

WM's Renewable Energy Program

A&WMA Ontario

Waste Management and
GHG Reduction Seminar

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THINK GREEN.®

WM Project Development

WM Renewable Energy is a corporate business unit with the directive to achieve the highest value for LFG

WMRE works with WM landfill management to identify and select the optimal project for the site.

WMRE then develops, designs, constructs, owns and operates the plants, markets the energy and renewable attributes, and performs all financial, tax, and accounting functions

Types of Landfill Gas Projects

Power - On-site power plant, with electricity delivered to nearby utility power distribution line.

Medium Btu - Delivered in dedicated pipe to single user:

- Heating - boilers, kilns, burners, green houses, etc.
- Off-site utility or co-gen at industrial plants
- Liquid disposal

High Btu - Cleaned to natural gas or fuel specifications:

- Delivered into natural gas pipeline
- On-site CNG fueling station
- On-site LNG or CNG production and trucked off-site

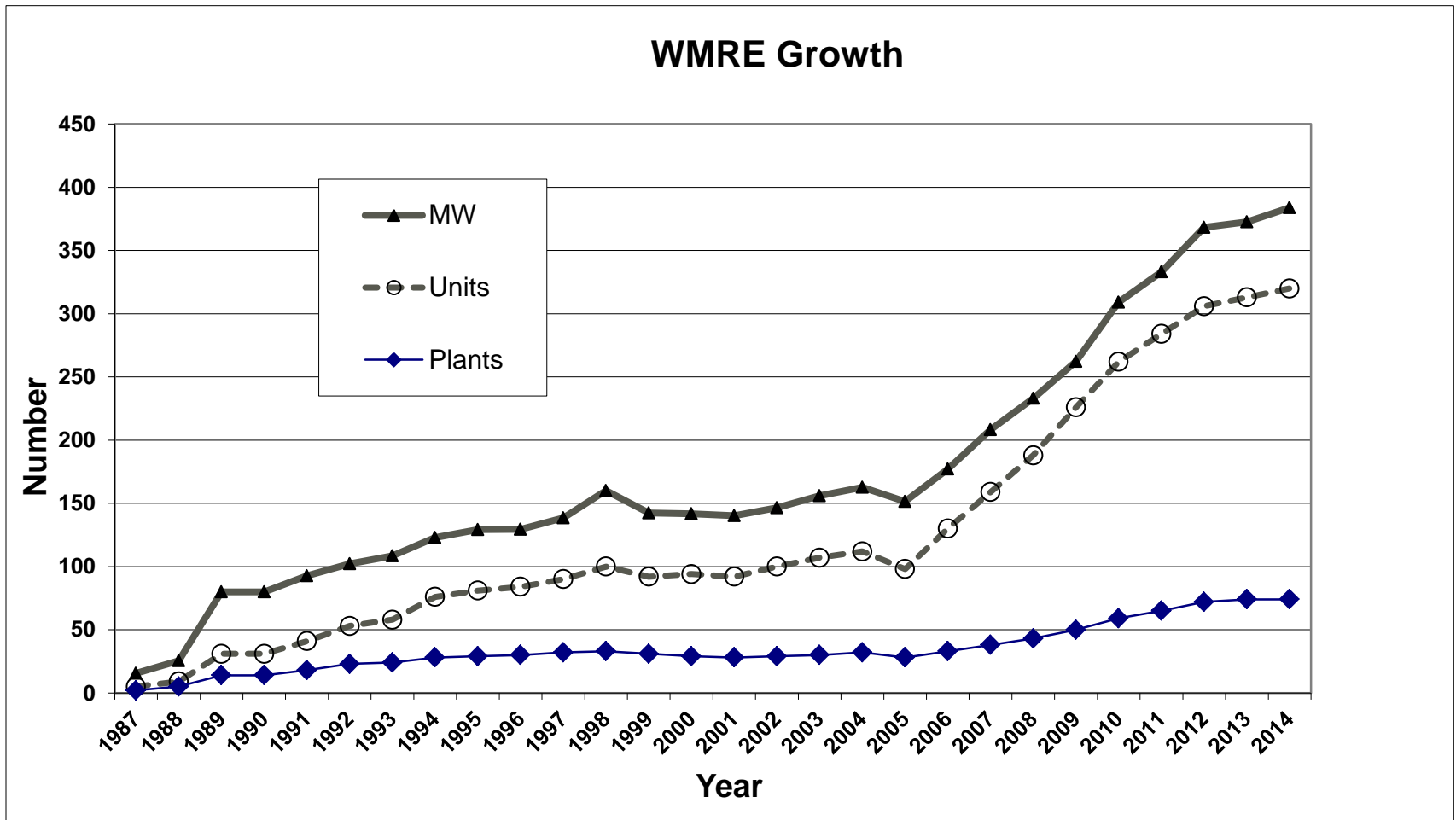
WM Landfill Gas Project Inventory

Type of Project	Owned by WM	3rd Party Developer	TOTAL
On-Site Power	74	29	103
Off-Site Power	2	2	4
Medium BTU	6	6	12
Liquid Disposal	4	0	4
High BTU	1	9	10
LNG	1/2	1/2	1
Totals	87.5	46.5	134

On-Site Power Plants are the most common

- Established technology and well-defined operations cost
- Access to market is universal (utility distribution lines)
- No product quality risk (electrons)
- Price premiums and stability available in many markets
 - PURPA guaranteed a buyer of output
 - Renewable Portfolio Standards in 29 states. Renewable Energy Credits add \$0.50 to over \$50/mwh, or are bundled with energy at a fixed premium price
 - State exemptions for sales and property tax, and income tax credits
 - Long-term fixed rate contracts are possible in some markets
 - Federal Production Tax Credits: \$11/mwh for 10 years - EXPIRED

