Advances in Energy from Waste in the US

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September 9, 2014

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SOLID WASTE MANAGEMENT CONSULTANTS

GBB -- Quality – Value – Ethics – Results

- Established in 1980
- Solid Waste Management and Technology Consultants
- Helping Clients Turn Problems into Opportunities

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GBB Waste Technology Services

- Economic, technical, and environmental reviews
- Markets development
- Process planning and design
- Waste characterization and sourcing
- Procurement and negotiation assistance
- Independent feasibility consultant
- Technology due diligence
- Acceptance testing and operations monitoring

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Renewable Energy from Waste

RENEWABLE Energy FROM WASTE CONFERENCE

NOVEMBER 17-20, 2014 SAN JOSE, CALIFORNIA

www.rewmag.com

Food Waste or Fuel Source?

DEPARTMENTS - CRITICAL THINKING

Harvey Gershman
OCTOBER 16, 2013

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HARVEY W. GERSHMAN

Hahvee…take out the gahbidge…it stinks!" my mom used to remind me of my household chore growing up in Pawtucket, R.I., in the '60s. We had a 30-gallon can for food waste in the back corner of our lot waiting to be collected by the city and delivered to pig farmers for feed. Neighboring Providence did it a little differently. It had to be bundled in newspapers and set out for collection, eventually to find its way to pig farmers.

Fast-forward to the new millennium. We are serious about increasing recycling even more by going after organics. The U.S. Environmental Protection Agency reports that food waste accounts for approximately 21 percent of landfilled municipal solid waste (MSW), or around 35 million tons per year (TPY). This waste is a resource that can be used to produce biogas, for power production or

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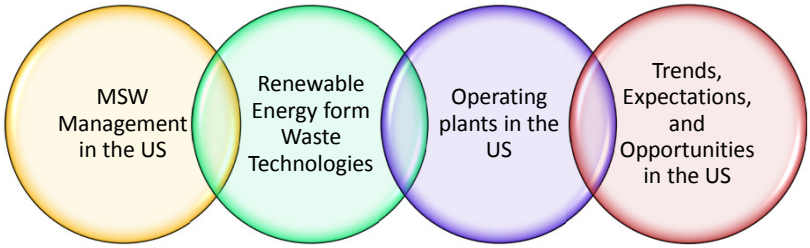
Outline



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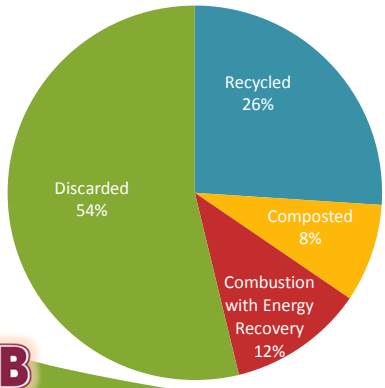
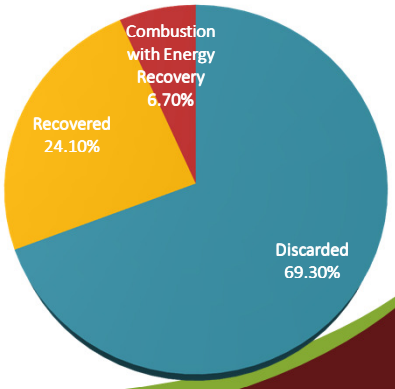
MSW Disposition in the U.S.

EPA Estimate:
251 million tons (2012)



Biocycle Estimate:
389 million tons (2008)



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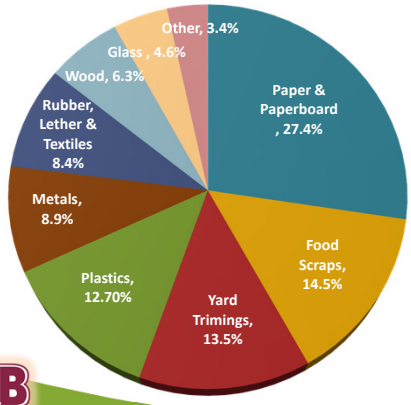
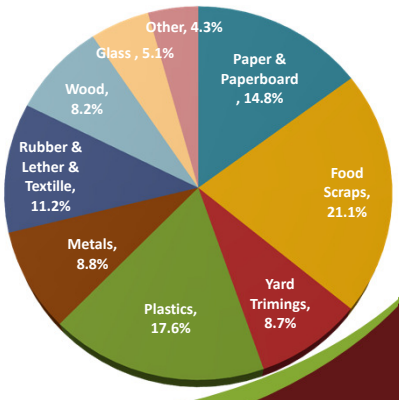
MSW Composition

Total MSW generation, 2012
(by material before recycling)



MSW going to landfills, 2012
(by material after recycling)



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U.S. Waste Management Infrastructure

Technology	Number
Transfer Stations	3,350
Material Recovery Facilities (MRF)	586
Mixed Waste Processing Facilities (MWPF)	51
Composting	2,300
Anaerobic Digestion	19
WTE	84
Landfills	1,908

