



***The Latest Updates on Waste-to-Energy and Conversion Technologies;
Plus Projects Under Development***

WASTECON 2012
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By
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Gershman, Brickner & Bratton, Inc.




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Outline*


- Introduction
- Selected Waste Conversion Technology companies and their projects
 - Technologies processing MSW
 - Technologies processing mixed non-recyclable plastics
 - Technologies processing organic waste
- Ongoing and future project developments
- Summary and Trends for Future
- Q&A

*Research support from Ljupka Arsova and Elizabeth Rice



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Intro - GBB Overview

- Headquartered in Fairfax, VA
- Established in 1980 as an objective adviser to governments, institutions, and businesses
- 30+ years implementing innovative solutions for waste and recycling industry
- Dedicated and focused exclusively to solid waste management
- Owner's representative and feasibility reports for financings
- "Change Agents" to produce better services and facilities

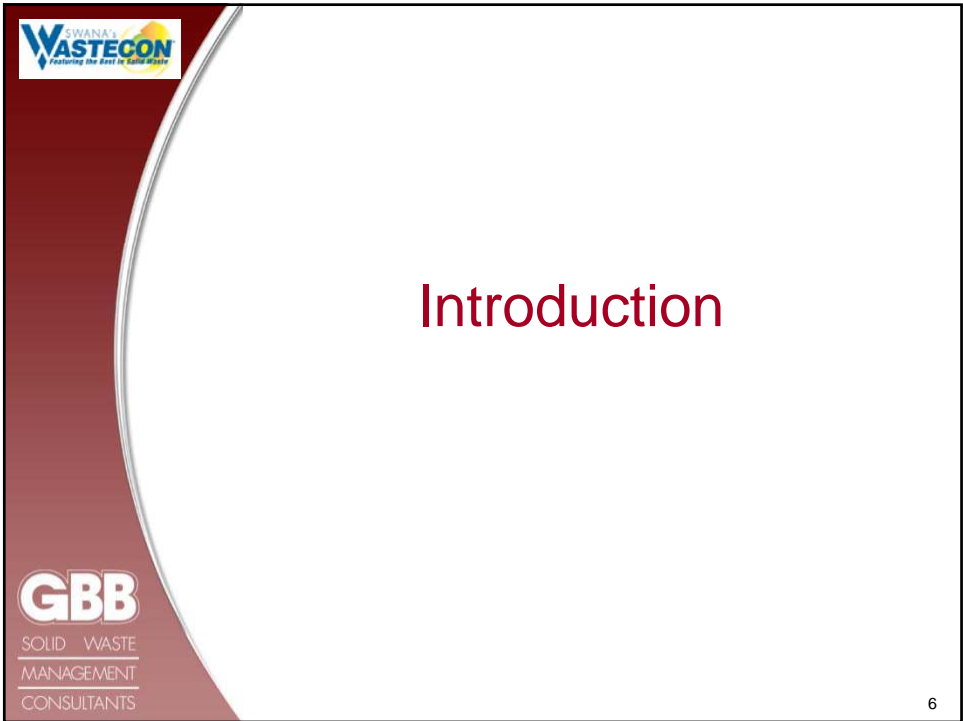
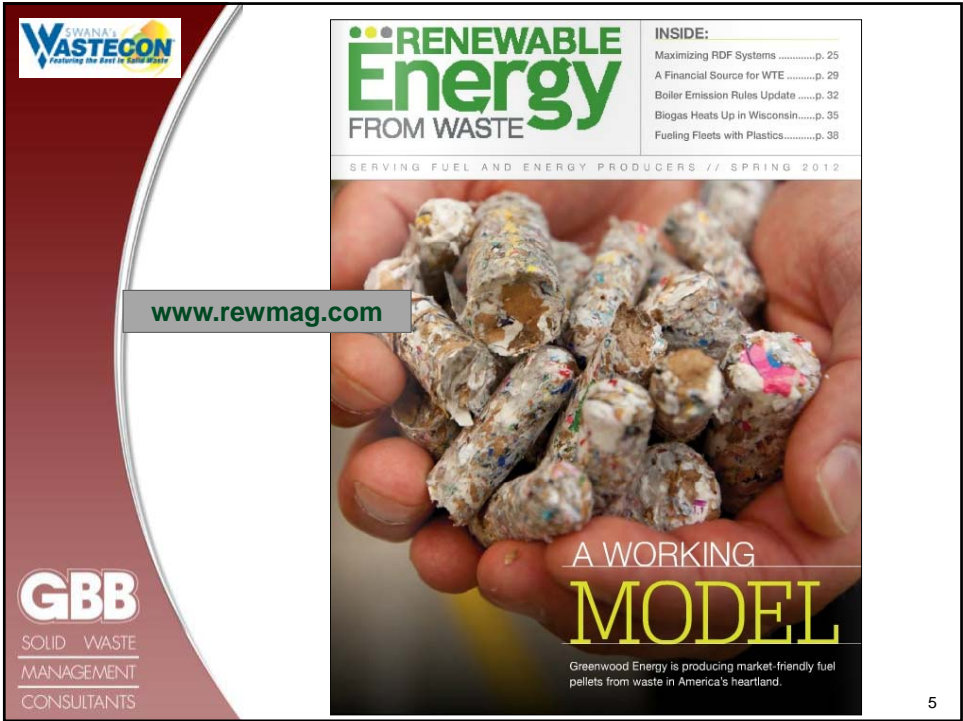
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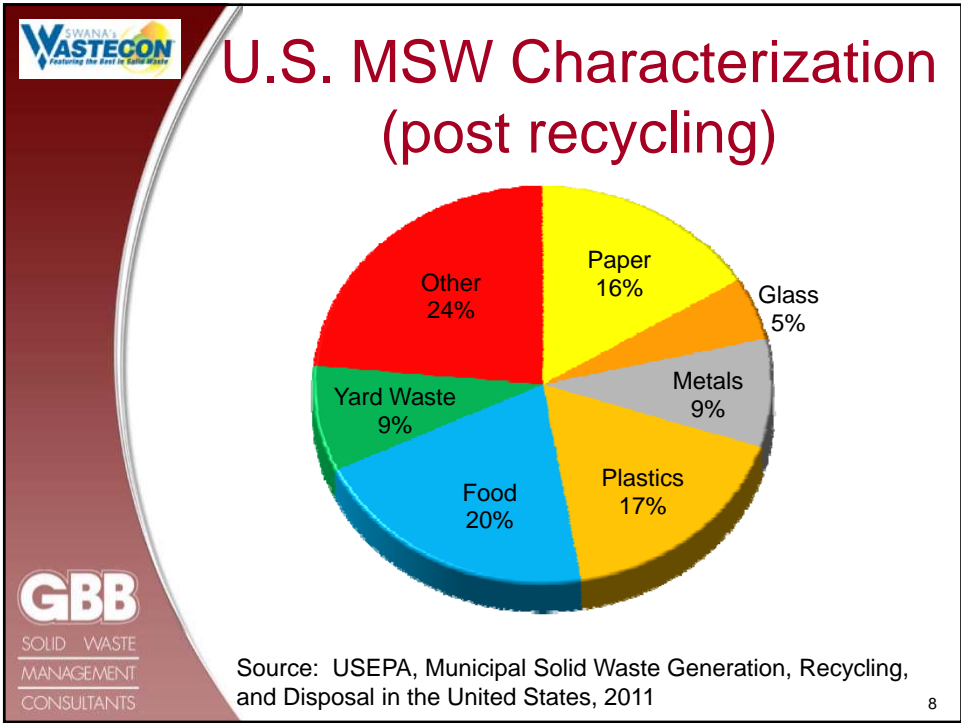
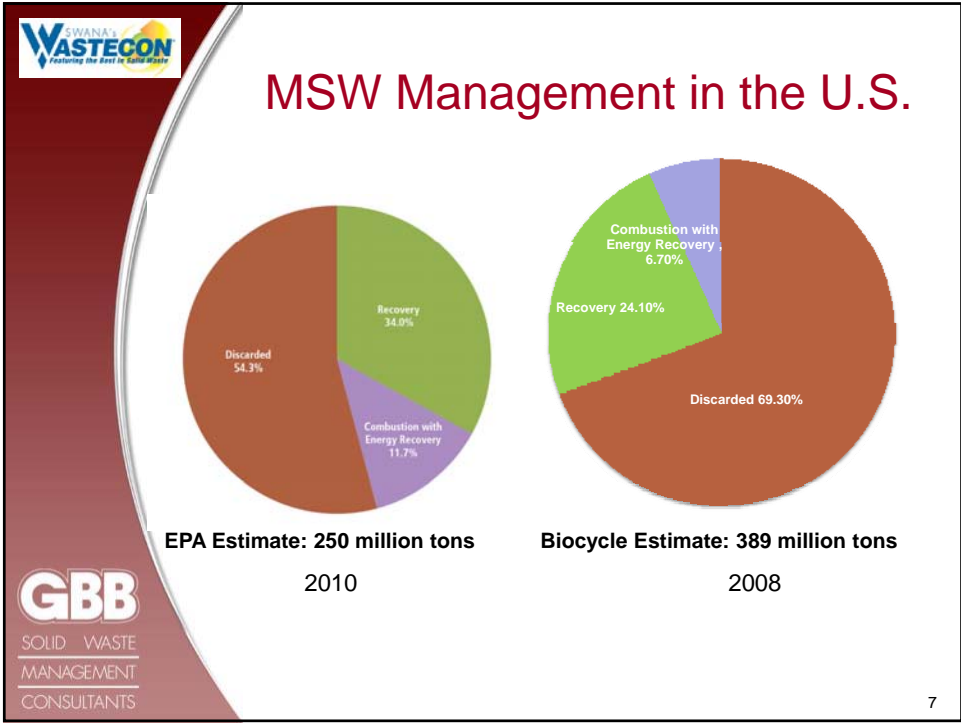


