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

**NAWTEC 20
Portland, Maine
April 23-25, 2012**

By
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Gershman, Brickner & Bratton, Inc.
And
Mark Hammond, Executive Director
Solid Waste Authority of Palm Beach County, FL

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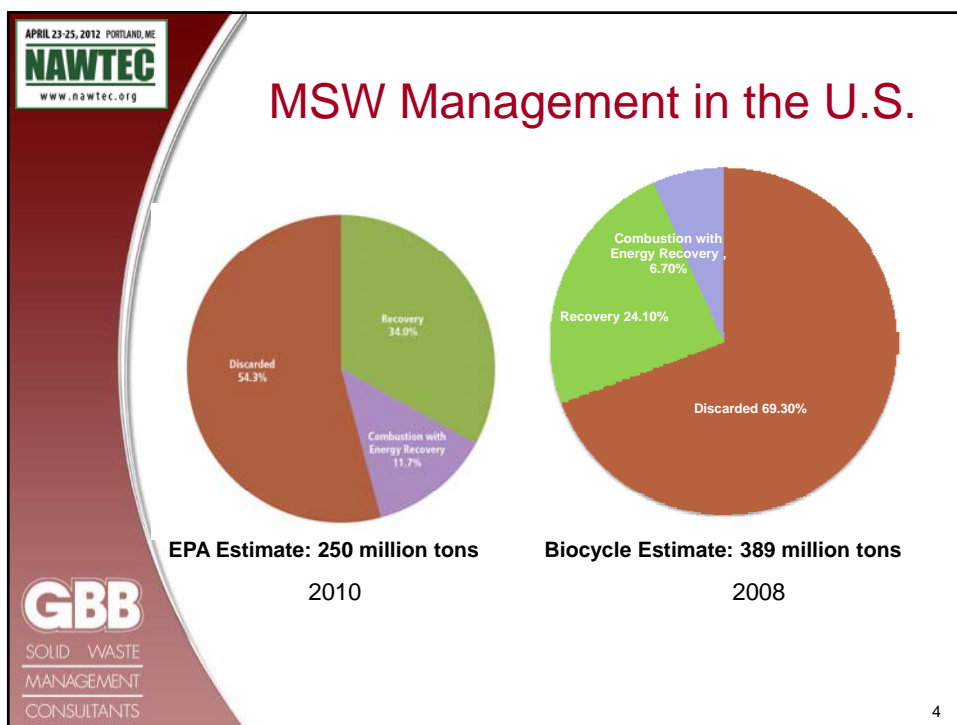
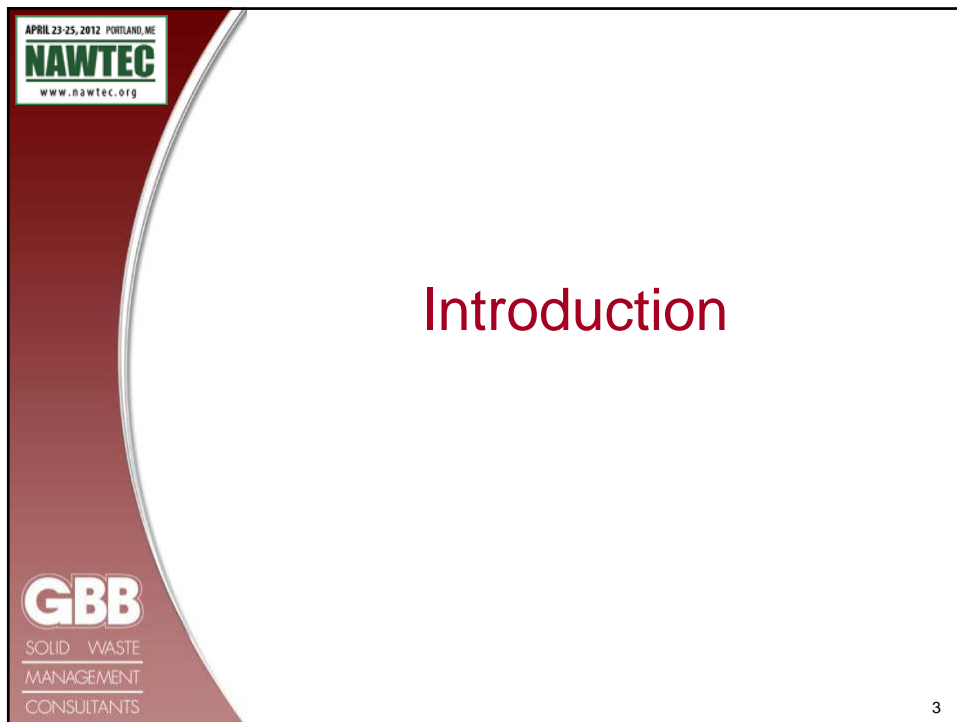
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Outline*

