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Waste Conversion Technologies: Commercial Viability and Progress

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Presented at WasteExpo
April 30, 2014

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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

INSIDE:

- Maximizing RDF Systemsp. 25
- A Financial Source for WTEp. 29
- Batter Emission Rules Updatep. 32
- BioGas Heats Up in Wisconsin.....p. 35
- Fueling Plants with Plastics.....p. 38

SEPPING FUEL AND ENERGY PRODUCERS // SPRING 2013

A WORKING MODEL

Greenwood Energy is producing market-friendly fuel pellets from waste in America's heartland.

Food Waste or Fuel Source?

DEPARTMENTS - CRITICAL THINKING

Harvey Gershman
OCTOBER 16, 2013

Hahree... take out the garbage. 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 bioas, for power production or



HARVEY W. GERSHMAN

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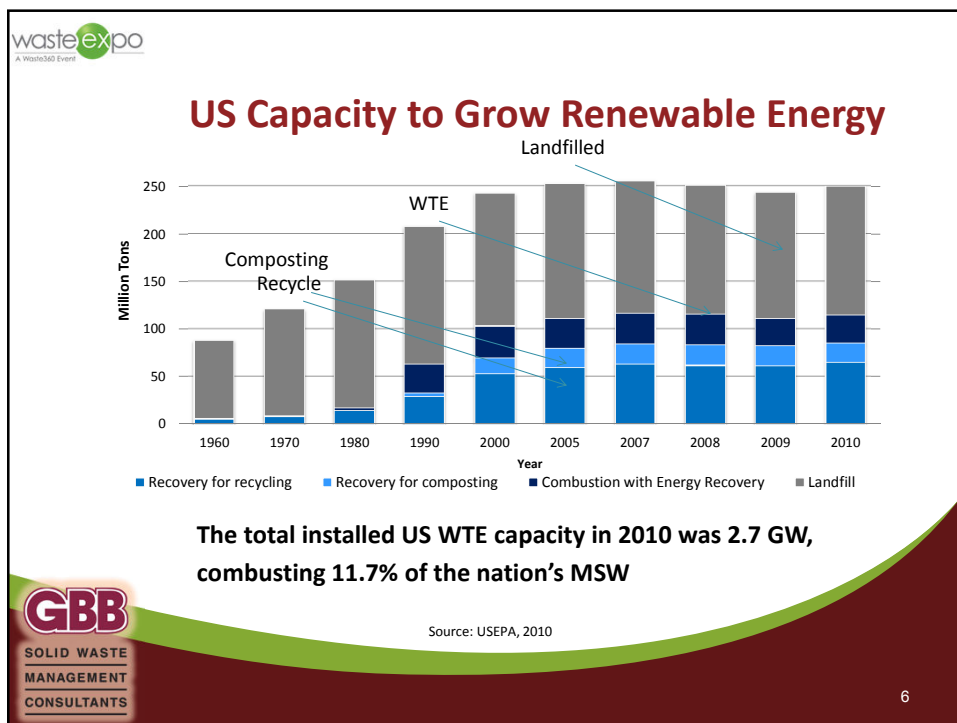
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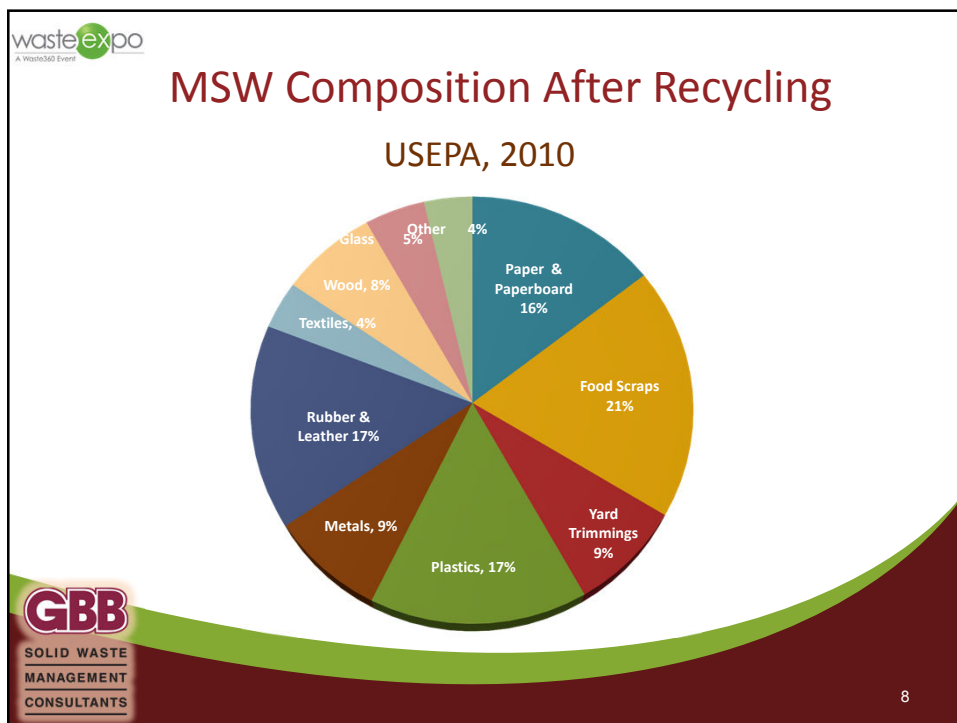
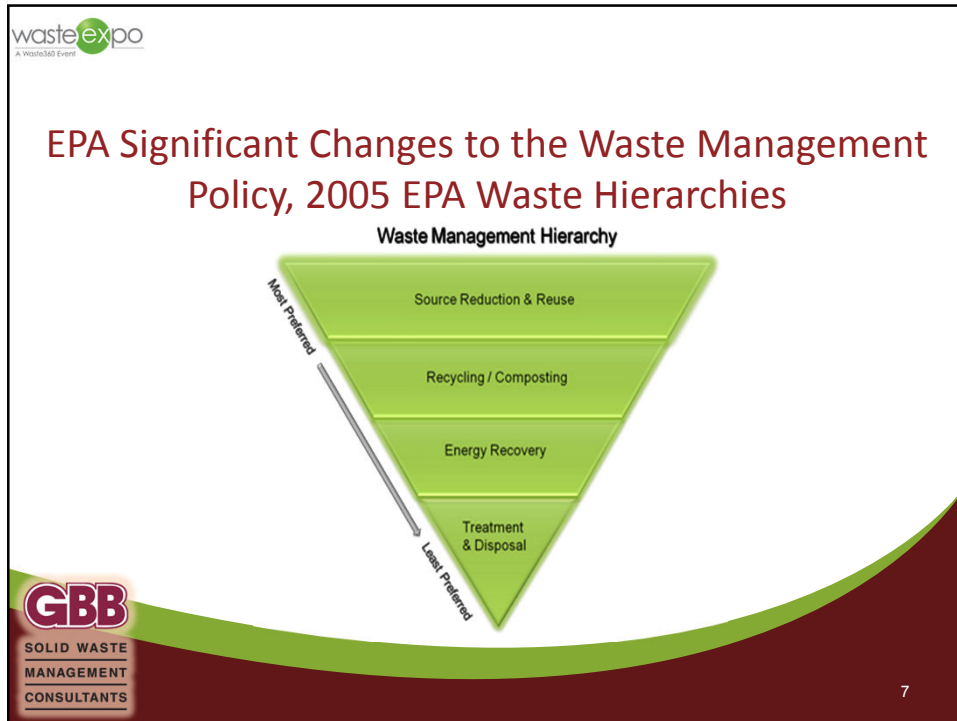
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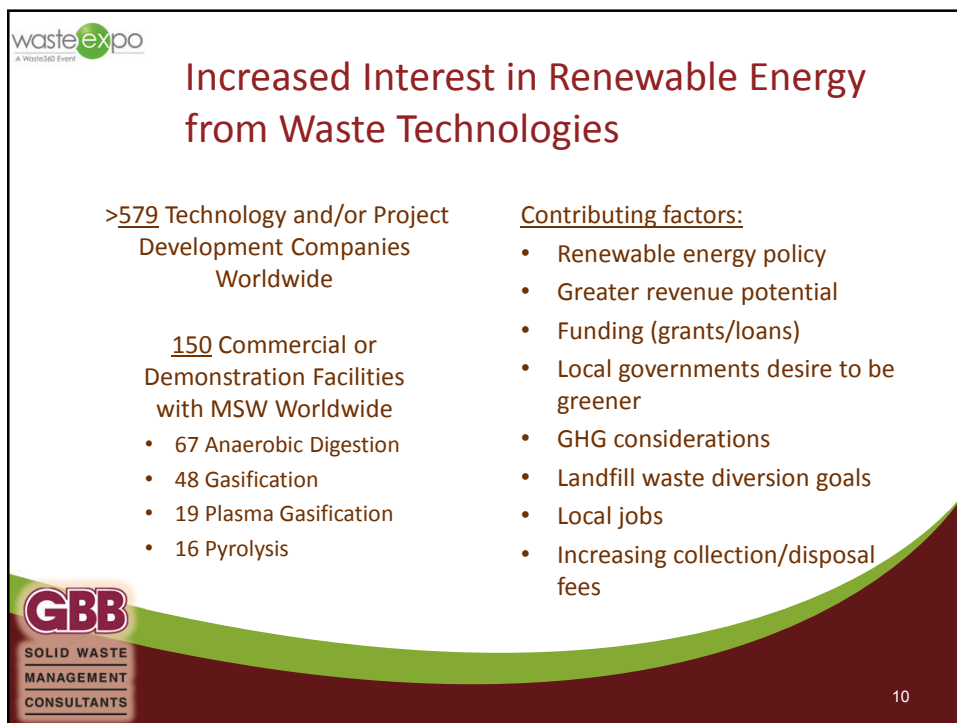
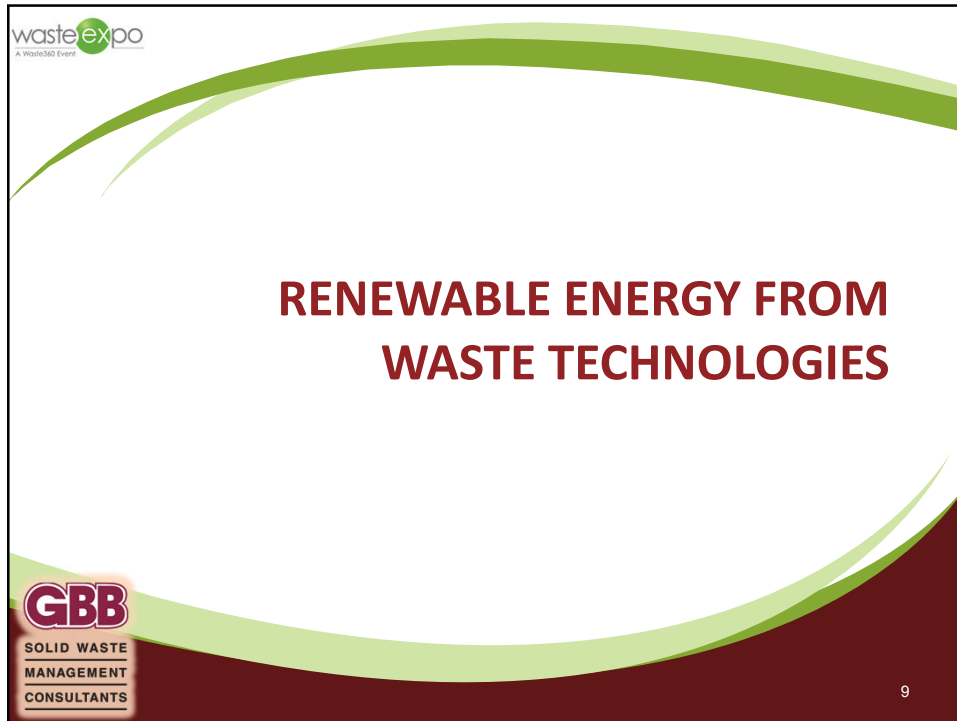
SOLID WASTE MANAGEMENT IN THE U.S.

