

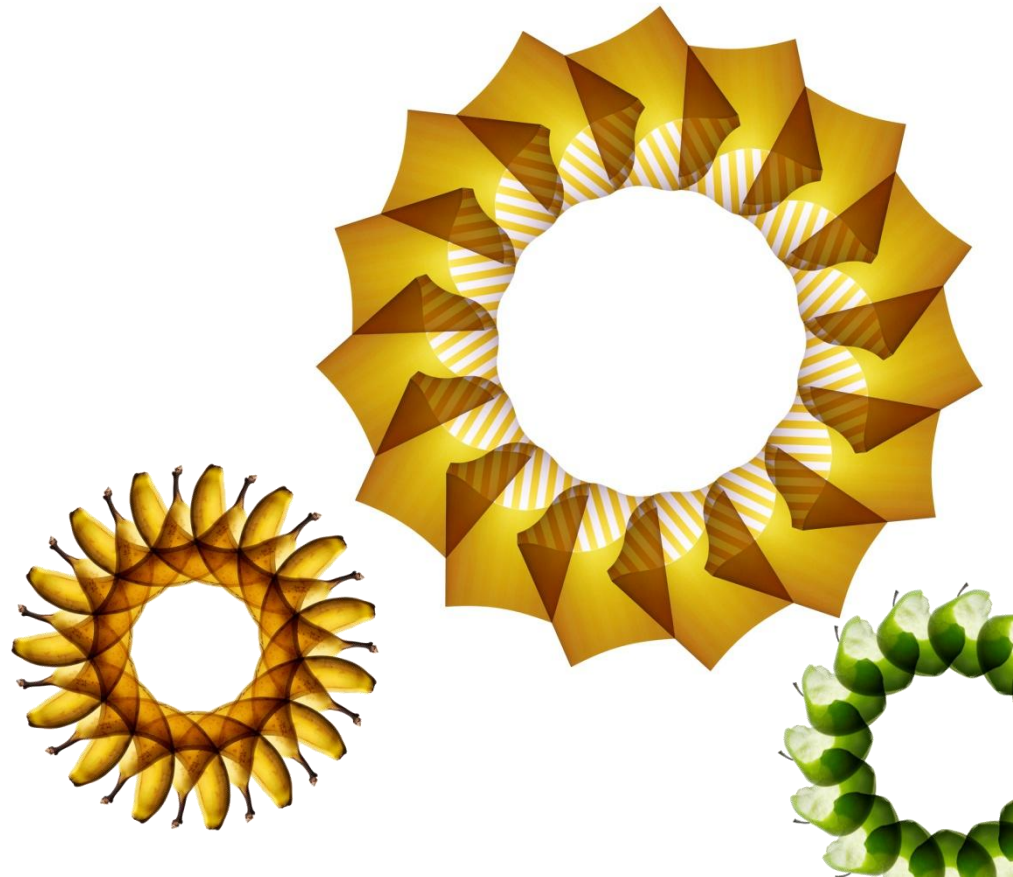
# Landfill Gas to Renewable Energy

**THINK GREEN.®**

Benefits of capturing and harnessing  
methane emissions from municipal solid  
waste landfills

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# Leading provider of environmental solutions

WM Sustainability Facts	WM's 2011 Operations Stats			
Creates enough energy to power more than 1.2M homes every year	<b>+21</b> MILLION CUSTOMERS	<b>390</b> COLLECTION OPERATIONS	<b>1</b> ACTIVE HAZARDOUS WASTE UNDERGROUND INJECTION FACILITY	<b>18</b> SECONDARY PROCESSING FACILITIES
Manages more than 10 million tons of recyclable commodities				
Operates more than 2000 natural gas collection vehicles	<b>5</b> ACTIVE HAZARDOUS WASTE LANDFILLS	<b>131</b> LANDFILL- GAS-TO- ENERGY PROJECTS	<b>12</b> CONSTRUCTION & DEMOLITION RECYCLING FACILITIES	<b>266</b> ACTIVE SOLID WASTE LANDFILLS
In 2011, exceeded our 2020 goal to reduce CO2 emissions from our fleet by 15 percent - we are at 20 percent and counting.				
A decade ahead of time, we met our 2020 goal of creating 100 certified Wildlife Habitat sites and protecting 25,000 acres at our sites.	<b>95</b> RECYCLING FACILITIES	<b>5</b> INDEPENDENT POWER PRODUCTION PLANTS 2 PRODUCE RENEWABLE ENERGY	<b>36</b> ORGANIC PROCESSING FACILITIES	<b>352</b> TRANSFER STATIONS
	<b>36</b> ARE SINGLE STREAM			
			<b>17</b> WASTE-TO-ENERGY PLANTS	<b>OVER 44,300</b> EMPLOYEES

