


APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
www.nawtec.org

## Comparison of Environmental Performance Expectations:


Gasification versus Mass-Burn WTE Facilities  
Currently Under Construction in North  
America

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

By  
Elizabeth A Rice  
Gershman, Brickner & Bratton, Inc.




**GBB**  
SOLID WASTE  
MANAGEMENT  
CONSULTANTS



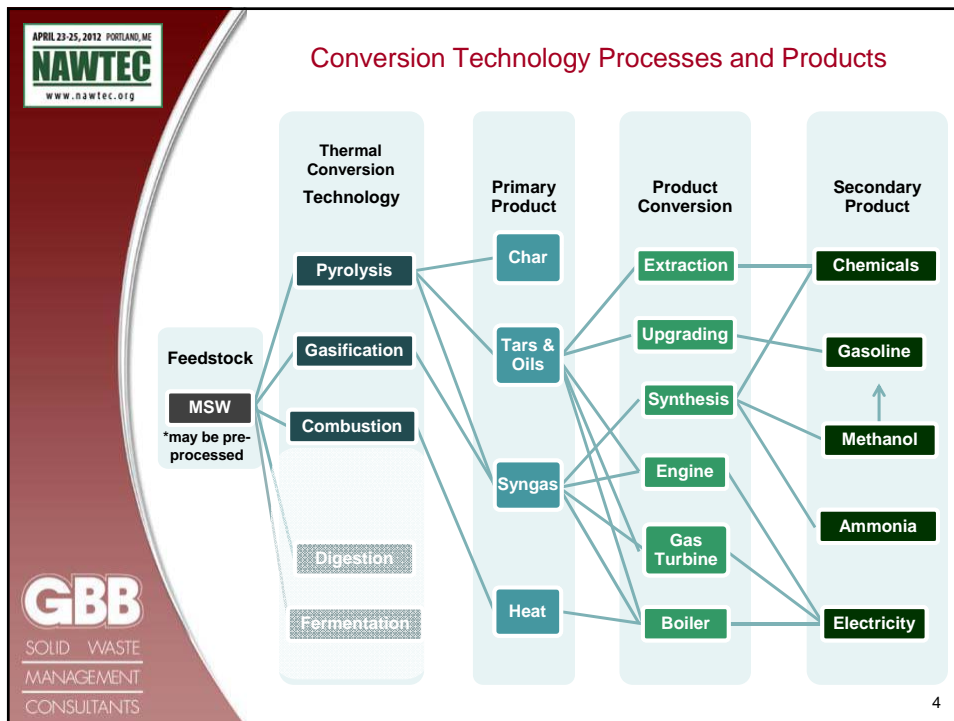
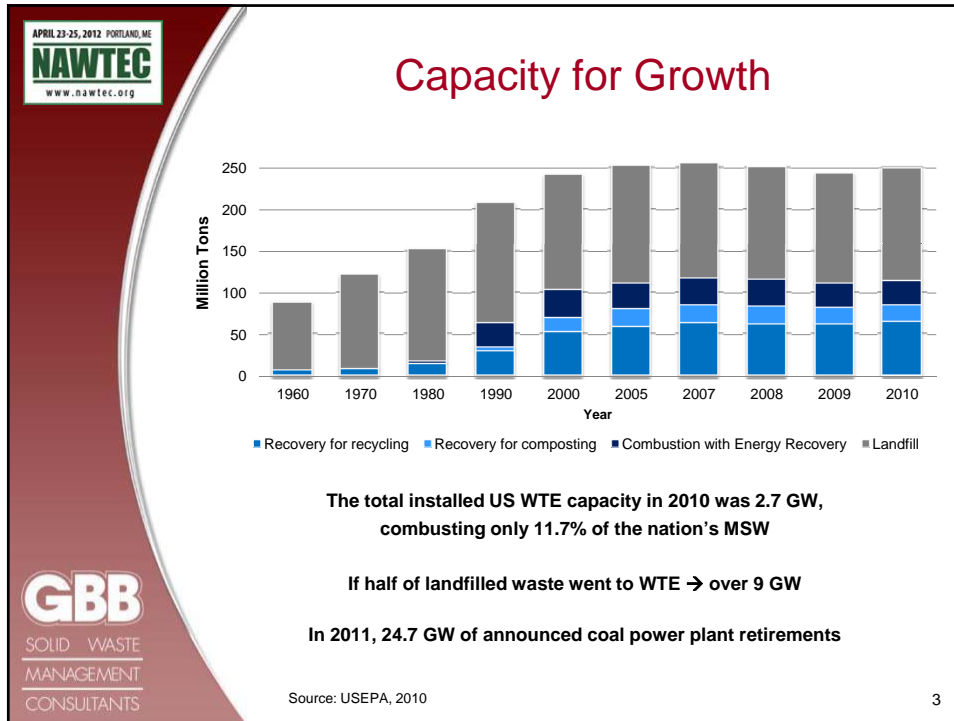
APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
www.nawtec.org

