PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Carbon Sequestration

4/2008

LANDFILL GAS SEQUESTRATION IN KANSAS

CONTACTS

Sean Plasynski
Sequestration Technology Manager
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-4867
sean.plasynski@netl.doe.gov

Heino Beckert
Project Manager
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26505-0880
304-285-4132
Heino.beckert@netl.doe.gov

David Newell
Principal Investigator
Kansas Geological Survey
1930 Constant Avenue
Lawrence, KS 66045
785-864-2183
dnewall@kgs.uk.edu

Background

Municipal solid waste landfills are the largest source of anthropogenic methane emissions in the United States, accounting for about 34 percent of these emissions in 2004. Most methane (CH_4) generated in landfills and open dumps by anaerobic decomposition of the organic material in solid-waste-disposal landfills is either vented to the atmosphere or converted to carbon dioxide (CO_2) by flaring. The gas consists of about 50 percent methane (CH_4), the primary component of natural gas, about 50 percent carbon dioxide (CO_2), and a small amount of non-methane organic compounds. The amount of methane created in a landfill depends on the quantity and moisture content of the waste and the design and management practices at the site. Methane emissions from landfills represent a lost opportunity to capture and use a significant energy resource.

Methane emissions account for about 10 percent of the total U.S. greenhouse-gas emissions when weighted by methane's global warming potential factor. Gas-to-energy projects, including upgrading landfill gas (LFG) to pipelines natural gas, have been eligible for an "unconventional gas" tax credit. However, this tax credit has provided insufficient incentives for development of new LFG-to-energy projects. Unless methane recovery from landfills increases, the increasing tonnage of a landfill waste will result in higher levels of methane emissions from this source in the future.

Description

Production of raw landfill gas from the Johnson County (Kansas) Landfill comes from 150 wells with daily production of LFG at approximately 2.2 to 2.5 billion cubic feet (mmcf). The produced methane is separated from the LFG, cleaned, and sent to a local pipeline for regional distribution of the natural gas. Via this project the Kansas Geological Survey is addressing the gas-processing cost issue by investigating the potential of injecting LFG into subsurface coal seams, thus utilizing natural processes to produce larger quantities of high quality methane (natural gas) by stripping and sequestering the CO_2 component of the LFG along with non-methane volatile organic compounds. The surface, matrix, and

fracture systems of the coal seams allow for this novel concept to be tested at a laboratory-scale by analyzing cores from coal seams.

PARTNERS

Kansas Geological Survey

Kansas University Energy Research Center

Deffenbaugh Industries

Kansas City LFG, LLC

Oak Ridge National Laboratory

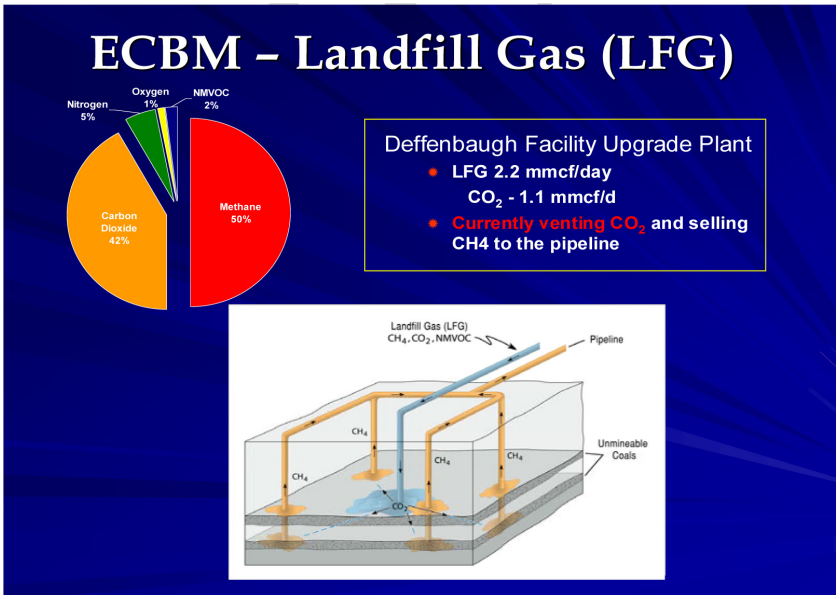
Primary Project Goal

The primary project goal has been to evaluate and assess the reservoir mechanisms and feasibility of subsurface processing of LFG using underlying coal seams while sequestering the CO_2 component from the landfill gas.