- 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
 - Palm Beach County, FL
- Summary and Trends for Future
- Q&A

*Research support from Ljupka Arsova, Neil Daniel, Elizabeth Rice

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Factors Contributing to Increased Interest in WTE

- President Obama, State of the Union address 2011- reinventing energy policy and setting a goal for 80% of the nations electricity to come from renewable energy sources by 2035
- In 2009, 19 alternative technologies received a total of \$564 million from DOE for pilot, demonstration and commercial Projects
- \$117 million in appropriations for conversion technologies in Biomass and Biorefinery Systems Research, Development & Demonstration program in 2012, up from \$82 million in 2010
- Federal Loan Guarantee Programs*
 - *U.S. Department of Agriculture (USDA) Renewable Energy loan guarantee programs*
 - *U.S. Department of Energy (DOE) Renewable Energy loan guarantee programs* (In summer 2011, biofuels and biomass technologies received \$240 million!)
- Filling up of nearby landfills and opposition against new ones
- Increase in disposal fees and transportation costs

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Capacity for Growth

Year	Recovery for recycling	Recovery for composting	Combustion with Energy Recovery	Landfill
1960	5	5	5	85
1970	10	10	10	110
1980	15	15	15	135
1990	20	20	20	150
2000	30	30	30	170
2005	40	40	40	170
2007	45	45	45	165
2008	45	45	45	165
2009	45	45	45	165
2010	45	45	45	165

Year

■ Recovery for recycling ■ Recovery for composting ■ Combustion with Energy Recovery ■ Landfill

The total installed US WTE capacity in 2010 was 2.7 GW, combusting only 11.7% of the nation's MSW

If half of landfilled waste went to WTE → over 9 GW


In 2011, 24.7 GW of announced coal power plant retirements

Source: USEPA, 2010

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

- 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

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



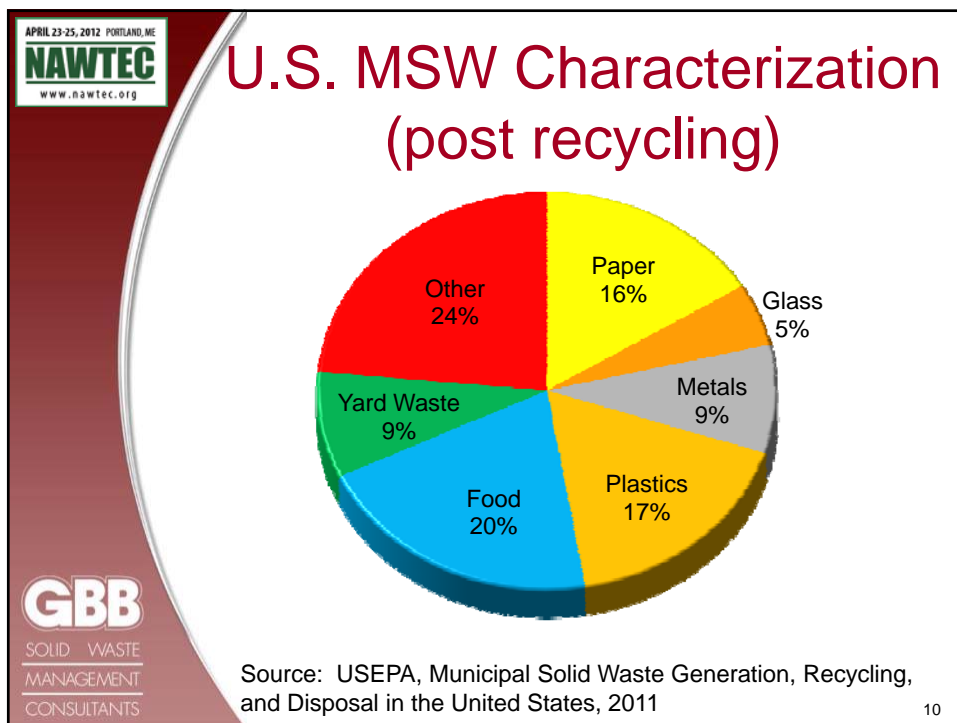
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Selected Waste Conversion Technology Companies and Projects

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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



The diagram illustrates the AlterNRG gasifier, a vertical cylindrical vessel. At the top, a 'Feed Port' leads into a 'Feed Pipe' which terminates in a 'Feed Bed'. Above the feed bed is a 'Refractory' lining. Below the feed bed is the 'Gasification Zone', which contains 'Tertiary Tuyere', 'Secondary Tuyere', and a 'Plasma Torch' at the bottom. The bottom of the gasification zone is a 'Coke Bed'. The entire vessel is labeled 'ALTER_{NRG} Westinghouse Plasma Corporation a Division of the NRG Group'. On the right side, two 'Syngas Outlet' ports are shown. The bottom of the vessel is labeled 'Removable Bottom' with a 'Tap Hole'.

