Woodard & Curran

# Landfill with GAS

**Maine Resource Recovery Association**

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18-Acres of Green Space
with Gas

# Making Biogas

## Production is food source, moisture and temperature dependent

- **Methanogenic Bacteria** Decompose Organic Materials  No Oxygen.
  a.k.a. Anerobic Digestion
  - Bacteria → methane
  - $H_2/CO_2$ (hydrogenotrophic methanogensis, $4H_2 + CO_2 \rightarrow CH_4 + 2H_2O$) or
  - acetate (acetoclastic methanogensis, $CH_3COOH + \rightarrow CH_4 + CO_2$)
- **Digester Gas**
  - Controlled environment, food scraps, manure, wastewater biosolids in vessel
- **Landfill Gas**
  - Uncontrolled environment

# Landfill Gas Composition

| | |
|---|---|
| **Methane** | 30% to 60% |
| **Carbon Dioxide** | 30% to 50% |
| **Oxygen** | 0 to 5% |
| **Nitrogen** | 0 to 20% |

**Moisture** –Saturated to Dew Point

## Contaminants

- Volatile Compounds
- Hydrogen Sulfide
- Siloxanes, Silicon Compounds
- PFAS

# How Much Gas?

First order Decay Model

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10}\right) e^{-kt_{ij}}$$

Gas production

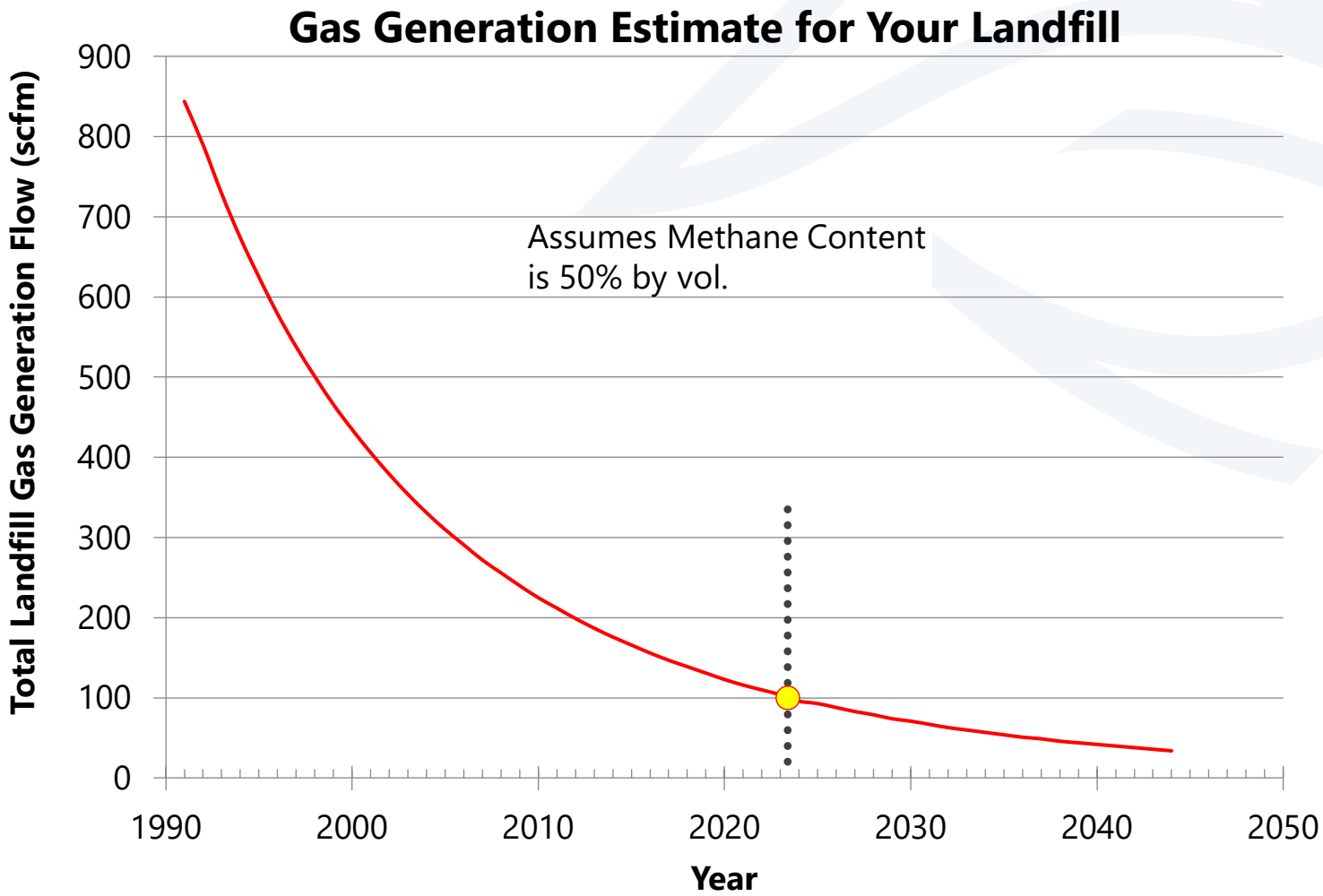
Waste Present

The organics content

Methane Potential, Lo,

Rate of Generation, k

Time, t



# Collect Gas


- Drill Well Shafts Into Landfill

- Install Wells
- Connect the Wells Together
- Apply Vacuum Pressure - Suck

# Control Emissions

- Off-site Migration
- Odor
- Greenhouse Gas
- Volatile Organics

## Combustion with a Flare

Solar Spark Flare


Utility Flare

Enclosed Flare

# Monetizing Landfill Gas

## IS THERE MONEY IN THE METHANE?

- ✓LANDFILL GAS TO ENERGY
- ✓ELECTRIC POWER
- ✓HEAT
- ✓COMBINED HEAT & POWER
- ✓RENEWABLE NATURAL GAS
- ✓CARBON CREDIT OFFSETS

# Produce Electricity

- Direct Use
- Utility Interconnection
  - Net metering
  - Power Purchase Agreement

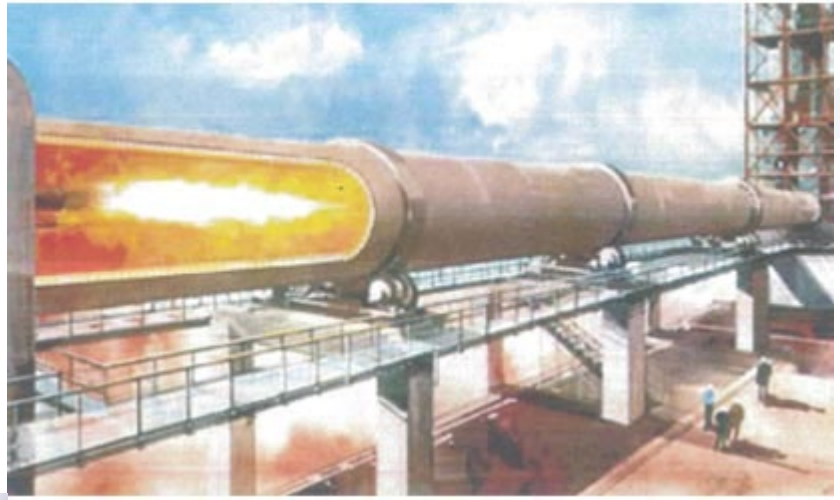
75kW Generator, Ford 460C.I. V-8
Montgomery Regional Solid Waste Authority (MRSWA) in Christiansburg, Virginia


1,000kW Generator, Caterpillar

# Produce Heat

<u>BOILER OR BURNER</u>

- Cement Kiln
- Asphalt Batching Plant
- Industrial Facility



OR

CHP

<u>WASTE ENGINE HEAT</u>

- Hot Water