# Landfill Gas: A Renewable Resource

- Natural anaerobic decomposition of organic waste
- Landfill gas is about 50% methane

Any technology or application that uses natural gas can also use landfill gas





# Landfill Gas Collection



< Perforated pipe wells are drilled into the waste, about one every acre



< The wells are connected to a header pipe. A blower places a vacuum on the header pipe to withdraw the gas.



< If it is not used as fuel for renewable energy, the gas is simply burned off in a flare

# Environmental Protection is Priority #1

The collection of LFG is required by regulation at larger landfills, and is an integral responsibility and cost of operating a landfill:

- Off-Site Underground Migration (RCRA Subtitle D)
- Groundwater Contamination (RCRA Subtitle D)
- Odor control
- Organic Carbon Emissions through cap (CAA - NSPS)

The use of LFG for renewable energy must be harmonized with the landfill owner's first priority of compliance and environmental protection

- According to EPA's 2012 National GHG Inventory, MSW landfills have decreased their methane emissions by over 27% since 1990.

# WM Renewable Energy from Waste

- Our 138 landfill gas (LFG)-to-energy plants provide enough renewable energy to power the equivalent of half a million homes
- Our WM/Linde Altamont plant converts LFG to ultra low-carbon liquefied natural gas and powers over 300 natural gas refuse trucks in CA
- WM generates more renewable energy than the entire US solar industry

WM landfill to energy projects create enough energy to power 500,000 homes  
Connect to WM's 2012 Sustainability report at  
<http://www.wm.com/sustainability/index.jsp>



# Types of Landfill Gas Projects

**Power** - Fuel for power plant on landfill, with electricity delivered to nearby utility power distribution line.

**Medium Btu** - Delivered in dedicated pipe to single user to displace fossil fuel in steam boilers, kilns, burners, green houses, etc.

**Liquid Disposal** - Fuel to evaporate contaminated water at landfill.

**High Btu** - Cleaned to natural gas specifications and delivered to a natural gas pipeline.

**Vehicle Fuel (LNG and CNG)** - Cleaned to natural gas fuel specifications, then compressed or liquefied at an on-site fueling station.

# Landfill Gas Project Inventory

Type of Project	US Total Sites	WM
Power	310 +	105
Medium BTU	110 +	18
Liquids Disposal	10 - 15	4
High BTU	30 $\pm$	10
Vehicle Fuel: CNG/LNG	5	1
Totals	470 +	138



# 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

- Not available at every landfill - 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
- 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?

## ADVANTAGES

- Technology has been proven over the last 20 years.
- Air permitting may benefit landfill because gas is removed from site.

## CHALLENGES

- Cost to process landfill gas is typically \$4 to \$6/MMbtu, while natural gas prices have recently ranged from \$3.50 to \$4.50/MMbtu.
- Higher LFG flow is needed for economy of scale and project viability.
- Natural gas pipeline must be nearby and accessible.
- Risk of process failure to continuously meet natural gas specifications.
- Renewable incentives require complicated structures and transactions, are not universally available, and credits can be volatile

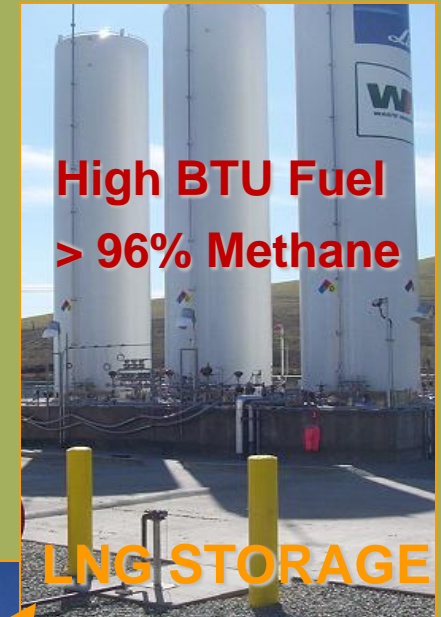
# RINs from High BTU “Renewable Gas”

