

# Methane Recapture



*NARUC Energy Regulatory Partnership Program*

*The Georgian National Energy Regulatory Commission  
and  
The Vermont Public Service Board*

*by*

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# Overview

- ❖ Overview of methane recapture methods
  - Landfill gas generation
  - “Cow power” – generation on farms
- ❖ Incentives
  - Regulations promoting renewable energy
  - Regulations impacting fossil fuel generation
  - Federal policies and tax credits
  - Economic incentives for private sector involvement

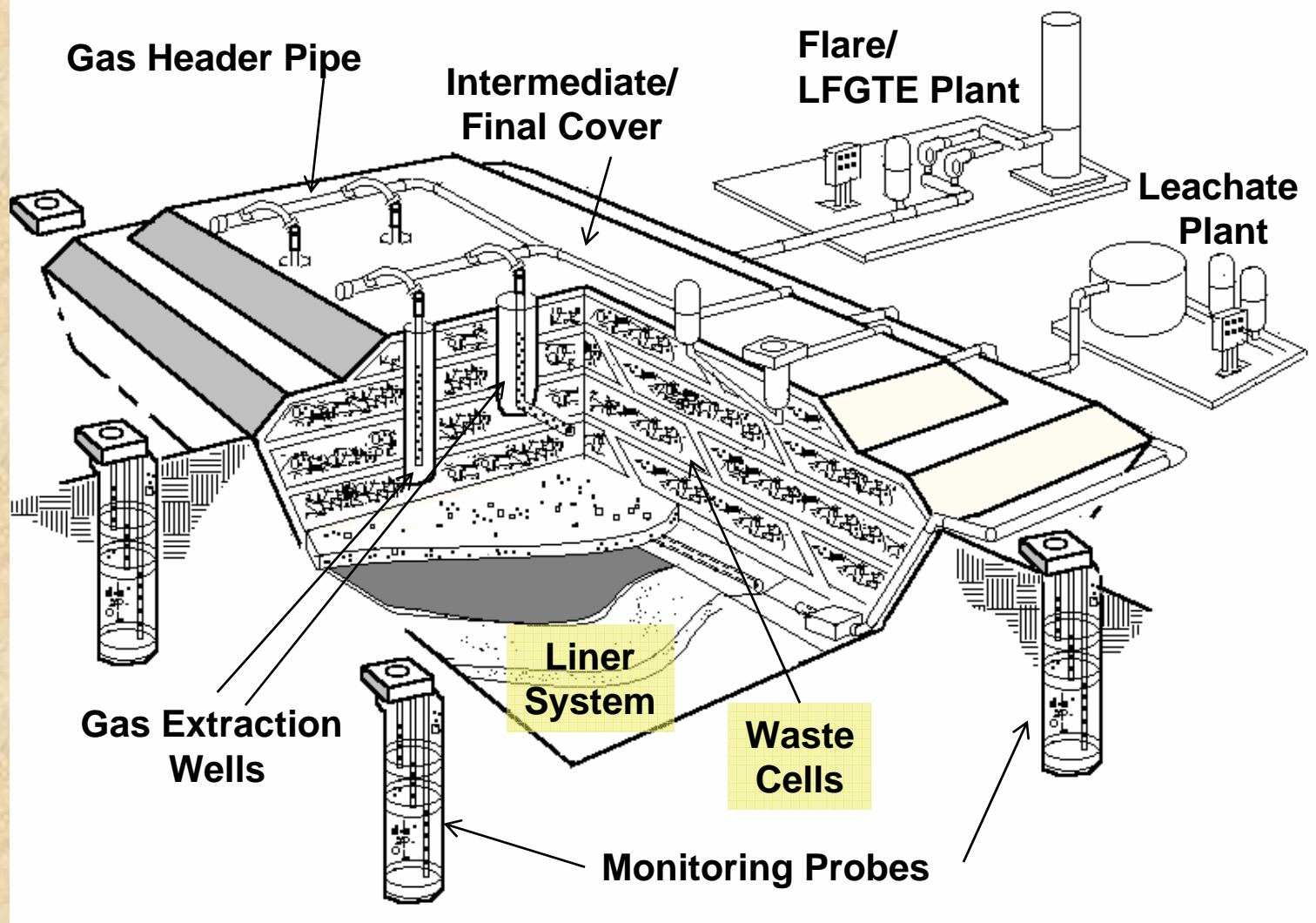


# *Methane Emissions Concerns*

- ❖ Methane as a greenhouse gas is over 20 times more potent by weight than carbon dioxide (CO<sub>2</sub>)
- ❖ If uncontrolled, methane contributes to smog and global warming, and may cause health and safety concerns
- ❖ Landfills contribute about 23 percent of human-related methane emissions in the U.S. , the second largest source
- ❖ Livestock waste contributes about 8 percent of human-related methane emissions in the U.S.