- Warm Building
- Melt Snow

# RNG – Renewable Natural Gas

## PROCESS TO A HIGH ENERGY CONTENT

- Pipeline Quality Natural Gas
- Vehicle Fuel

Republic Services
South Shelby Landfill
Memphis, Tennessee

# Economic Considerations

**Value**
Good Intentions
Must Do
Revenue
Job Creation

**Capital Expenditure**
Collection System
Gas Treatment Process
Equipment
Building

**Timeframe**
Immediate <>30 years

**O&M**
Labor, People
Monitoring
Well Adjustments
Routine Service
Repairs
Replacement Parts
Record Keeping
Air Emission Permits

# LMOP

EPA United States Environmental Protection Agency

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## Landfill Methane Outreach Program (LMOP)

CONTACT US



# About the Landfill Methane Outreach Program

LANDFILL METHANE OUTREACH PROGRAM

LMOP is a voluntary program that works cooperatively with industry stakeholders and waste officials to reduce or avoid methane emissions from landfills. LMOP encourages the recovery and beneficial use of biogas generated from organic municipal solid waste (MSW). Landfill gas (LFG) and other biogas generated from MSW (collectively referred to as biogas) contain methane, a potent greenhouse gas that can be captured and used as a renewable fuel for many end uses including electricity generation, industrial heat applications and vehicle fuel. Capturing and using biogas reduces local air pollution, creates health benefits, generates revenue and jobs in the community and may also offset the use of non-renewable resources.

LMOP forms partnerships with communities, landfill owners and operators, utilities, power marketers, states, project developers, Tribes and nonprofit organizations to overcome barriers to project development. LMOP focuses on LFG energy project development at MSW landfills, the largest source of methane emissions from the waste sector.

# University of New Hampshire Project

## Landfill Gas Replaced Natural Gas

### ECOLine

12.7-Mile Pipeline Landfill to University Gas Processing Plant
$49 Million (est.)

### COGEN (Heat & Electricity)

Up to 85% of the Campus Energy

# Land is Valuable


**THE CROSSING AT WALKERS BROOK**

**Reading, Massachusetts**

# Closing Remarks