## Outline

- Introduction
- Facilities Permitted in North America
  - Expansions
  - Greenfield Projects
- Factors Influencing Performance
- Comparison of Permit Limits
- Conclusions



**GBB**  
SOLID WASTE  
MANAGEMENT  
CONSULTANTS



APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
www.nawtec.org

## Challenges to Commercialization

**Non-technical Barriers:**

- **Social Acceptability**
  - Perceptions of Pyrolysis & Gasification in society not consistently positive
- **Environmental Legislation and Energy Policy**
  - Not all fuels produced eligible for renewable incentives
  - Demand for Renewable Energy increasing
- **Market fluctuation**
  - Feedstock availability (location and consistency of supply)
  - Market value of plastics and end products variable
  - Competition with the price of oil
- **Financing of Demonstration Units**
  - Projects need to be large enough to be economically feasible
  - Initial set-up stage can be unpredictable if met with public opposition, can exhaust funds

**GBB**  
SOLID WASTE  
MANAGEMENT  
CONSULTANTS

5

APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
www.nawtec.org

## Past and Future Developments

Hillsborough County, FL

Lee County, FL

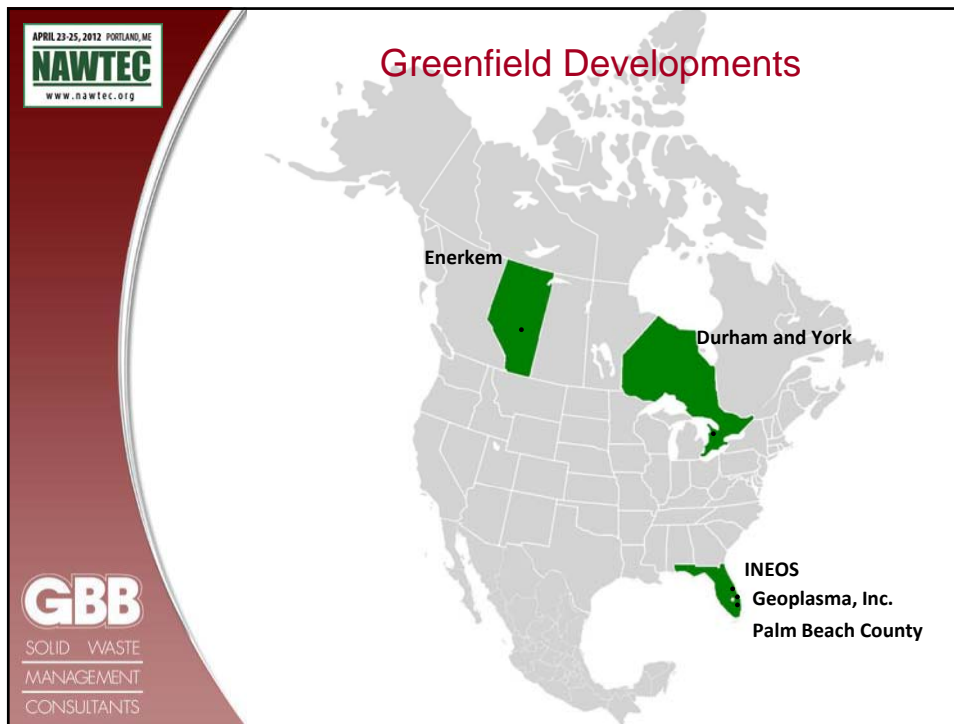
Energy Answers, Baltimore, MD

Olmstead County, MN

Honolulu, HI

**GBB**  
SOLID WASTE  
MANAGEMENT  
CONSULTANTS

6





**Gasification Facilities**

Developer	Process	APC
INEOS	Feedstock shredded and dried, combined with oxygen in gasifiers. Syngas introduced into a fermentation system and converted to ethanol using bacterial metabolic activity. Off-gases combusted in a boiler, with heat recovery steam generator for power generation	Vent Gas Boiler, Activated Carbon and Lime Injection, Scrubbing of Vent Gas, Desulfurization Unit, Dry Gas Cleaning System
Geoplasma	Feedstock processed, and gasified in vertical cylindrical vessel heated with plasma torches. Syngas combusted in a multi-stage thermal oxidizer. Heat recovery steam generator for power generation	SCR, Activated Carbon Injection, FGD, ESP, Baghouse
Enerkem	Feedstock delivered processed, gasified in bubbling fluidized bed reactor in the presence of added water and steam. Syngas treated with cyclones and cooled, then scrubbed. Syngas heated and treated before being converted into methanol and/or chemical feedstocks through catalytic synthesis reactors, then esterification for ethanol pathway	Two-stage Wet Scrubber, Low NOx Burner, Two Cyclones in Series, Baghouse