Objectives

Project objectives are the following:

- Drilling and coring of selected samples of underlying targeted coal seams of the Johnson County Landfill and subsequent laboratory testing of these coal-bearing cores.
- Specific laboratory testing of selected coal cores for reservoir properties of porosity, permeability, methane content, and CO_2 adsorption potential while displacing CH_4
- Determining the relationship and dynamics of methane, CO_2, and nitrogen on the internal surfaces of the coal samples.
- Evaluating the novel concept of subsurface processing of landfill gas (LFG) using the underlying coal seams of the Johnson County Landfill near Kansas City, Kansas.



Field Test for Validating ECBM-Landfill Gas (LFG)

Benefits

The landfill gas (LFG) project has evaluated the potential decrease of fugitive greenhouse gas emissions, both methane (CH_4) and carbon dioxide (CO_2), by sequestering CO_2 while providing increased methane (CH_4) for home heating, industry, and other commercial uses. Working closely with the EPA has allowed DOE to better assess the role that non-CO_2 greenhouse gas emissions abatement can play in a nationwide strategy for reducing greenhouse gas intensity.

Accomplishments

A final report of the project effort has been completed with detailed results highlighting the assessment of this novel approach for potentially processing landfill gas in underlying coal seams. Initial results of the effort show that there is potential for the carbon dioxide component of the LFG to be adsorbed by the coals and shales on a 2:1 ratio compared to the gas that was originally present.

The volume of in-place methane in the coals and shales underlying the Deffenbaugh Quarry was calculated by using the average of the gas contents of the coal and shale core samples and the average thickness of the gas-bearing coal or shale at each well. A unit was discounted as a viable source of gas if it had less that 10 standard cubic feet per ton (scf/ton) or if it was not at least one foot thick at either of the two core holes drilled at the landfill / quarry project site. The total gas-in-place was calculated to be 985.6 mcf/acre.

Proximate analysis of the coals indicate that they straddle the boundary between high-volatile B and high-volatile A bituminous rank coals. The coals and associated gas shales are under-saturated relative to their gas content with the degree of saturation decreasing with depth.

Assuming 1½ square miles of land (960 acres) at the Deffenbaugh Quarry/ Johnson County Landfill can be utilized for coalbed and shale gas recovery, the total amount of in-place gas calculates to 946,200 mcf, or 946.2 mmcf, or 0.95bcf (i.e., 985 mcf/acre X 960 acres).

PERFORMANCE PERIOD

9/30/2004 to 3/31/2007

COST

Total Project Value

$130,899

DOE/Non-DOE Share

$86,408 / $44,491

ADDRESS

National Energy Technology Laboratory
1450 Queen Avenue SW
Albany, OR 97321-2198
541-967-5892

2175 University Avenue South
Suite 201
Fairbanks, AK 99709
907-452-2559

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-4764

626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-4687

One West Third Street,
Suite 1400
Tulsa, OK 74103-3519
918-699-2000

CUSTOMER SERVICE

1-800-553-7681

WEBSITE

www.netl.doe.gov

Conclusions

Based on the modeling effort of the project:

- CO_2 sequestration in coalbeds is possible – coal is an efficient CO_2 sink
  - No CO_2 breakthrough in 10 years (160 acre spacing)
  - Limited loss in CH_4 production in 10 yrs (160 acres, 100% CO_2)
- Displacement of CH_4 by injection of CO_2 in coalbeds is a complex concept
  - CH_4 recovery process maximized when 100% CO_2 is injected
- Need to conduct follow-on Pilot Sequestration Project to validate simulation results obtained with this initial effort.