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RENEWABLE ENERGY FROM WASTE TECHNOLOGIES

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WTE plants in the US

Status of WTE facilities	
Operating Facilities	80
Inactive Facilities	4
Total number of facilities	84
Facilities under construction	1

Alexandria, VA – Covanta (mass burn facility)

Hartford, CT (RDF dedicated boiler)

WTE facilities by Technology	
Mass Burn	64
Refuse Derived Fuel (RDF)	13
Modular	7

Source: Energy Recovery Council, 2014

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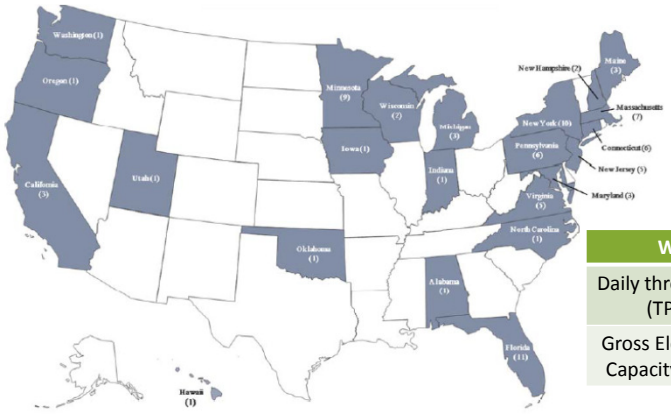
WTE plants in the US (continued)



WTE Capacity	
Daily throughput (TPD)	96,249
Gross Electricity Capacity (MW)	2,554

Source: Energy Recovery Council, 2014

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Solid Waste Authority of Palm Beach County, FL

Source: SWA of Palm Beach Facebook page

- Notice of Award, April 2011
  - 3,000 TPD Mass Burn facility
  - 130 MW renewable power; enough for over 86,000 houses
  - $668 million construction price
  - $20.5 million first year O&M cost
- Advanced emissions control system
- Groundbreaking - April 2012
- Expected commercial operation 2015

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WTE Expansions

Hillsborough County, FL- Covanta Energy

Lee County, FL- Covanta Energy

Honolulu, HI- Covanta

Olmsted County, MN

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Gasification

- Partial combustion in an air-controlled environment
- Product: Syngas for production of electricity, chemicals/ fuels (ethanol)
- Feedstocks: MSW, biomass, medical waste,
- Plasma gasification: a plasma arc is used as a heat source

Enerkem
Fiberight
Fulcrum BIOENERGY
ALTER NRG
INEOS Bio
INTERSTATE WASTE TECHNOLOGIES
SIERRA ENERGY
COVANTA CLEERGAS™
PlascoEnergy GROUP

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Enerkem

- Commercial plant in Edmonton, Alberta- 10 million gal/year, start-up June 2014
  - City MSW Processing Facility with Vecoplan equipment prepares feedstock
- Commercial scale demonstration facility in Westbury, CA (since 2009, 1.3 million gallons/year)
- Pilot plant in Sherbrooke, CA (since 2003)
- Under development: Pontotoc, Mississippi and Varennes, Québec, each 10 million gal/year (MRF construction in 2015)

Edmonton Transfer conveyor between MSW processing and Enerkem Facility

Enerkem Edmonton Facility June 2014

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INEOS Bio

- Gasification followed by biocatalyst fermentation and distillation
- Biomass to Bioethanol operating now; MSW to Bioethanol later in 2014
- Plant:
  - Vero Beach, Indian River County, FL- commercial demonstration facility
    - process ~150,000 TPY of yard, wood and vegetative wastes
    - produce 8 million gal/year ethanol and 6 MW (gross) of electric power

Indian River BioEnergy Center

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Pyrolysis

- Thermal conversion in the absence of oxygen
- Non-recyclable plastics to oils, fuels
- Plastics-to-Oil Technologies Alliance formed by ACC

Plastic2Oil

VADXX ENERGY

agilyx

RES POLYFLOW™ RENEWABLE ENERGY SOLUTIONS

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Anaerobic Digestion

Biological degradation of organic material in absence of oxygen

- Biogas fuel for electricity and/or heat production; can be conditioned to pipeline quality
- Digestate for soil amendment, animal bedding, or rolled into a composting process
- 19 plants operating in the US

CR&R Eisemann – Perris, CA
(under construction)

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Companies in U.S. at Work with AD

Organic Waste Systems

EISENMANN

ZeroWaste ENERGY, LLC. Recovery and Energy with Zero Waste

BEKON Energy Technologies GmbH & Co. KG

HARVEST Power of We

CR&R

eci Bio Energy

quasar energy group

biogas USA entec

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HARVEST™
Power of We™

- US company founded in 2008 in Waltham, MA
- Licensed European AD technologies
- More than 10 composting plants
- Three commercial AD plants
  - Richmond Energy Garden, Canada- 40,000 TPY of food and yard waste
  - London Ontario Energy Garden, Canada- 65,000 TPY of mixed organic waste
  - Energy Garden in Bay Lake, FL (Disney World) - 100,000 TPY of Mixed organic waste