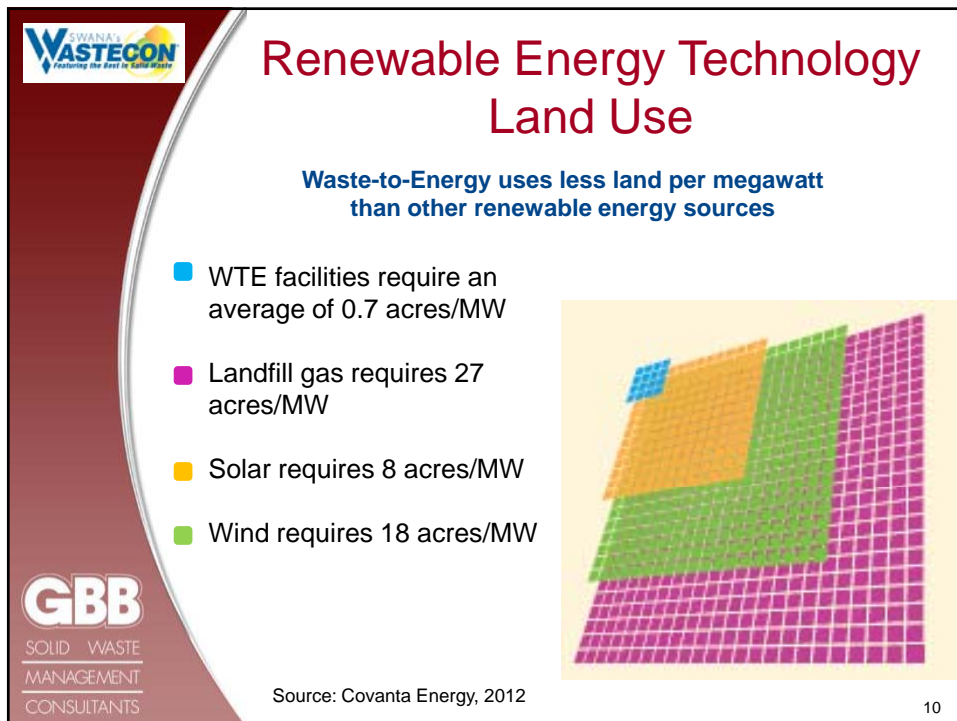
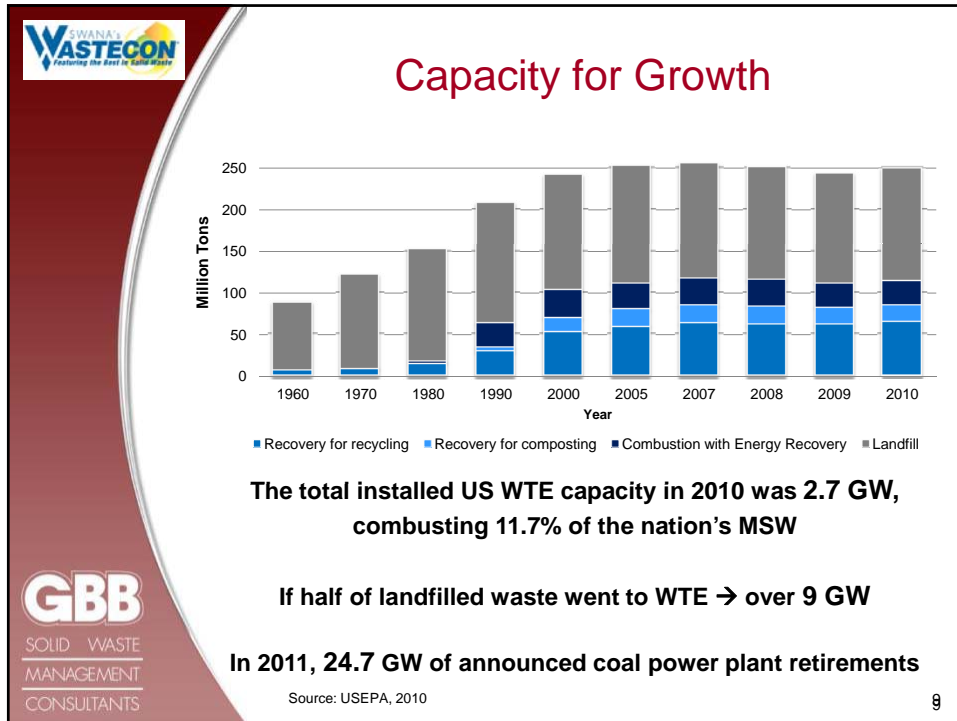
GBB Waste to Energy and Conversion Technology Services