# Landfill with Energy Plant



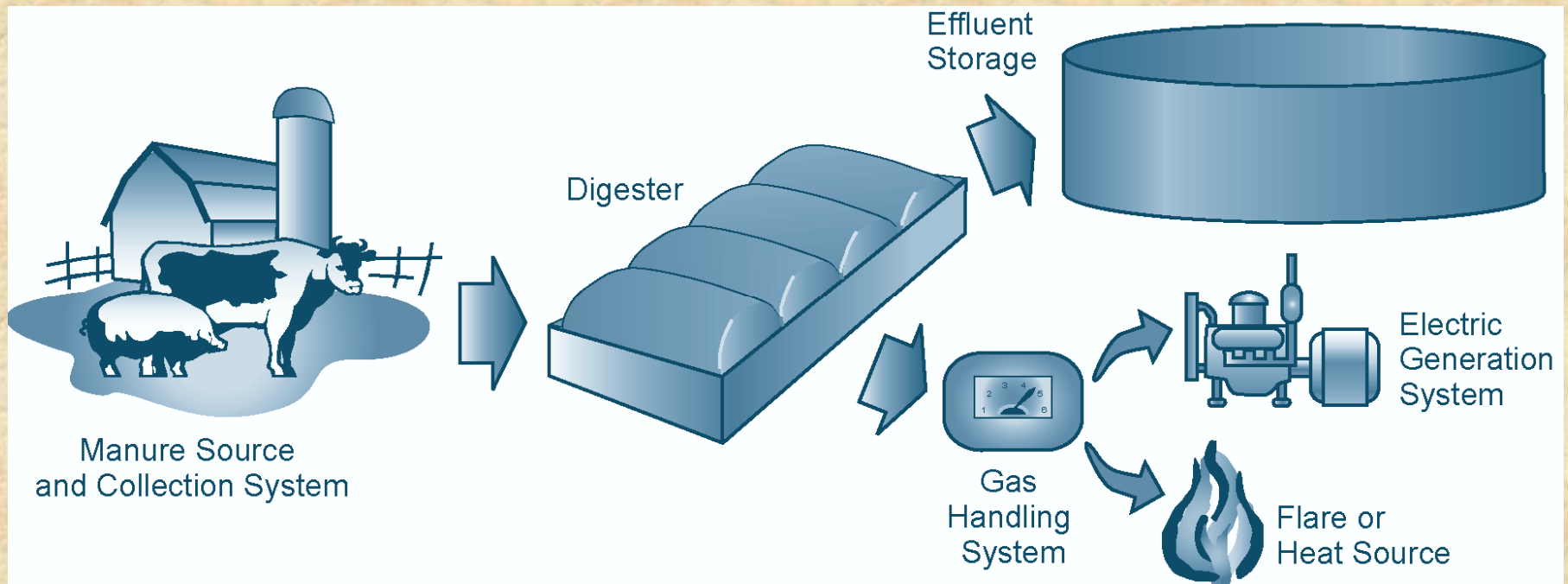


# *Landfill Gas System*

- ❖ Requires a capped landfill, with or without a liner system, that promotes methane production
- ❖ Requires a gas handling system, including gas extraction wells, that moves landfill gas to energy end use
  - Includes piping, pump or blower, gas meter, pressure regulator, and condensate drains; maybe gas scrubber
- ❖ Landfill gas to energy plant includes gas flaring equipment, internal combustion engine or gas turbine, and generator



# Components of a Biogas System



- ❖ Manure Collection
- ❖ Anaerobic Digester
- ❖ Effluent Storage
- ❖ Biogas Handling
- ❖ Biogas Use



# Biogas System

- ❖ Includes manure collection system such as ponds, anaerobic lagoons, and holding tanks
- ❖ Digester is a heated, oxygen-free environment
  - Bacteria digest the volatile components of the manure, creating biogas while killing pathogens
- ❖ Gas handling system and gas-to-energy plant similar to landfill gas system
- ❖ Digester remains are stored in a effluent storage tank – continued bacteria digestion creates more methane
- ❖ Manure byproduct is separated: the liquids can be spread on fields as fertilizer and the dry solids can be composted or used for cow bedding



# *Methane Gas Generation*

- ❖ Landfill gas (LFG)
  - ~50% methane/~50% CO<sub>2</sub> and trace organics
- ❖ For every 1 million tons of municipal solid waste:
  - ~432,000 cubic feet per day of LFG
  - ~0.8 megawatts (MW) of electricity
- ❖ Digester Biogas
  - usually 60-80% methane
  - heating value of 600-800 Btu/ft<sup>3</sup>
- ❖ 500 cows can produce over one million kWh of energy annually