Logos: NAWTEC (APRIL 23-25, 2012 PORTLAND, ME www.nawtec.org) and GBB SOLID WASTE MANAGEMENT CONSULTANTS.

APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
 www.nawtec.org

## INEOS Bio – Vero Beach, FL


- INEOS Bio and partner New Planet Energy
- Designed to produce 8 million gallons of bioethanol and net 2 MW of electricity from 150,000 tons of MSW and renewable biomass
- Scheduled to begin commercial operation in mid-2012
- \$2.5M grant from the State of Florida, \$50M grant from DOE, and \$75M commitment from USDA, Total project investment will be more than \$130M

**GBB**  
 SOLID WASTE  
 MANAGEMENT  
 CONSULTANTS

9

APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
 www.nawtec.org

## Geoplasma - St. Lucie County, FL



- Geoplasma is a division of the Jacoby Group,
- Designed to produce net 18 MW of electricity from 193,000 tons of MSW and tires annually (600 TPD)
- Cost cited at \$130M
- Construction expected to begin in 2012, operation by 2014
- Utilizes a plasma arc gasifier developed by Westinghouse Plasma Corporation, a division of Alter NRG



**GBB**  
 SOLID WASTE  
 MANAGEMENT  
 CONSULTANTS

10



APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
 www.nawtec.org

## Energkem – Edmonton, Alberta

- Partnership with the City of Edmonton, to receive post-recycled waste
- Designed to produce 10 million gallons of methanol from 112,000 tons of RDF annually (300 TPD)
- Plans for additional facility development to produce 9.5 million gallons of bioethanol in future years
- Secured an offtake agreement with Methanex for methanol produced

**GBB**  
 SOLID WASTE  
 MANAGEMENT  
 CONSULTANTS

11

APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
 www.nawtec.org

## Mass Burn Facilities


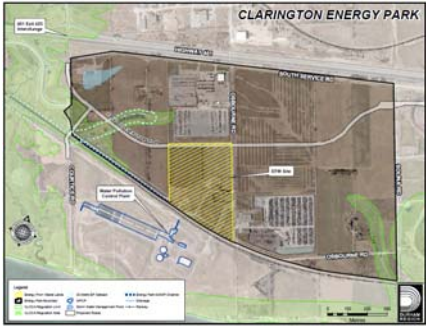
Developer	Process	APC
Durham/York	Mass Burn Municipal Waste Combustor, with Stoker Grate Steam Boilers, equipped with Covanta's Very Low NOx Combustion Process	SNCR, ESP, Activated Carbon Injection, Ammonia Injection, Dry Recirculation Lime Injection Scrubber, Baghouse
SWAPBC	Mass Burn Municipal Waste Combustor with reuse of cooling tower water from the existing facility	SCR, ESP, Activated Carbon Injection, Spray Dryer Absorber with Lime Injection, Baghouse