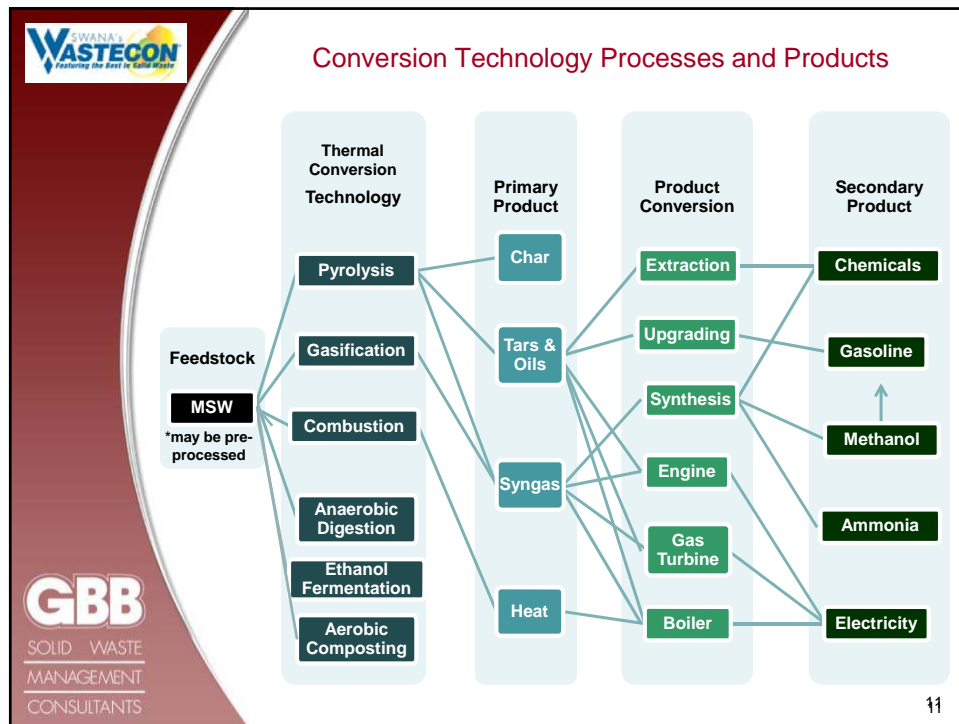
- Reviews addressing economic feasibility, technology effectiveness, environmental issues, and procurements, and project development support for retrofits or new facilities:
 - City of Allentown, PA
 - City of Annapolis, MD
 - Marion County, OR
 - County of Maui, HI
 - New Hanover County, NC
 - Orange County, NC
 - City of Plano, TX
 - Prince William County, VA
 - Rhode Island Resource Recovery Corporation
 - Solid Waste Authority of Palm Beach County, FL
- Due diligence reviews and business planning for private companies considering purchasing technologies or investing in projects
- Waste characterization and sourcing; processing conceptual design and cost estimating
- Independent feasibility consultant

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Factors Contributing to Increased Interest in WTE and CTs

- Federal renewable energy policy and funding
- Local governments desire to be greener and to divert more from landfills
- Local jobs
- Increase in disposal fees and transportation costs

...however, there is no disposal crisis

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591 (and counting) Companies Offering Technology and/or Development Services Worldwide

- 34 Aerobic Composting
- 109 Anaerobic Digestion
- 37 Ethanol Fermentation
- 169 Gasification
- 45 Plasma Gasification
- 52 Pyrolysis
- 60 WTE: mass burn, modular, dedicated boilers, and RDF
- 81 Others (agglomeration, autoclave, de-polymerization, thermal cracking, steam reforming, hydrolysis)

Source: Gershman, Brickner & Bratton, Inc., April 2012

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150 Conversion Companies Operating either Commercial or Demonstration Facilities with MSW Worldwide

- 67 Anaerobic Digestion
- 48 Gasification
- 19 Plasma Gasification
- 16 Pyrolysis