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Energy/Fuel Product Values Are Key

	WTE	500-600 kWh	@\$0.06/kWh	Yields	\$30-\$36
1 ton MSW to:	Synthetic Crude	4 barrels	@\$80 /barrel	Yields	\$320.00
	Ethanol	80 gallons	@\$2.50/gallon	Yields	\$200.00

++ sale of chemical feedstocks, heat and/or recovered metals

Obviously the systems Capital Costs and O&M Costs impact the NET MSW costs!

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Locations Advancing Processing/WTE Technologies

- Mass burn WTE expansions completed
 - Hillsborough County, FL - Covanta
 - Lee County, FL - Covanta
 - Olmsted County, MN – Olmsted County
 - Honolulu, HI – Covanta
- Mass burn WTE facilities under construction
 - Durham York (Ontario CN) - Covanta
 - Palm Beach County, FL (SWAPBC) – B&W
- 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, IO – to be determined
 - Metro Vancouver, CN – to be determined
 - Prince William County, VA – LEEP
 - Puerto Rico – Energy Answers
 - Region of Peel, Ontario, CN - Covanta

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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
 - Montgomery, AL- under construction w/Zero Waste Energy
- Anaerobic Digestion plants under development :
 - City of Newport News, VA - quasar
 - 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
 - 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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Technologies and Risk

Source: Gershman, Brickner & Bratton, Inc. 2014

Alternative	Risks/Liability	Risk Summary
Processing for Recyclables and Fuel	Proven commercial technology	Low
Composting	Proven commercial technology	Low
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
Mixed-Waste Composting	Previous large failures; limited large-scale plants in operation; product quality issues	Moderate to High
Pyrolysis and Gasification	Previous failures at scale; no operating experience with large -scale operations in the U.S.; full-scale demonstrations nearing operation	High

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Gasification/Fermentation

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

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

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Enerkem

- Commercial scale demonstration facility in Westbury, CA (since 2009, 1.3 million gallons/year)
- Pilot plant in Sherbrooke, CA (since 2003)
- On-going work on commercial facilities:
 - Edmonton, Alberta- 10 million gal/year, start-up 2013
 - Pontotoc, Mississippi & Varennes, Québec, each 10 million gal/year (MRF construction in 2015)



Edmonton facility under construction-
September 2013

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Fiberight

novozymes
Rethink Tomorrow




Fiberight High-Solids Pulping

Ethanol Fermentation Feedstock- MSW

- **Plants:**
 - Demonstration plant in Lawrenceville, VA- opened October 2012
 - Blainstown, IA- 6 mill gal/year, expected to be fully operational in summer 2014.
 - Has site control for first commercial-scale biofuel plant in Elkridge, MD
 - Recent contract with City of Marion, Iowa; also recently selected as Preferred Contractor by Iowa City, Iowa (Dec. 2013)


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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


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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



There are 13 AD plants accepting food waste in the U.S., including demonstration, pilot and commercial projects
Renewable Waste Intelligence, March 2013

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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 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- under construction- 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 Dec. 2013)- 90,000 TPY of commercial food waste
 - Operating at ½ capacity in Jan. 2014
 - Scaling up through Spring 2014
 - 3 plants under construction and development



