



Project Summary

Emerging Technologies for the Management and Utilization of Landfill Gas

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The report presents information on emerging technologies that are considered to be commercially available (Tier 1), currently undergoing research and development (Tier 2), or are considered as potentially applicable (Tier 3), for the management of landfill gas (LFG) emissions or for the utilization of methane (CH_4) and carbon dioxide (CO_2) from LFG. Discussion of emerging technologies is based on information that was readily available as of September 1997.

The emerging technologies that are considered to be Tier 1 are 1) phosphoric acid fuel cells, 2) processes for converting CH_4 from LFG to compressed LFG for vehicle fuel or other fuel uses, and (3) use of LFG as a fuel source for leachate evaporation systems. The Tier 2 technologies covered in the report are 1) operation of landfills as anaerobic bioreactors, 2) operation of landfills as aerobic bioreactors, 3) production of methanol from LFG, 4) production of commercial CO_2 from LFG, and 5) use of LFG to provide fuel for heat and CO_2 enhancement in greenhouses. Tier 3 technologies, considered as potentially applicable for LFG, include Stirling and Organic Rankine Cycle engines. These two technologies could potentially use waste heat from flares used to control landfill gases to generate mechanical energy. However, they have not yet undergone field demonstration at a landfill to determine if they would be cost effective.

This Project Summary was developed by EPA's National Risk Management Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The report presents information on emerging technologies for utilizing CH_4 and CO_2 from LFG. The focus of the report is on Tier 1 and Tier 2 emerging technologies for LFG utilization (e.g., as an energy source, to develop raw materials). Additional coverage is given to two technologies that are considered as potentially applicable for the utilization of LFG: Stirling and Organic Rankine Cycle engines. The report is not an exhaustive review of emerging technologies for the management and utilization of LFG but those processes that are being demonstrated or are planned for demonstration. Discussion of the emerging technologies is based on information that was readily available as of September 1997.

Information Development and Presentation

Information for the various management and utilization technologies was obtained primarily from the technology developers. Data contained in recent publications were also used. Section 1.0 of the report contains an introduction and overview of the

report including a discussion of incentives for LFG utilization. Section 2.0 of the report discusses emerging technologies that are considered to be commercially available. These Tier 1 technologies that are undergoing field-scale demonstration include:

- Phosphoric acid fuel cells for generating electricity and waste heat;
- Processes for converting CH₄ from LFG to compressed landfill gas (CLG) for vehicle fuel and other fuel uses; and
- Use of LFG as a fuel for leachate evaporation systems.

Section 3.0 of the report describes Tier 2 technologies. Field demonstrations have been performed for some of these technologies (e.g., anaerobic and aerobic bioreactors, use of LFG for fuel to heat greenhouses and provide CO₂ enhancement), while others have undergone only bench-scale demonstrations (e.g., production of methanol or commercial CO₂). Section 4.0 describes those technologies that are considered as potentially applicable for generating energy from waste heat produced by flares used to control landfill gases. These technologies include the Stirling engine and Organic Rankine Cycle engines.

For the Tier 1 technologies, the report provides an introduction and general overview of the technology, a process description, performance, technical issues encountered during the project, information on the project economics, and emissions and secondary environmental impacts data. For all of the technologies, the report provides information on the technical

feasibility, emissions, and economics of each technology to the extent that the developers of the technologies were able to provide such information. The development of the technologies is ongoing and the developers of the technologies are identified in each section of the report. An example of process economics information

contained in the report is presented in Figure 1 for the economies of scale of CLG production facilities.

Process descriptions for each LFG utilization technology are provided. Figure 2 is an example flow diagram from the report on a process for converting methane from LFG to CLG.