**GBB**  
 SOLID WASTE  
 MANAGEMENT  
 CONSULTANTS

12

APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
www.nawtec.org

## Durham and York, Ontario


- Certificate of Approval in June of 2011 from Ontario Minister of the Environment
- 480 TPD (2 x 240) mass burn WTE facility in Clarington, Durham
- Covanta Energy Limited selected to design, construct, and operate the facility, located in Ontario's Clarington Business Park
- Net 14 MW of electricity from 156,800 tons per year of MSW
- Financing for the facility provided by Durham and York, total cost of \$260M
- Construction began in fall of 2011, projected commercial operation in 2014

**GBB**  
 SOLID WASTE  
 MANAGEMENT  
 CONSULTANTS

13

APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
www.nawtec.org

## Palm Beach County, FL



- Solid Waste Authority of Palm Beach County, permitted by Florida DEP for the Renewable Energy Facility No.2
- In April 2011 selected Babcock & Wilcox Power Generation Group to design, construct, and operate the facility
- Located adjacent to the SWAPBC Renewable Energy Facility No.1
- 95 MW gross of electricity generated from 3,000 tons per day of MSW (3 x 1,000)
- Under construction, projected to begin commercial operation in spring of 2015
- Capital costs cited at \$668M, first year O&M cost of \$20.5M

**GBB**  
 SOLID WASTE  
 MANAGEMENT  
 CONSULTANTS

14

APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
www.nawtec.org

**GBB**  
SOLID WASTE  
 MANAGEMENT  
 CONSULTANTS

## Expectation of Performance

Four primary factors differentiating expectations of overall performance and emission production between facilities currently permitted:

15

APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
www.nawtec.org

**GBB**  
SOLID WASTE  
 MANAGEMENT  
 CONSULTANTS

*These facilities show wide variation of combination of these four differentiating factors:*

Developer	Geoplasma	Ineos Bio	Enerkem	Palm Beach	Durham/ York
<b>Technology</b>	Plasma Gasification	Gasification, Fermentation	Gasification, Catalytic Synthesis	Mass Burn (B&W)	Mass Burn (Covanta)
<b>Feedstock</b>	RDF	RDF (biomass)	RDF	MSW	MSW
<b>TPD Feedstock</b>	600	300	300	3000	480
<b>Product Outputs</b>	Net 18 MW	7.9 M gal/yr ethanol, Net 2 MW	9.5 M gal/yr ethanol	Gross 95 MW	Net 14 MW, steam


16



APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
 www.nawtec.org

**GBB**  
 SOLID WASTE  
 MANAGEMENT  
 CONSULTANTS

### Onondaga County Resource Recovery Facility



- Operating as Covanta Onondaga, L.P. since 1995
- Processes 990 tons per day of MSW (3 x 330)
- Generates 39.5 MW
- 14-year average of 631 kWh/ton of MSW processed
- Waterwall furnaces with Martin® reverse-reciprocating grates
- APC:
  - SNCR
  - ESP
  - Ammonia Injection
  - Semi-dry Flue Gas Scrubbers injecting Lime and Activated Carbon
  - ESP