# *LFG/Biogas Use*

- ❖ Electricity generation
  - Internal combustion engines, gas turbines, microturbines
  - For on-site use and/or sale to grid
- ❖ Direct use of methane gas
  - Co-generation (combined heat and power)
  - Fuel for boilers and heaters
  - Direct thermal (dryers, kilns, greenhouses)



# *Electricity Generation*



**Internal  
Combustion Engine**  
(range from 100 kW to 3 MW)



**Microturbine**  
(range from 30 kW to 250 kW)



**Gas Turbine**  
(range from 800 kW to 10.5  
MW)



# *Benefits of Methane Recapture*

- ❖ Reductions in methane – potent greenhouse gas
- ❖ Financial benefits of selling electricity
- ❖ Reductions in odors and manure pathogens
- ❖ Water-pollution-control opportunities through better management of landfill or manure waste
- ❖ Integrate well into landscapes – fewer aesthetic concerns
- ❖ Production of local renewable power
- ❖ Farm generation provides a significant revenue stream, improving dairy economics and diversification
- ❖ Farm generation provides high quality fertilizer and fiber byproducts



# *Feasibility of Methane Recapture*

- ❖ Size of facility
  - Production and collection of methane gas stable year round
  - About 500 milking cows to produce enough energy for biogas system to be economically viable
- ❖ Existing Infrastructure
  - Capped landfill with gas capture and flares
  - Manure management system in place
- ❖ Incentives – regulatory and economic



# *Methane Recapture in Vermont*

- ❖ Landfill recovery gas plants:
  - Coventry Landfill – 8 MW online
  - Moretown Landfill – 3 MW online
- ❖ CVPS Cow Power farms:
  - Six farms online
  - All farms have over 500 cows and produce between 0.78 and 3.5 million kwh a year



# *Methane Recapture in U.S.*

- ❖ At least 450 operational LFG projects in 43 states supplying:
  - 11 billion kilowatt hours of electricity
  - 77 billion cubic feet of LFG to direct-use applications annually
- ❖ Total of 120 operational biogas projects in 26 states supplying:
  - 254 million kilowatt hours of electricity annually



# *Incentives for Renewables*

- ❖ Regulations promoting renewable energy
  - Renewable portfolio standards
  - Feed-in tariffs
  - Green pricing programs
  - Net metering
- ❖ Indirect economic incentives
- ❖ Federal policies and tax credits
- ❖ Economic incentives for private sector involvement
  - Loans and grants
  - Outreach programs



# *Renewable Portfolio Standards*

- ❖ Renewable Portfolio Standards require that a certain quantity of power sold by retail service providers come from renewable energy
- ❖ Goal is to reduce reliance on fossil-fuel-fired generation and resulting environmental impacts and price volatility
- ❖ 28 states have some form of renewable energy requirement
- ❖ Most programs utilize a system of tradeable renewable energy credits to demonstrate compliance



# *Renewable Portfolio Standards*

- ❖ Renewable Energy Credits represent the environmental attributes of renewable generation
- ❖ Certified generators are granted one REC for each MWh of renewable generation
- ❖ RECs may be bought and sold
- ❖ RECs can be traded separately from underlying electric generation
  - Providers only need to buy RECs, not the actual power produced, from renewable sources to demonstrate compliance with the RPS



# *Renewable Portfolio Standards*

- ❖ Significant differences among state programs
- ❖ Goals can be in percentage of power supply (range from 10-30%) or specify number of MW or MWh
- ❖ Some programs allow existing renewable resources and others allow only new resources to qualify
- ❖ Time period to achieve compliance with goals varies, as do penalties for noncompliance
- ❖ Some states allow RECs from out-of-state facilities, others require RECs from in-state facilities only
- ❖ Some states set upper limits on the cost of RECs and have provisions allowing a waiver of requirements



# *Vermont SPEED Program*

- ❖ SPEED (Sustainably Priced Energy Enterprise Development) Program established to encourage utilities to invest in renewable resources without RPS
- ❖ Vermont RPS does not take effect if
  - utilities (collectively) meet load growth since 2005
  - and at least 5% of load is met through new renewable resources (SPEED resources)



## *Vermont Feed-In Tariff*

- ❖ New statute (H. 446 ) changes SPEED to implement a pilot feed-in tariff
- ❖ Tariff specifies a rate (above market prices) at which utility will purchase energy from renewable sources
- ❖ Costs of the program are borne by ratepayers
- ❖ The bill directs the Board to review and reset the tariffs every two years
  - Board opened investigation in June 2009
  - Board must set new rates by January 2010