Source: Gershman, Brickner & Bratton, Inc., April 2012


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Technologies Processing Mixed MSW

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ALTER^{NRG}

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- Plasma gasification- developed in partnership with Westinghouse Plasma Corp.
- Feedstock: different including auto shredder residue, plastics, biomass, wood waste
- Product; SYNGAS for power generation or further conversion to ethanol
- Preprocessing NOT required
- Plants:
 - Demonstration facility in Madison, PA, 48 TPD
 - Commercial in Japan, Canada, India, and the U.S.
 - Under development in 11 countries through partnerships with Coskata, SMSIL, NRG Energy
 - St. Lucie County, FL terminated Geoplasma project 4/17/12



AlterNRG gasifier






BlueFire Ethanol

- Concentrated Acid Hydrolysis Process
- Feedstock: post-recycled MSW, rice and wheat straws, wood waste and other agricultural residues
- Product: ethanol, and other viable alternatives to petroleum derived fuels
- Preprocessing required- shredding and drying of the feedstock





- Plants under development:
 - Lancaster, CA – 3.7 million gallon per year, feedstock post-sorted MSW
 - Mecca, CA – 17 million gallon per year, feedstock post-sorted MSW and wood waste
 - Fulton, MS – 19 million gallon per year, feedstock: woody biomass and mill wastes



Fulton, MS site prepared for construction, June 2011

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Dynamis Energy, LLC

- Based in Eagle, Idaho
- Designs, builds, owns and/or operates modular gasification plants
- Preprocessing of the feedstock NOT required

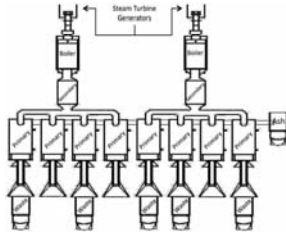




Diagram depicts a typical 200-ton per day capacity plant.

PROJECTS



Ada County, Idaho

- o Agreement signed in 2011 and expansion requested in March 2012 for 408 TPD
- o Construction planned for fall 2012
- o Expected to start operating in 2013.


Puerto Rico

- o Two plants contracted each with capacity to process 180K TPY MSW
- o Construction is expected to start during 2012


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- Gasification followed by catalytic conversion to bio-fuels and chemicals
- Feedstock: MSW, wood chips, treated wood, sludge, petcoke, spent plastics and wheat straw
- Preprocessing- drying, sorting and shredding
- Facilities:
 - Commercial scale demonstration facility in Westbury, CA (since 2009, 1.3 million gallons/year)
 - Pilot plant in Sherbrooke, CA (since 2003, used to test over 25 different solid, slurried, and liquid feedstock)
 - On going projects on full-scale commercial facilities:
 - Edmonton, Alberta- 10 mill gallons per year under construction, start-up 2013
 - Pontotoc, Mississippi & Varennes, Québec, each 10 mill gallons per year under development




Enerkem's Westbury facility

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Fulcrum BioEnergy


- Gasification followed by alcohol synthesis; InEnTec technology partner
- Feedstock: MSW
- Product: ethanol
- Preprocessing required


- Sierra BioFuels- First commercial scale plant under construction in City of McCarran, NV
 - 10.5 million gallons ethanol per year
 - Have local and state regulatory permits
 - Have feedstock contracted through Waste Connections and WM
 - Have offtake agreement for full output of plant
 - Estimate completion in 2nd half of 2013
 - Received USDA \$105 million loan guarantee in August 2012

Have secured enough MSW feedstock to produce more than 700 million gallons of biofuels at facilities to be located across the US.





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Fiberight High-Solids Pulping


- Ethanol fermentation
- Feedstock- MSW
- Preprocessing- separation, cleaning and preparation of the organic fraction of the MSW
- Plants:
 - Pilot plant in Lawrenceville, VA- in partnership with Novozymes robust enzyme catalysts and enzyme recycle process developed
 - Blairstown, IA- 6 mill gallons per year, commenced production at corn ethanol converted, expected to be fully operational in the first half of 2013.
 - Has site control for first commercial-scale biofuel plant in Elkridge, MD
- In 20-year partnership with TMO Renewables, UK, to build fifteen bio-refinery plants across the US in the next five year




TMO Blairstown, Iowa Layout


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Pilot facility in Fayetteville, AR

- Gasification followed by biocatalyst fermentation and distillation
- Feedstock: MSW
- Product: Bioethanol
- Preprocessing- drying of the feedstock
- Plants:
 - Fayetteville, AR- pilot plant
 - Vero Beach, Indian River County, FL - under construction
 - process 150,000 TPA MSW
 - produce 8 million gallons of fuel-grade ethanol and 6 MW (gross) of electric power
 - start-up and commissioning began in summer 2012
 - Lake County (IN) Solid Waste Management District- under development