- The EPA Renewable Fuel Standard (RFS2) mandates that fuel refiners obtain renewable fuel credits to meet a minimum percentage of renewable fuel production.
- Renewable fuel credits are called RINs (Renewable Identification Number), and represent 77,000 BTUs of fuel (13 RINs per MMBTU).
- CNG and LNG produced from landfill gas qualify for RINs.
- Landfill owner can sell High BTU gas via a natural gas pipeline to a CNG or LNG fueling station, or construct a fueling station at the landfill.
- RINs prices have ranged from \$0.40 to \$1.00, equal to \$5-\$13/MMBTU.
- RIN revenue is shared by gas producer and renewable fuel vehicle user.

## ISSUES

- The “pathway” from producer to user must be approved by EPA
- Uncertain future of regulation
- RIN buyers require extensive documentation and credit support
- RIN pricing can be volatile.

# Facility for LFG to LNG



**High BTU Fuel  
> 96% Methane**

# On-Site Power Plants are the most common

## ADVANTAGES

- Established technology and well-defined operations cost
- Access to market is universal (utility distribution lines)
- No product quality risk (electrons)
- Renewable energy incentives target electricity
- Long-term fixed rate contracts are possible in some markets

## CHALLENGES

- Air permitting: may limit plant capacity, add capital cost, or delay project, and in some cases be a fatal flaw
- Utility interconnect costs and capacity constraints
- Electricity and renewable markets vary widely by state



# Renewable Energy Revenue Sources

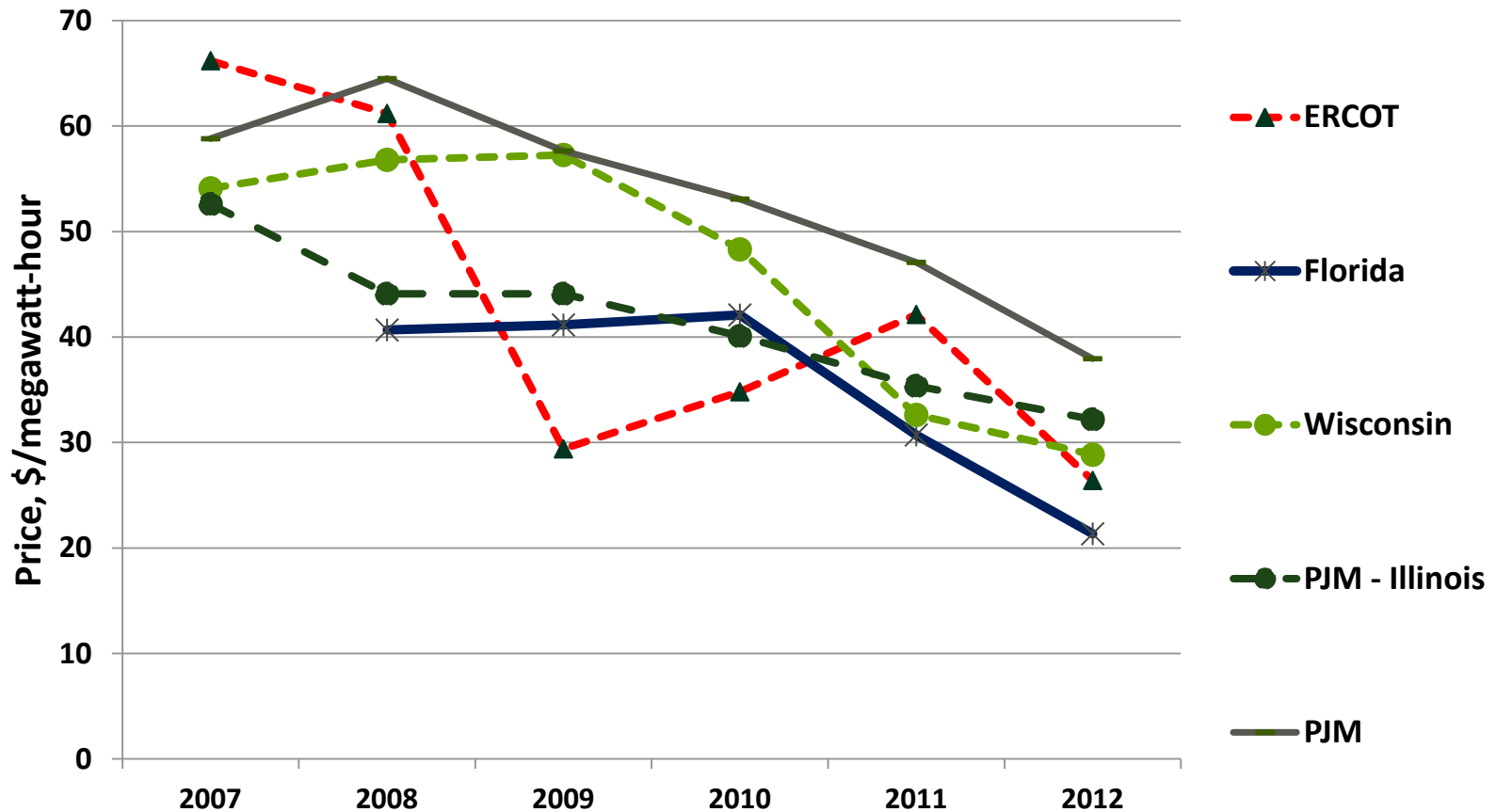
- Sale of energy at wholesale price to utility or retail energy provider.
- Renewable Energy Credits
- Federal Tax Credits: \$11/Mwh for 10 years
- Federal MACRS accelerated depreciation
- State Incentives: investment credits, tax exemptions, grants, loans