# *Vermont Feed-In Tariff*

- ❖ Program cap of 50 MW and project size cap of 2.2 MW
- ❖ Contract term: 20 years
- ❖ Wind energy tariffs
  - ≤15 kW: \$0.20/kWh
  - >15 kW: \$0.14/kWh
- ❖ Landfill and biogas tariff of \$0.12/kWh
- ❖ Solar tariff of \$0.30/kWh
- ❖ Future tariffs based on cost of generation plus profit less applicable tax credits and other incentives
- ❖ Profit set at rate of return of Vermont electric utilities



# *Green Pricing Programs*

- ❖ Green pricing programs are utility-specific programs that allow customers to pay higher rates to promote renewable generation
- ❖ Utility can use the money to subsidize particular generation technology or to buy renewable energy credits



# *Green Pricing Programs*

- ❖ In Vermont every utility is required to have a renewable energy pricing program (or green pricing) or a program that allows customers to voluntarily donate money to a fund established to support renewable energy
  - **Clean Energy Development Fund**
- ❖ Customers can either pay a higher rate or donate a fixed dollar amount
- ❖ Utility uses the money to support renewable energy and retires the RECs associated with the project it is supporting



# *CVPS Cow Power Program*

- ❖ Customers can elect to pay an extra 4 cents per kilowatt hour for their electricity
- ❖ For every kilowatt-hour requested, CVPS pays the farmer 95 percent of the market price for energy plus the Cow Power charge of 4 cents
- ❖ If not enough kilowatt-hours are available from CVPS farms, CVPS attempts to acquire and retire RECs from other regional renewable generation
- ❖ If no RECs are available in the regional market for 4 cents per kWh or less, CVPS deposits payments into the CVPS Renewable Development Fund



# Net Metering

- ❖ Customers install small renewable power at their residence or business
  - 250 kW cap in Vermont
- ❖ Cap on total amount of participating generation
  - 2% of utility's load
- ❖ When a customer generates more energy than that consumed, the customer receives a credit at the retail rate for the net excess generation on the following utility bill



## *Indirect Economic Incentives*

- ❖ Policies directed at fossil-fuel-fired generation can provide indirect incentives for renewables
- ❖ Primarily market mechanisms that require fossil-fuel-fired generators to pay costs associated with environmental impact of generation
- ❖ Examples – cap and trade programs for NO<sub>x</sub>, SO<sub>2</sub>, and CO<sub>2</sub>



# *Regional Greenhouse Gas Initiative*

- ❖ First mandatory CO<sub>2</sub> cap-and-trade program in U.S.
- ❖ Ten Northeastern and Mid-Atlantic states - reduces CO<sub>2</sub> emissions from the power sector 10% by 2018
- ❖ Each electric power generator (> 25 MW) must hold allowances covering its emissions of CO<sub>2</sub>
- ❖ States sell emission allowances through quarterly auctions and invest proceeds in consumer benefits
  - Vermont created All-Fuels Efficiency Program
- ❖ Third RGGI auction occurred in March 2009
  - Vermont received \$756,000; allowance clearing price \$3.51/ton



# *Emissions Trading of Methane*

- ❖ Landfill gas eligible for offsets under RGGI program
  - small landfills (< 2.5 million tons design capacity)
- ❖ Chicago Climate Exchange (CCX) is an example of a voluntary GHG reduction and trading program
  - Offers a credit of 18.25 metric tons CO<sub>2</sub> per metric ton of methane combusted
  - Prices have ranged from \$1 to \$6.50 per metric ton



# *Federal Financial Incentives*

- ❖ Production Tax Credit
  - Federal income tax credit of 1.0 cent/kWh for landfill gas energy plants
  - Placed in service by December 31, 2008
  - 10-year window for credits



# *Federal Financial Incentives*

- ❖ Renewable energy provisions in Stimulus Act
  - Extended the placement-in-service deadline for certain energy sources under production tax credit (including landfill gas) to December 31, 2013
  - Allows owners of new renewable energy facilities to claim an upfront 30% investment tax credit instead of over 10 years or to elect a tax-free cash grant instead of claiming tax credit
  - Non-tax provisions include a loan guarantee program for renewable energy projects – Department of Energy to guarantee up to \$60 billion



# *Grant and Loan Programs*

- ❖ State and federal grant and loan programs are available for funding biogas and landfill gas projects
- ❖ Vermont grant programs include:
  - Clean Energy Development Fund - administered by the DPS - established to support the development of renewable energy in Vermont
  - CVPS Renewable Development Fund - provides grants and loans and encourages farm owners to develop new renewable generation including CVPS Cow Power™ projects



# *National Outreach Programs*

- ❖ Voluntary programs creating alliances among states, energy users/providers, industry, and communities
  - EPA's Landfill Methane Outreach Program
  - AgSTAR - collaborative program of EPA, Department of Agriculture, and Department of Energy
- ❖ More information at:
  - [www.epa.gov/lmop](http://www.epa.gov/lmop)
  - [www.epa.gov/agstar](http://www.epa.gov/agstar)