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- Headquartered in Ottawa, Canada
- Gasification followed by plasma torches to refine the syngas product
- Preprocessing- separation of inert materials
- Plants:
 - Commercial-scale demonstrational, 94 TPD- Train Road, Ottawa, CA
 - R&D, 5TPD, Castellgali, Spain
- Selected by the Salinas Valley Solid Waste Authority (CA) as a viable technology for planned Resource Management Park, Environmental Impact Study currently underway
- Shortlisted in Santa Barbara, CA
- Other plans to build facilities in Canada and China









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Additional Technologies Processing MSW

Company	Technology	Product	Status	Featured plants in N. America	No. of commercial plants
	Gasification & Fermentation	Ethanol	demo	Under development: Flagship in Boligee, Alabama (55 mill gallons per year)	1 under construction
	Gasification & metal recovery	SYNGAS and metals	commercial	N/A	>16
	Gasification	SYNGAS	commercial	Under development: Costa Rica & Huntington Beach, CA	145 >20 on MSW
	Plasma gasification	SYNGAS	commercial	Commercial: Columbia Ridge, Arlington, OR, Dow Corning, Midland, MI,	9
	gasification	Electricity	Mock-up	Under construction: Town of Montgomery, NY	
	Gasification	SYNGAS	commercial	N/A	9



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Technologies Processing Mixed Non-recyclable Plastics

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Technologies Processing Mixed Non-recyclable Plastics

<u>Company</u>	<u>Technology</u>	<u>Product</u>	<u>Status</u>	<u>Featured plants in N. America</u>	<u>No. of commercial plants</u>
	Pyrolysis	Crude oil & combustible gas	demo	Demo: Tigard, OR, 10 TPD	none
	Microwave Pyrolysis	Crude wax & combustible gas	demo	Under construction: Blackville, SC 20 TPD	1 under construction
	Catalytic Pyrolysis	Diesel Fuel	commercial	R&D at SEMASS WTE, Rochester, MA	5
	Far Infrared Pyrolysis	Crude oil & combustible gas	commercial	Demo: Montgomery County, MD, closed 2011	N/A
	Catalytic Pyrolysis	Crude oil & combustible gas	Pilot	Pilot: Niagara Falls, NY (45TPD)	none
	Pyrolysis	Synthetic crude	N/A	Under development: Hennepin County, MN Manatee County, FL	none
	Pyrolysis	Crude oil & combustible gas	Pilot	Pilot: Akron, Ohio	none




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Technologies Processing Organic Wastes



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CR&R Inc. – Perris, CA


- Selected as one of four Los Angeles County alternative technology projects
- 150 TPD from CR&R dirty-MRF, post-recycled residual output to DRANCO anaerobic digestion system; convert the biogas generated into biomethane for their truck fleet
- In January 2011, received a \$4.5 million California Energy Commission Alternative and Renewable Fuel and Vehicle Technology Program grant
- Construction is expected to commence in 2012 and be completed in 2014

DRANCO


- Dry anaerobic digestion technology developed in Belgium
- 5 demonstrational and 25 commercial plants worldwide
- Feedstock: organic fraction of the MSW, dewatered sewage sludge, biowaste and other source-separated organic waste streams



DRANCO
Organic Waste Systems





Dranco AD plant in Hotaka, Japan



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W2e Organic Power

- Wet anaerobic digestion technology
- Pre-processing required
- Teamed with CIYCOR and Eisenmann
- Plants:
 - Columbia, SC- commercial scale prototype under construction
 - 48,000 tons per year; 3.2 MW
 - Process organics from households and businesses
 - Start-up expected 2012
 - Gastonia, NC & Baton Rouge, LA- commercial scale under development

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Zero Waste Energy LLC





- San Jose signs new contract to boost recycling
- Technology: dry fermentation anaerobic digestion-Kompoferm system
- Products: biogas and compost
- Objective to bring the commercial recycling rate to 80 percent by 2014 from current level of 22 percent
- Will be processing over 270,000 tons per year of waste that would otherwise be disposed in a landfill.
- The plans are being finalized, site preparation has begun, operations planned to begin in summer 2012.