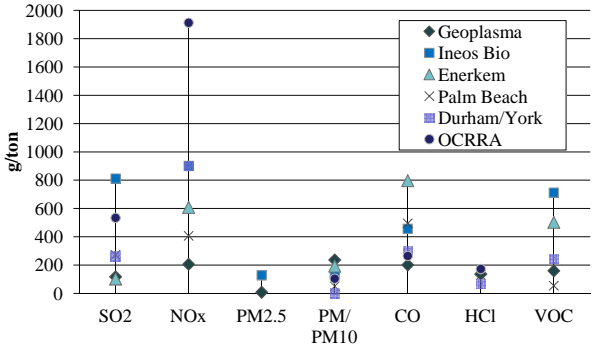
17

APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
 www.nawtec.org

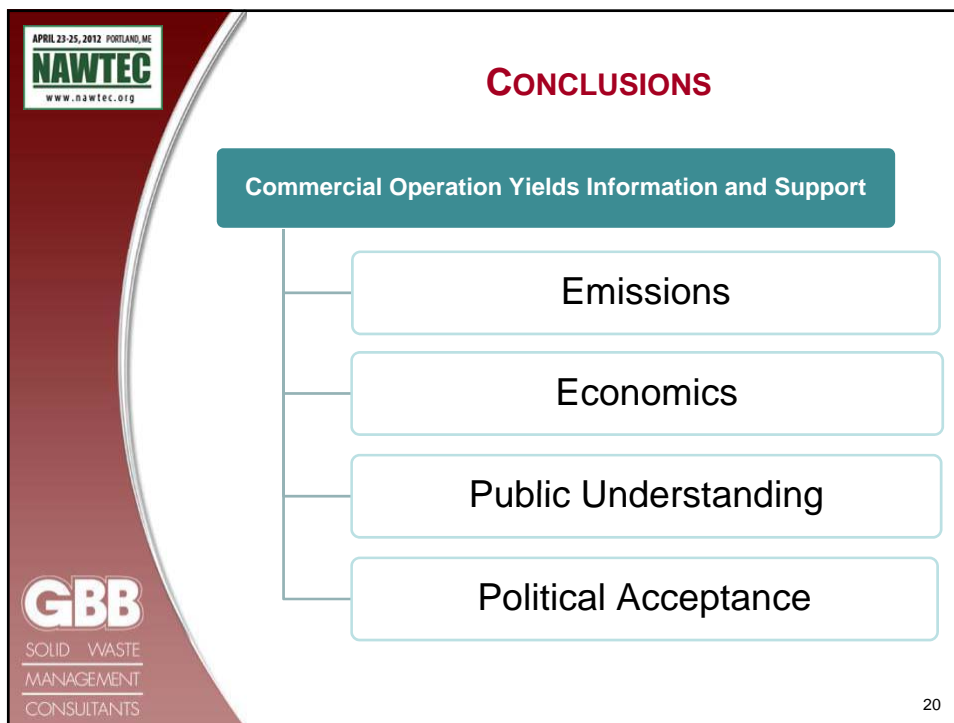
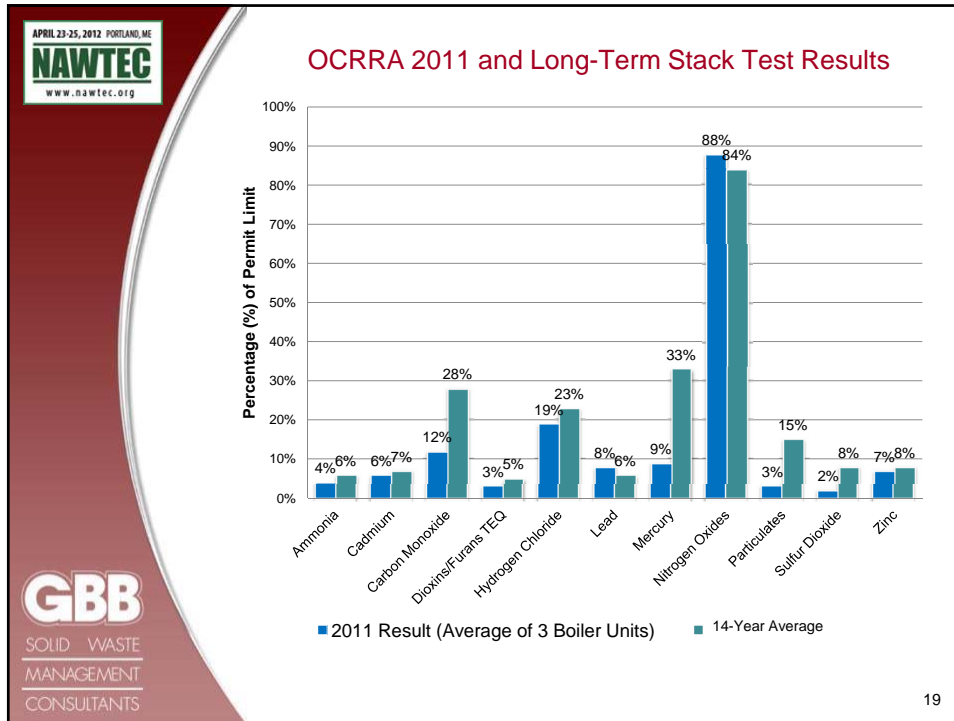
**GBB**  
 SOLID WASTE  
 MANAGEMENT  
 CONSULTANTS