AlterNRG gasifier

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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




Fulton, MS site prepared for construction,
June 2011

- 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

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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

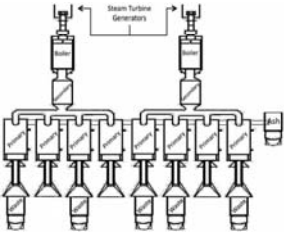




Diagram depicts a typical 200-ton per day capacity plant.

PROJECTS

Ada County, Idaho

- Agreement signed in 2011 and expansion requested in March 2012 for 408 TPD
- Construction planned to start July 1st, 2012
- Expected to start operating in 2013.


Puerto Rico

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

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Enerkem

- 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



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


- 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

Fiberight High-Solids Pulping



TMO Blairstown, Iowa Layout 17




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INEOS Bio

- 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
 - under construction and expected to be completed in the mid 2012
 - Lake County (IN) Solid Waste Management District- under development



Pilot facility in Fayetteville, AR

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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	
THERMOSELECT	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

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Company	Technology	Product	Status	Featured plants in N. America	No. of commercial plants
 agilyx	Pyrolysis	Crude oil & combustible gas	demo	Demo: Tigard, OR, 10 TPD	none
 CLIMAX GLOBAL ENERGY	Microwave Pyrolysis	Crude wax & combustible gas	demo	Under construction: Blackville, SC 20 TPD	1 under construction
 COVANTA	Catalytic Pyrolysis	Diesel Fuel	commercial	R&D at SEMASS WTE, Rochester, MA	5
 ALPHA KAT	Far Infrared Pyrolysis	Crude oil & combustible gas	commercial	Demo: Montgomery County, MD, closed 2011	N/A
 Plastic2Oil	Catalytic Pyrolysis	Crude oil & combustible gas	Pilot	Pilot: Niagara Falls, NY (45TPD)	none
 Re	Pyrolysis	Synthetic crude	N/A	Under development: Hennepin County, MN Manatee County, FL	none
 Rational energies	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 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-Kompoform 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 July 2012.



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Additional Technologies Processing Organic Waste

<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>
 ARROWECOLOGY THE WAY TO ZERO WASTE	Dry anaerobic digestion	Biogas and compost	commercial	Commercial- Sidney , AU Pilot- Hidera, Israel	1
 BEKON Waste Technologies GmbH & Co. KG	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
- Advancing new facilities with ‘proven’ technologies:
 - Baltimore, MD – Energy Answers
 - Frederick County, MD (NMWDA) - Wheelabrator
 - Durham York (Ontario CN) - Covanta
 - City of Los Angeles, CA – Green Conversion Systems
 - Palm Beach County, FL (SWAPBC) – B&W
 - Puerto Rico – Energy Answers
 - Vancouver, British Columbia, CA
- Existing facilities being sold/upgraded/
 - Harrisburg, PA
 - New Hanover County, NC

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**Solid Waste Authority
of Palm Beach County**

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Solid Waste Authority of Palm Beach County, FL



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

- **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
- \$668 million construction price
- 3,000 tons per day of MSW capacity
- 325 full-time construction jobs with more than 900 people to be employed during some phases of construction
- When operational, the new plant is expected to employ 64 permanent, full-time workers

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Project Procurement Approval Chronology - Solid Waste Authority of Palm Beach County, FL

- 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
- 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 (ILSR) were received suggesting:
 - Approval to be postponed
 - Alternative waste disposal methods to be studied, especially more recycling

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Project Procurement Approval Chronology - Solid Waste Authority of Palm Beach County, FL

- 2011 (continued)
 - GBB again hired to review and fact check the accuracy of the statements and claims made by Florida Sierra Club and ILSR
 - The following summarizes the 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
- 2011 Result: Authority Governing Board approves awarding contract in April 2011
- 2- **GROUNDBREAKING CEREMONY APRIL 4th!**

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The screenshot shows a web browser window titled "SWA Waste-to-Energy Construction Webcam". On the left is a sidebar with a calendar for April 2012, image thumbnails, and playback controls. The main area displays a live video feed of a construction site. In the background, a large industrial facility with a tall smokestack is visible. In the foreground, there's a dirt area with a white pickup truck, a yellow excavator, and several workers in safety gear.

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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 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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Summary and Trends for Future

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Technologies and Risk

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

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
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
Mixed-Waste Composting	Previous large failures; No large-scale commercially viable plants in operation; subject to scale-up issues	Moderate to high
Chemical Decomposition	Technology under development; not a commercial option at this time	High

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Opinion of Trends for the Future...

- New technologies will need 4-6 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'
 - 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



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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



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

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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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