## Recent and Future Challenges

- Energy prices have dropped, following drop in natural gas prices
- No more states implementing Renewable Portfolio Standards, and some considering reduction or repeal
- Federal Tax Credit eligibility deadline at end of 2013.

# Market Price Trends

## Bundled Energy plus Renewable Energy Credits



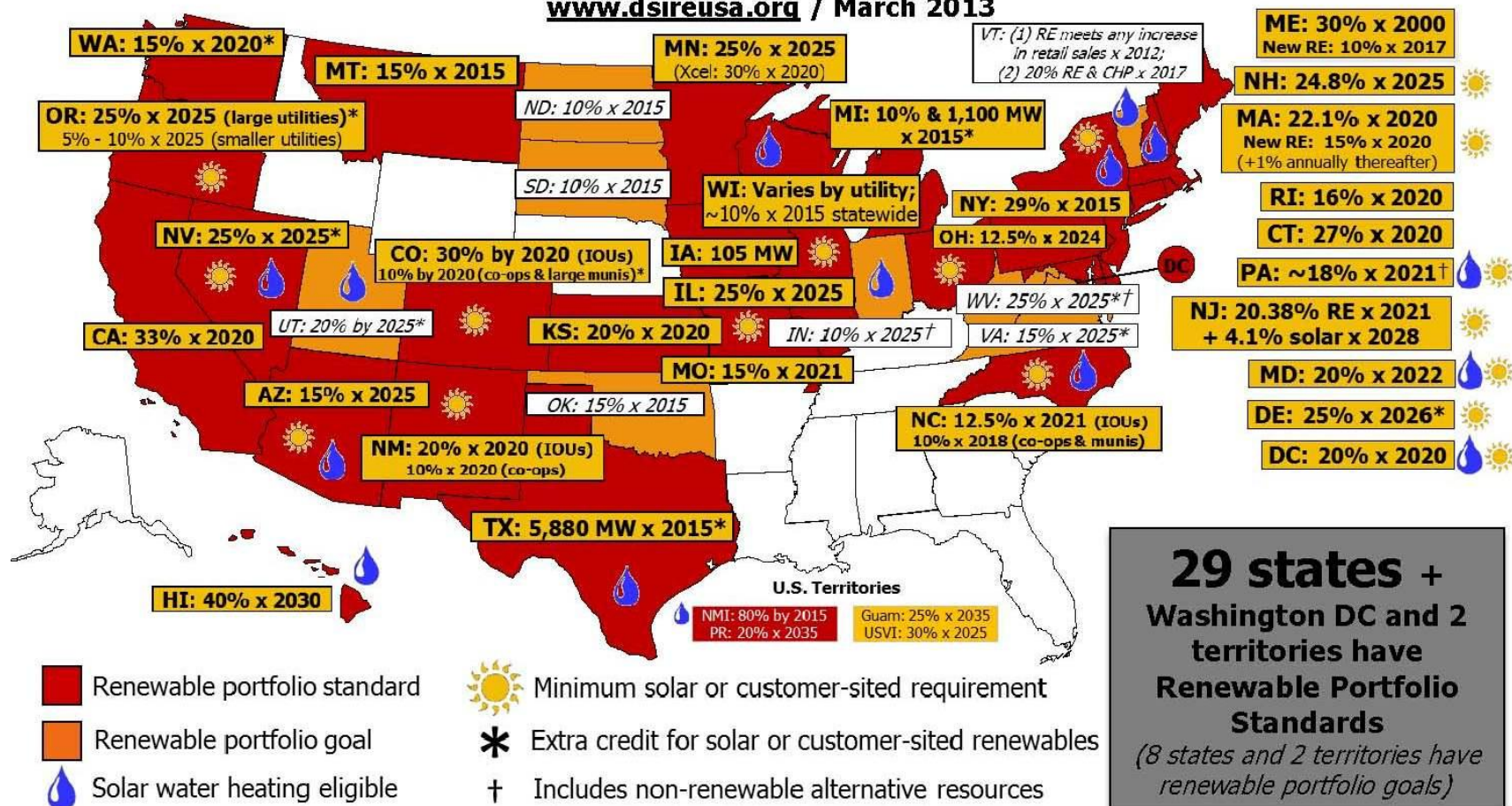
# Renewable Energy Credits (RECs)