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<div>  <h2>Additional Technologies Processing Organic Waste</h2> </div>						
Company	Technology	Product	Status	Featured plants in N. America	No. of commercial plants	
 ARROWECOLOGY THE WAY TO ZERO WASTE	Dry anaerobic digestion	Biogas and compost	commercial	Commercial- Sidney , AU Pilot- Hidera, Israel	1	
 BEKON Waste Management Systems & Co. Inc.	Dry anaerobic digestion	Biogas and compost	commercial	N/A	14	
 eci Bio Energy	BTA , wet anaerobic digestion	Biogas and compost	commercial	Toronto, CA Demo: Dufferin Commercial: Newmarket	17	
 entec biogas USA	Anaerobic digestion	Biogas and compost	commercial	Under development: El Paso, TX	120	
 HARVEST Power of We	Anaerobic digestion Aerobic composting	Biogas and compost	commercial	Under Construction: London, Ontario 65,000 TPA	6 aerobic composting	
 TERRABON	Bio-refining	acetic acid, ketones, and alcohols	demo	Demo: Bryan, TX- 700 TPD	1 under development	




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Ongoing and Future Project Developments



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Locations Advancing “Proven” Technologies

- Mass burn WTE expansions
 - Completed:
 - Hillsborough County, FL - Covanta
 - Lee County, FL – Covanta
 - Olmsted County, MN – Olmsted County
 - Under construction: Honolulu, HI – Covanta
- Mass burn under construction
 - Durham York (Ontario CN) – Covanta
 - Palm Beach County, FL (SWAPBC) – B&W
- Advancing new facilities with ‘proven’ technologies:
 - Baltimore, MD – Energy Answers
 - Frederick County, MD (NMWDA) - Wheelabrator
 - City of Los Angeles, CA – Green Conversion Systems
 - Puerto Rico – Energy Answers
 - Vancouver, British Columbia, CA
- Existing facilities being sold/upgraded/
 - Harrisburg, PA
 - New Hanover County, NC

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City of Los Angeles, CA – Green Conversion Systems

- 365,000 TPY post-recycled residential waste
- “Advanced Thermal Recycling” system by Fisia Babcock Environment GmbH (formerly Steinmueller)
- Reference facility: Hamburg, Germany
- Air emissions to be well below permit limits and real time air emission readings to be public
- Emphasis on aesthetics
- Ash processed for aggregates

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Source: http://www.ecoling.ch/englisch/refmva_eng1.htm



Durham/ York (Ontario CN) Covanta



- Design, construction and operation by Covanta
- \$260 million financed by Durham and York regions
- 140,000 TPY of waste
- 17.5 MW power and steam
- Recovered ferrous (e.g. steel) and non-ferrous (e.g. aluminum etc.) metals for recycling
- Under construction with target operation date late 2014



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New Hanover County, NC- Covanta



- Retrofit and operation of the existing WTE plant
- 500 TPD
- Facility first opened in 1984, and shutdown in April 2011
- 10MW electrical power
- Following procurement process, on June 4th, 2012- New Hanover County Board of Commissioners voted 5:0 to enter into negotiations with Covanta
- GBB is the technical consultant for the County



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Solid Waste Authority of Palm Beach County, FL



- Babcock & Wilcox Power Generation Group, Inc. (B&W PGG)**, and its partner, **KBR, Inc.** were selected to build the plant in April 2011.
- B&W PGG to operate and provide maintenance services once the plant is operational



Source: Babcock & Wilcox; artist's rendering of proposed facility.

- \$668 million construction cost
- 3,000 tons per day of MSW capacity
- 325 full-time construction jobs (900 including all part time), 64 permanent, full-time operation jobs.
- 2009
 - Authority two-stage contractor procurement included due diligence review of new technology offerings
 - GBB hired to review potential alternative technologies and present its findings to Authority Governing Board
 - Authority authorized to continue its two-stage procurement process with mass burn technology


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Solid Waste Authority of Palm Beach County, FL (Cont'd)

- 2011
 - Authority received competitive proposals and made selection recommendation to the Authority Governing Board
 - Comments from the Florida Sierra Club and Institute for Local Self Reliance were received suggesting approval to be postponed, alternative waste disposal methods to be studied, especially more recycling
 - GBB again hired to review and fact check the accuracy of the statements and claims made by Florida Sierra Club and ILSR
 - Summary of GBB analysis:
 - WTE is fully compatible with recycling and integral to well-managed solid waste systems
 - WTE reduces GHG emissions
 - Management and financial difficulties were contributing factors to WTE plants that have issues; the issues were not operational issues
 - Resurgence of interest in WTE technologies
 - Solid waste systems cost money
- See: <http://www.gbbinc.com/WTE-PB.shtml> for white papers
- Authority Governing Board approves awarding contract in April 2011
- GROUND BREAKING CEREMONY was APRIL 4, 2012!**

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SWA Waste-to-Energy Construction Webcam

April 2012



August 2012



Check it out!: <http://www.swa.org/vm95webcam/>

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**Some U.S. Locations Currently
Investigating/Advancing
Waste Conversion Technologies**