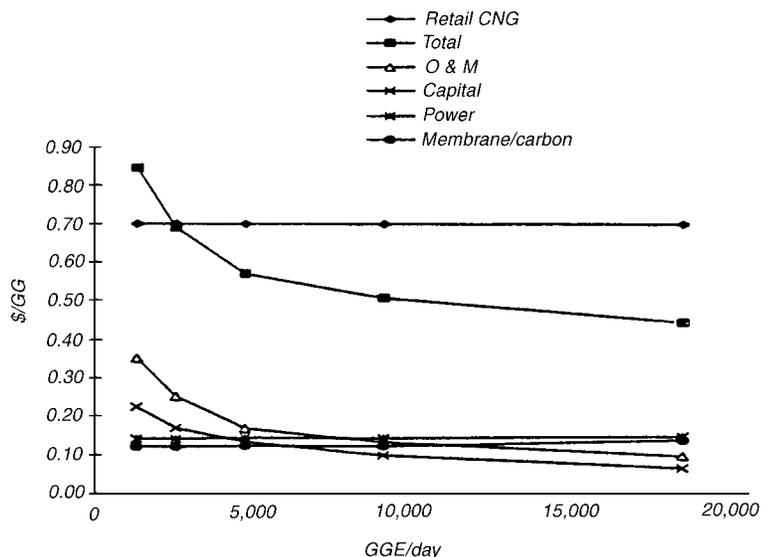


Figure 1. Estimated economies of scale for CLG production facilities (GGE = gallons of gasoline - equivalent).

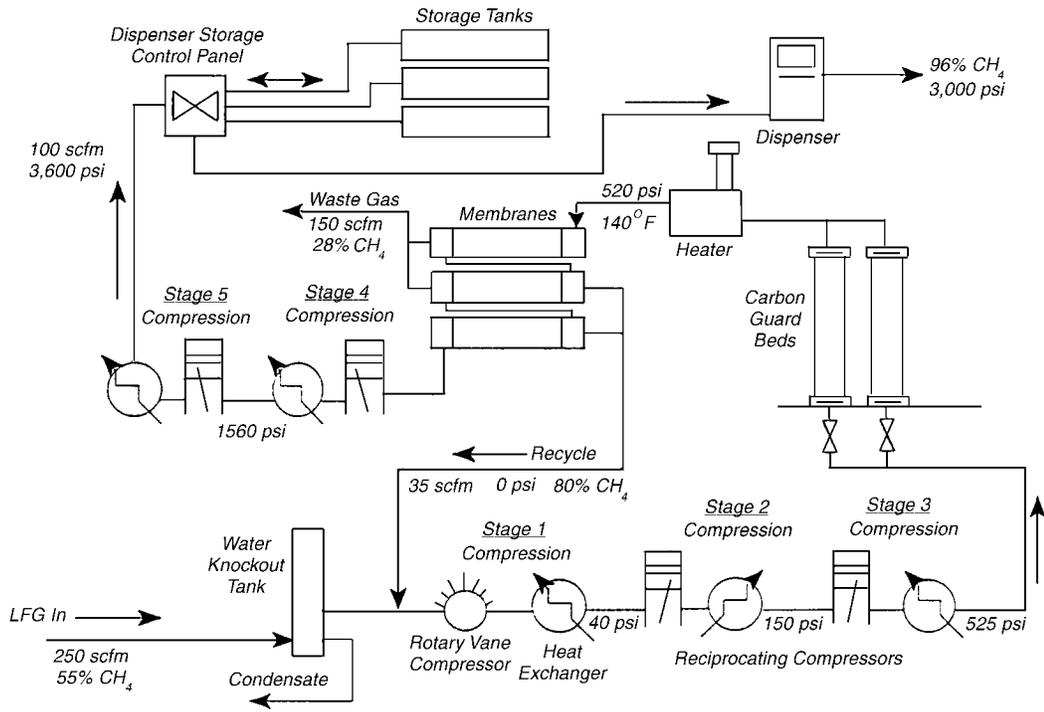


Figure 2. Flow diagram of the Los Angeles County Sanitation Districts' CLG Production Facility
 ($1^{\circ}\text{F} = 9/5^{\circ}\text{C} + 32$, $1\text{ ft}^3/\text{min} = 0.0283\text{ m}^3/\text{min}$, and $1\text{ psi} = 6.89\text{ kPa}$).

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The complete report, entitled "Emerging Technologies for the Management and Utilization of Landfill Gas," (Order No. PB98-127913 Cost: \$27.00, subject to change) will be available only from:

*National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-605-6000*

The EPA Project Officer can be contacted at:

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