore, harnessing the power of Landfill Gas is a step in the right direction. ■

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