Monterey, CA



San Jose, CA

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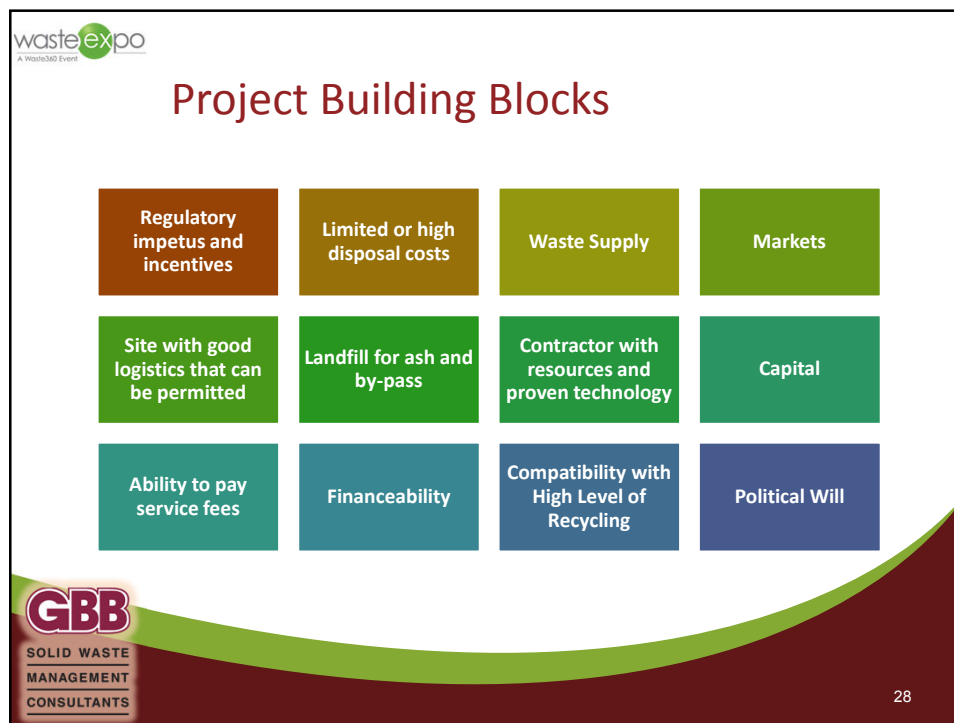
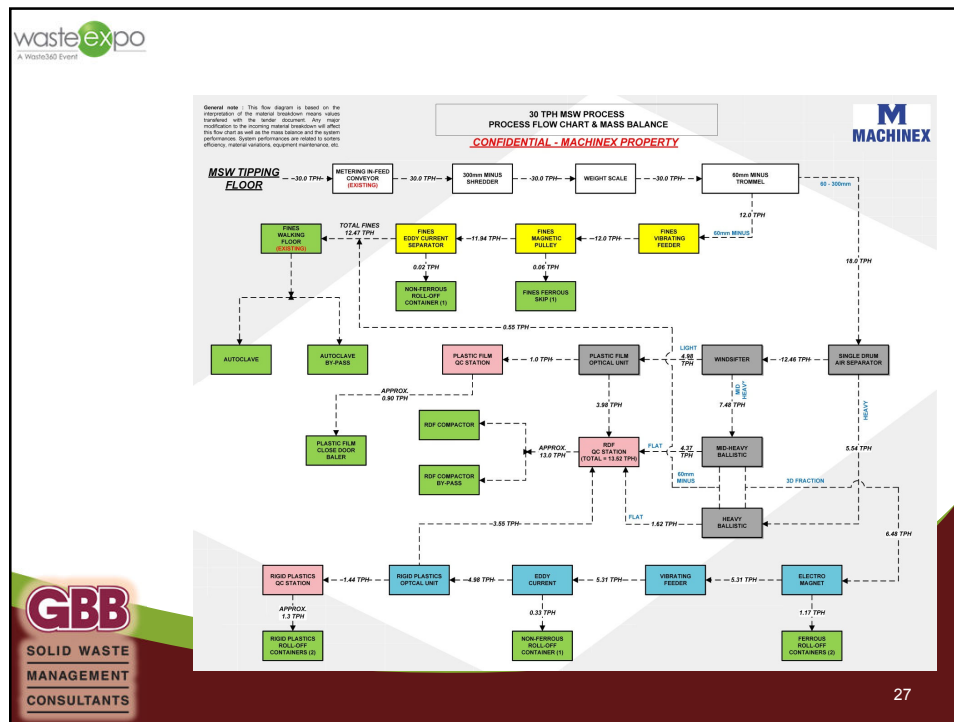
Mechanical Biological Treatment (MBT)