- Ada County, ID
- Baton Rouge, LA
- City of Allentown, PA
- City of Cleveland, OH
- City of Dallas, TX
- City of Glendale, CA
- City of Green Bay, WI
- City of Plano, TX
- City of San Antonio, TX
- City of Taunton, MA
- Columbia, SC

- County of Maui, HI
- Fulton, MS
- Gallatin County, KY
- Hennepin County, MN
- Lake County, IN
- Los Angeles County, CA
- New York City, NY
- Prince William County, VA
- Salinas Valley, CA
- San Bernardino County, CA
- Santa Barbara County, CA

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- County wants to create the Prince William Renewable Energy Park (PWREP) at the landfill (currently receiving 875 TPD MSW)
- County seeking to host a waste conversion technology demonstration facility on the County's landfill or composting sites
- Issuing RFP to identify qualified technology companies to design, build, finance, own and operate their demonstration
- Looking for technologies proven at throughputs of 50 to 200 TPD on a continuous basis
- Eligible technologies include pyrolysis, gasification, anaerobic digestion, plasma torch or other conversion method producing a fuel or energy product, such as electricity, syngas, steam, useable heat and/or other industrial outputs
- Issued in June 2012, due October 17, 2012
- Check status on the County's e-procurement web page under solicitations: <https://www2.pwcgov.org/e-proc/default.asp>



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Summary and Trends for Future


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 <h2>Technologies and Risk</h2> <p>Source: Gershman, Brickner & Bratton, Inc. August 2012</p>		
Alternative	Risks/Liability	Risk Summary
Mass Burn/WaterWall	Proven commercial technology	Very Low
Mass Burn/Modular	Proven commercial technology	Low
RDF/ Dedicated Boiler	Proven commercial technology	Low
RDF/Fluid Bed	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; No large-scale commercially viable plants in operation; subject to scale-up issues	Moderate to high
Pyrolysis	Previous failures at scale, uncertain commercial potential; no operating experience with large - scale operations	High
Gasification	Limited operating experience at only small scale; subject to scale-up issues	High
Chemical Decomposition/ Depolymerization	Technology under development; not a commercial option at this time	High


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 <h2>Opinion of Trends for the Future...</h2>	
<ul style="list-style-type: none"> • New technologies will need 3-5 years to learn if they work and their economics (permits, financing, construction and initial operating time) • Added economic benefit of placing value on carbon credits and power from waste as 'renewable energy' <ul style="list-style-type: none"> • Possible impetus for growth of more proven technologies that are now deemed too expensive • Renewable fuel standards from EPA and added recycling requirements (e.g. ethanol) 	


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Opinion of Trends for Future (Cont'd)

- Continuation of public sector taking “Low Risk” attitude until conversion technologies and companies more proven
- Continued recycling industry demand for more paper, aluminum, and plastics
- More mixed waste processing
 - Added recycling side-benefit
 - Most conversion technologies require pre-processing for feedstock preparation
 - Electric utilities may become a player for RDF
- ‘Environmentalists’ and ‘Zero Waste’ proponents will continue to fight WTE and Waste Conversion Technologies calling them all “incineration”

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U.S. Plants Past, Present, and Future

YEAR	WTE/ RDF	Pyrolysis and Gasification	MRF	Recovered (million tons)
2001	83/26	0	523	104.3
2011	71/15	1	565	114.5
2021	74/17	26	615	129.6




Source: Gershman, Brickner & Bratton, Inc., 2011

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Canada Plants Past, Present, and Future

YEAR	WTE/ RDF	Pyrolysis/ Gasification	MRF/MBT	Recovered (million tons)
2001	8/0	0/0	-/-	7.7
2011	7/1	0/2	66/0	9.3
2021	8/1	0/4	75/0	11.9




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Source: Gershman, Brickner & Bratton, Inc., 2011

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Project Building Blocks

- ☐ Limited and High Alternative Disposal Costs
- ☐ Waste Supply
- ☐ Energy and Materials Market(s)
- ☐ Site for Facility
 - ☐ Good logistics for waste receipt, energy market(s), and residue disposal
 - ☐ Can be permitted
 - ☐ Accepted by neighbors
- ☐ Landfill for ash and by-pass
- ☐ Contractor with resources and proven technology or willingness to take technology risk
- ☐ Capital
- ☐ Financeability
- ☐ Compatibility with High Level of Recycling
- ☐ Political Will



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A Realistic & Ultimate Goal:

Fully Integrated and Efficient Waste Management System with Significant Diversion (Recycling) and WTE-WCT
...in a 50-50 partnership!
...for more jobs, better environment, and energy independence!




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Thank you!!

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