Richmond Energy Garden

London Energy Garden

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quasar energy group

- US company established in 2006 in Cleveland, OH
- Initially European technology, now, more than 98% of the components are purchased in the U.S. and more than 76% of those are from Ohio-based companies
- Integrated Anaerobic Digestion System (iADs) is patent pending technology developed at Ohio State University
- Projects:
  - 8 operating commercial AD projects in the US
  - 3 commercial projects under construction

Cleveland, Ohio- 42,600 TPY of Biosolids, FOG and food waste

Wooster, OH- 20,000 TPY, Pumpable and high solids organic biomass

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ZeroWaste™ ENERGY, LLC.
Recovery and Energy with Zero Waste

- US company based in Lafayette, CA
- Dry Anaerobic Digestion licensee for:
  - KompoFERM
  - SmartFERM
- Plants:
  - Monterey Regional Waste Management District- 5,000 TPY of food and green waste
  - City of San Jose (start-up November 2013)- 90,000 TPY of commercial food waste
  - Operator for Infinitus in Montgomery, AL
  - 3 plants under construction and development

Monterey, CA

San Jose, CA

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TRENDS, EXPECTATIONS, AND OPPORTUNITIES FOR THE FUTURE

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Technologies and Risk

Alternative	Risks/Liability	Risk Summary
Mass Burn Combustion	Proven commercial technology	Low
RDF Combustion	Proven technology; limited U.S. commercial experience	Moderate to Low
Anaerobic Digestion	Proven technology; limited U.S. commercial experience	Moderate to Low
Pyrolysis and Gasification	Previous failures at scale; no operating experience with large -scale operations in the U.S.; full-scale demonstrations nearing operation	High

Source: Gershman, Brickner & Bratton, Inc. 2014

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Current Trends

- Conversion technologies are advancing
  - AD is the leader
  - Other conversion technologies yet to prove themselves
- Drivers: sustainability goals, Zero waste targets, lowering waste management costs

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Locations Advancing Conversion Technologies

- Advancing new facilities with thermal technologies:
  - Three Rivers Solid Waste Management. Authority - Pontotoc, MS – Enerkem
- Anaerobic digestion specific RFPs issued:
  - Humboldt Waste Management Authority, Eureka, CA
- Anaerobic Digestion plants under development:
  - Town of Bourne, MA - Harvest Power
  - Town of Brunswick, ME - quasar and Village Green Ventures
  - City of Columbia, SC - W2E
  - City of Portland, OR - Columbia Biogas
  - Monticello, IN- Waste No Energy LLC
  - City of Charlotte, NC - Blue Sphere
  - Johnson, Rhode Island- Blue Sphere
  - Perris, CA - CR&R/Eisenmann
  - County of Santa Barbara, CA – Mustang Renewable Power Ventures
  - Prince William County, VA – to be determined

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Locations Advancing Processing/WTE Technologies

- Mixed Waste Processing/AD Operating
  - Newby Island (San Jose, CA) – Republic/Zero Waste to Energy
  - Montgomery, AL- Infinitus /Zero Waste Energy
- Advancing new facilities
  - Allentown, PA – Delta Thermo Energy Inc.
  - Baltimore, MD – Energy Answers
  - City of Cleveland, OH – to be determined
  - County of Hawaii, HI – to be determined
  - City of Houston, TX – to be determined
  - City of Los Angeles, CA – Green Conversion Systems
  - County of Maui, HI - Anaergia
  - Frederick County, MD (NMWDA) - Wheelabrator
  - Iowa City, IA – to be determined
  - Metro Vancouver, CN – to be determined
  - Prince William County, VA – LEEP
  - Puerto Rico – Energy Answers
  - Region of Peel, Ontario, CN – to be determined
  - Prince George's County, MD
  - Wicomico County, MD

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Opinion of Trends for Future

- More mixed waste processing (MBT is gaining interest)
  - Added recycling side-benefit
  - Most conversion technologies require pre-processing for feedstock preparation
  - Electric utilities may become a player for RDF
  - CNG from AD projects and municipal fleet use (City of Montgomery, Al project)
- "One-bin" approaches key to watch
- 'Environmentalists' and 'Zero Waste' proponents continue to fight WTE and Waste Conversion Technologies calling them all "incineration"

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Legislation and Regulations

- *Will more states ban food scraps from disposal?*
- *Will U.S. landfill disposal ever be as expensive as in EU and UK?*
- Permitting needs to be streamlined/rational
- Several states stepping up recycling/diversion goals and Producer Responsibility (EPR)
- EPA needs to help lead the way with RFS and EF rules

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Questions and comments?
Thank you!
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