WMRE Power Plant Growth



WMRE Operations



WMRE Plants in Illinois

<u>Site</u>	<u>Startup</u>	<u>Current MW</u>	<u>Landfill Status</u>
Lake	1988	3.1	Closed
CID	1989	3.1	Closed
Settlers Hill	1989	6.2	Closed
Tazewell	1989	2.2	Closed
Milam	1991	2.4	ACTIVE
Kankakee	1992	1.6	Closed
Woodland	1992	4.8	Closed
Greene Valley	1996	6.2	Closed
Five Oaks	2008	3.2	ACTIVE
Prairie View	2011	4.8	ACTIVE
Total WM Plants	10 sites	37.6	

Milam RNG Plant	2014	High btu	ACTIVE
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Undeveloped landfills: Cottonwood Hills, DeKalb County, Prairie Hill

Renewable Energy Plant



Slow-down in growth in 2013

- Market Energy prices peaked in 2008-2009
- Lull in utility and municipal RFPs: WM signed 23 long-term fixed-rate contracts in 2010-2012, but only 2 in 2013.
- Fewer states adding or expanding renewable portfolio standards, especially in the southeast
- Section 45 tax credits expired in 2013
- Fewer WM landfills with sufficient gas

Bundled Energy Prices

(Rounded and averaged for selected sites)

Market	2008	2009	2010	2011	2012	2013
IL- ComEd	54	47	39	34	32	39*
IL- Ameren	60	61	40	35	33	32
PJM	65	68	53	47	38	47*
Wisconsin	57	57	48	33	29	34
Texas	61	30	35	42	27	33
Florida	41	41	42	30	22	23

*Significant REC component in YOY rebound

Why not more Medium BTU Projects?

ADVANTAGES

Simple technology: compressor and a pipeline to the end user.

Air permitting may benefit the landfill because gas is removed from site.

CHALLENGES:

- Need a nearby industrial facility with a sufficient fuel requirement.
- Pipeline r-o-w must be available and at reasonable cost.
- User may reduce or eliminate demand, resulting in stranded asset.
- User sometimes requires gas cleanup.
- Pipeline regulations add risk and require specialized expertise
- Current low price of natural gas, which sets baseline for pricing.
- There are no renewable incentives targeted to direct sale of LFG.

Why not more High BTU Projects?

Technology has been proven over the last 20 years.

Reduces on-site emissions.

- Higher LFG flow threshold for economy of scale.
- Nitrogen removal adds to cost.
- Natural gas pipeline must be nearby and accessible.
- Risk of processing upsets or LFG quality variations, resulting in failure to continuously meet natural gas specifications.
- Historical lack of renewable premiums

Renewable Natural Gas

Cost to process LFG to RNG is equal to or greater than natural gas price: need renewable incentives and premiums to make a profit

- Current incentive is the federal renewable fuel credit, worth \$4 to over \$8 per mmbtu (RINs)
- Put renewable natural gas in pipeline at landfill, contract with CNG fueling stations to sell renewable attributes, sell renewable fuel credits to refineries - HIRE AN EXPERT TO HELP YOU THROUGH THE SYSTEM AND RULES
- EPA “Pathway” more straightforward with on-site CNG
- Long-term fixed-rate contracts are just now being considered by “obligated parties”

Why not Convert LFG to High-priced Liquids?

*Gas to Liquids (GTL) technology was developed in 1920's.
Large price gap between gas and oil makes GTL attractive.
Should be available for Renewable Fuel Credits*

- WM signed JV agreement with Velocys and NRG to develop gas to liquids plants using biogas and natural gas
- First plant will be at East Oak in Oklahoma

Fossil Fuel Value - \$/MMBTU

Commodity	Product Units	Recent Prices per Product Unit	MMBTUs per Product Unit	Value Per MMBTU
Coal	Ton	\$50 - \$100	23±	\$2 - \$4
Natural Gas	mcf	\$3 - \$5	1	\$3 - \$5
Oil	Barrel	\$100	5.9±	\$17
Diesel	Gallon	\$3 - \$4	0.14	\$20 - \$30
Wholesale Electricity	mwh	\$30 - \$40	11± for LFG	\$3 - \$4

LFG value by Project Type

LFG Project Type	Market	Product Price, \$/mmbtu	Con- version %	LFG Base Value	Renewable Premium	Renewable LFG Value
Power	Power	\$3 - \$4	Inc. in price	\$3 - \$4	RECs: \$0-\$5 S45: \$1.40	\$3 - \$9
Med BTU	Natural Gas	\$3 - \$5	90%	\$1-\$4	\$0	\$1 - \$4
High BTU	Natural Gas	\$2 - \$5	85%	\$2-\$4	RINs: \$4-\$8	\$6 - \$12
Gas to Liquids	Diesel	\$20 - \$30	50%	\$10 -\$15	RINs: \$4-\$8	\$14 - >\$20

Comparison is for product price range only and does not consider capital investment, commodity risk, product specification risk, operating expense, permitting constraints, etc.

WM's Development Strategy for LFG

1. Track LFG improvements at undeveloped landfills
2. As third-party contracts come to term, evaluate for extension, acquisition, or redevelopment
3. Evaluate medium btu and liquid disposal opportunities at each site.
4. Pursue power plants with long-term fixed-rate contracts.
5. Be selective in pursuing High BTU projects at current natural gas prices. Decision to proceed would likely hinge on a long-term REC contract or ability to execute long-term fixed rate RINs contract.
6. Continue to monitor GTL progress as an alternative.
7. Some locations may just not work yet: be patient.