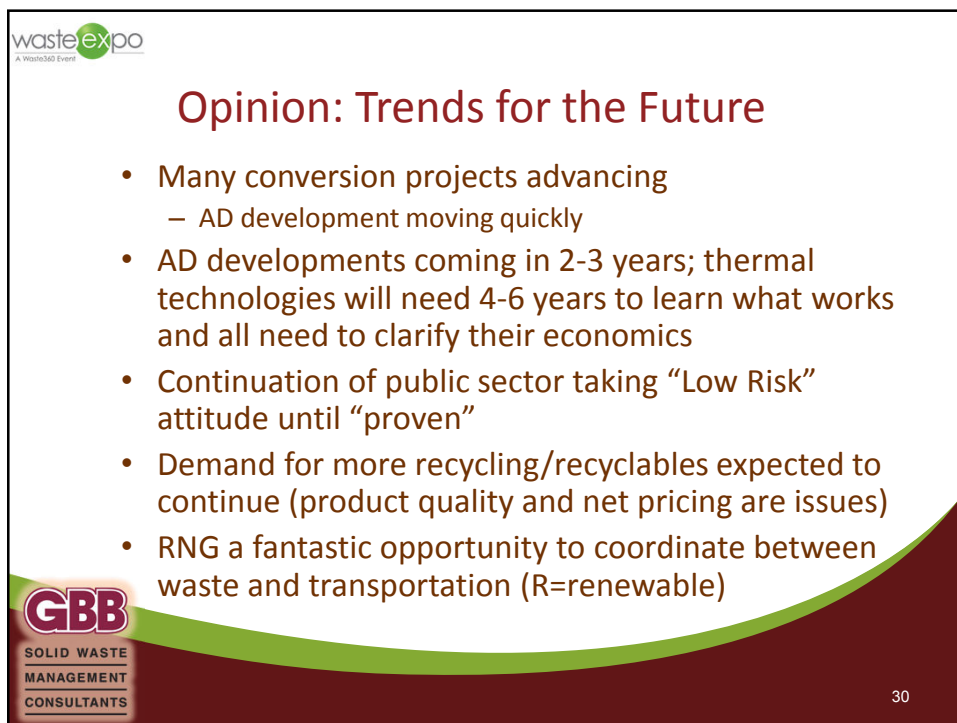
- Originated in Germany in 1999 (now 36 operating MBTs)
- 330 plants in EU most in: Germany, Austria, Italy, Switzerland and the Netherlands; UK catching up
- Includes:
 - Mechanical sorting of recyclables and organics
 - Food scraps and green waste processed through AD and composting units; mulching too
 - Residuals converted to high BTU refuse-derived fuel (RDF)
- RDF key to MBT diversion results
 - 54% to dedicated boilers, 16% to coal plants, 11% to cement kilns and 19% to others

Source: Mechanical Biological Treatment of Municipal Solid Waste. UK Department for Environment Food & Rural Affairs (DEFRA). February 2013

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Opinion of Trends for Future (Cont'd)

- 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”
 - Less waste to manage is an excellent policy to embrace!

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Questions and comments?

Thank you!

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