### Air Permit Limits

g/ton of feedstock processed	Geoplasma	Ineos Bio	Enerkem	Palm Beach	Durham/York	OCRRA
SO <sub>2</sub>	117.2	812.29	101.88	272.16	260.19	534.42
NO <sub>x</sub>	206.26	901.11	608.36	407.14	899.51	1913.34
PM2.5	7.9	127.76				
PM/PM10	236.76	136.74	192.96	51.17	66.91	104.25
CO	201.37	457.31	797.32	495.32	297.36	265.2
HCl	136.31			129.55	66.91	172.86
VOC	159.72	712.78	502.76	54.43	245.32	



18



APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
www.nawtec.org

## FUTURE ACTIVITY

- Community evaluations of conversion technologies
  - Ada County, ID
  - Baton Rouge, LA
  - City of Allentown, PA
  - City of Dallas, TX
  - City of Glendale, CA
  - City of Plano, TX
  - City of San Antonio, TX
  - City of Taunton, MA
  - Columbia, SC
  - Fulton, MS
  - Gallatin County, KY
  - Lake County, IN
  - Los Angeles County, CA
  - Mason City, IO
  - Maui County, HI
  - New York, NY
  - Prince William County, VA
  - Salinas Valley, CA
  - San Bernardino County, CA
  - Santa Barbara County, CA
- Several have concluded with the initiation of procurements
- As facilities currently under construction begin to come on-line, more procurements to come
- Time frames may be short, so be prepared!

**GBB**  
SOLID WASTE  
MANAGEMENT  
CONSULTANTS

21

APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
www.nawtec.org

## *Thank you!!*

**Elizabeth Rice**  
[ERice@gbbinc.com](mailto:ERice@gbbinc.com)

1-703-573-5800  
1-800-573-5801  
1-703-698-1306 (fax)

[www.gbbinc.com](http://www.gbbinc.com)

**GBB**  
SOLID WASTE  
MANAGEMENT  
CONSULTANTS

22

APRIL 23-25, 2012 PORTLAND, ME  
**NAWTEC**  
www.nawtec.org

- REFERENCES
- [1] Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010. United States Environmental Protection Agency, Solid Waste and Emergency Response. November 2011.
- [2] 2010 Worldwide Gasification Database. US Department of Energy National Energy Technology Laboratory. <<http://www.netl.doe.gov/technologies/coalpower/gasification/worlddatabase/index.html>>. 2010.
- [3] St. Lucie Plasma Gasification Facility in Fort Pierce, St. Lucie County, FL, Air Construction Permit Application. Golder Associates, 2009.
- [4] Florida Department of Environmental Protection. St. Lucie Plasma Gasification Project. Air Permit No. 1110138-001-AC. 2010.
- [5] INEOS New Planet BioEnergy. Indian River County BioEnergy Facility Air Construction Permit Application. CDM, 2010.
- [6] Florida Department of Environmental Protection. INEOS New Planet BioEnergy. Indian River County BioEnergy Facility. Air Permit No. 0610096-001-AC. 2010.
- [7] Province of Alberta Environmental Protection and Enhancement Act. Enerkem Greenfield Alberta Biofuels G.P., Edmonton Chemical (Biofuel) Manufacturing Plant. Approval No. 249118-00-00. 2009.
- [8] Solid Waste Authority of Palm Beach County. Prevention of Significant Deterioration Permit Application. Palm Beach Renewable Energy Facility # 2. Malcolm Pirnie, 2010.
- [9] Florida Department of Environmental Protection. Palm Beach Renewable Energy Park, Palm Beach Renewable Energy Facility No. 2. Air Permit No. 0990234-017-AC (PSD-FL-413). 2010.
- [10] Durham York Energy Centre, Application for a Basic Comprehensive Certificate of Approval (Air & Noise). Golder Associates, 2011.
- [11] Durham York Energy Centre. Certificate of Approval No. 7306-8FDKNX. 2011.
- [12] United States Environmental Protection Agency. Office of Air Quality Planning and Standards. Emissions from Large and Small MWC Units at MACT Compliance. 2007. Print.
- [13] Onondaga County Resource Recovery Facility Annual Report of Facility Performance and Stack Test Summary, Operating Year 2010. Onondaga County Resource Recovery Agency. May 2011.

GBB  
SOLID WASTE  
MANAGEMENT  
CONSULTANTS

23