## Compliance RECs

- 29 states and D.C. have Renewable Portfolio Standards (RPS) that require electricity producers to obtain a minimum percentage of their power from renewable energy resources.
- Producers purchase Renewable Energy Credits (RECs) from qualified renewable resources, such as wind, biomass, and landfill gas.
- Value range = \$3 to over \$60 per Mwh, varies with state
- A recent report indicates that in as many as 14 states, bills have been introduced that would water down or repeal the RPS mandates. None have been signed into law so far.

# Renewable Portfolio Standard Policies

[www.dsireusa.org](http://www.dsireusa.org) / March 2013



# Long-Term Fixed Rate Contracts

- Many utilities, municipalities, and co-ops have issued RFPs for renewable energy to satisfy their state RPS or sustainability goals.
- The contracts are for bundled energy and RECs, for terms up to 20 yrs.

**These contracts allow the renewable energy provider to avoid the volatility and uncertainty of market pricing.**

- In the last 3 years, WM has executed 18 long-term fixed-rate contracts.
- There has been a noticeable decline in offerings from utilities in the past 1-2 years.



# Federal Production Tax Credits

- “Section 45” Federal tax credit of \$11/Mwh can be claimed by the owner of a renewable energy generation facility which uses landfill gas as fuel.
- \$11/Mwh tax credit is equivalent to a before-tax energy price premium of \$18/Mwh at a tax rate of 40%.
- Tax credit can be claimed for a period of 10 years after the placed in service date.
- Facility must commence construction prior to January 1, 2014 to qualify.
- Looking forward to the possibility of a new federal renewable energy tax structure as part of comprehensive tax reform, which includes more than just electricity production
  - Go to [http://biomasspowerassociation.com/pages/gov\\_energy.php](http://biomasspowerassociation.com/pages/gov_energy.php) to view ARIES concept (bottom of the page)

# Renewable Energy Plant



# Fuel Skid

Compresses, filters, and dewateres the gas





# Engine Room



# Transformer converts power to utility line voltage





# Development Strategy for Landfill Gas

- Medium Btu sales are the simplest technology and may be the best application for a project, but depend on an industrial user being reasonably close to the landfill and the long-term viability of the user.
- High BTU projects are not feasible at current natural gas pricing. RINs require niche applications and ideal situations, and may not resolve long-term price and volatility concerns.
- Power plants can often give the highest return and lowest investment risk, if market price of energy and RECs are high enough, or a long-term fixed rate contract can be negotiated.
- Some locations may just not work yet: be patient and creative.