Innovative Approaches to Managing Northampton's Solid Waste

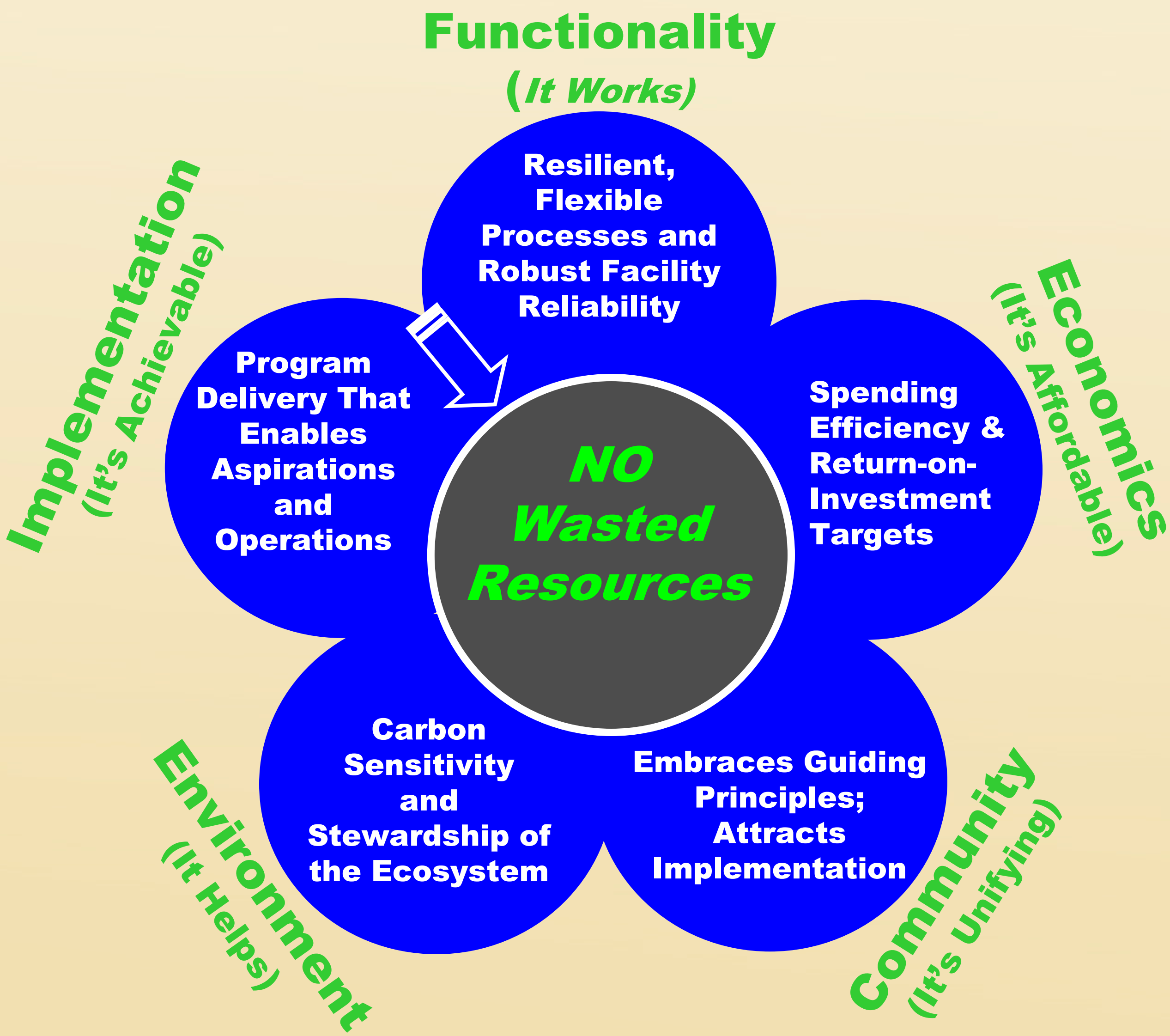
No Wasted Resources SM

November 19, 2008

Northampton's Solid Waste Management Option Investigation

- Reduce, Reuse, Recycle
- Collection
  - Drop-off
  - Subscription
  - Citywide curbside
    - Source Separated Recyclables
    - Single Stream
- Waste Processing (Conversion)
- Disposal
- Post Disposal Resource Recovery

NO WASTED RESOURCES



Outline of Presentation

- Zero Waste
- Waste Processing (Conversion)
  - Established
  - Emerging
- Carbon Footprint of Solid Waste Management Practices

Innovative Approaches to Handling Northampton's Solid Waste

Zero Waste

What are the Drivers?

- Climate Impacts
- Sustainability
- Getting Beyond 70% Diversion

Where Have We Been?

- Preferred hierarchy of reduce-reuse-recycle in place for a generation
- Massachusetts waste reduction rate has increased from mid teens to 60% in 2006 (47% overall recycling)
- Program emphasis has broadened from “end of pipe” core municipal recycling programs to encompass
  - Organics
  - Commercial sector
  - Manufacturers
  - PAYT grown from 94 in 2000 to 122 in 2007
- We have all become a lot more familiar with our “trash”

Where are we Going?

- Existing DEP Master Plan Update calls for

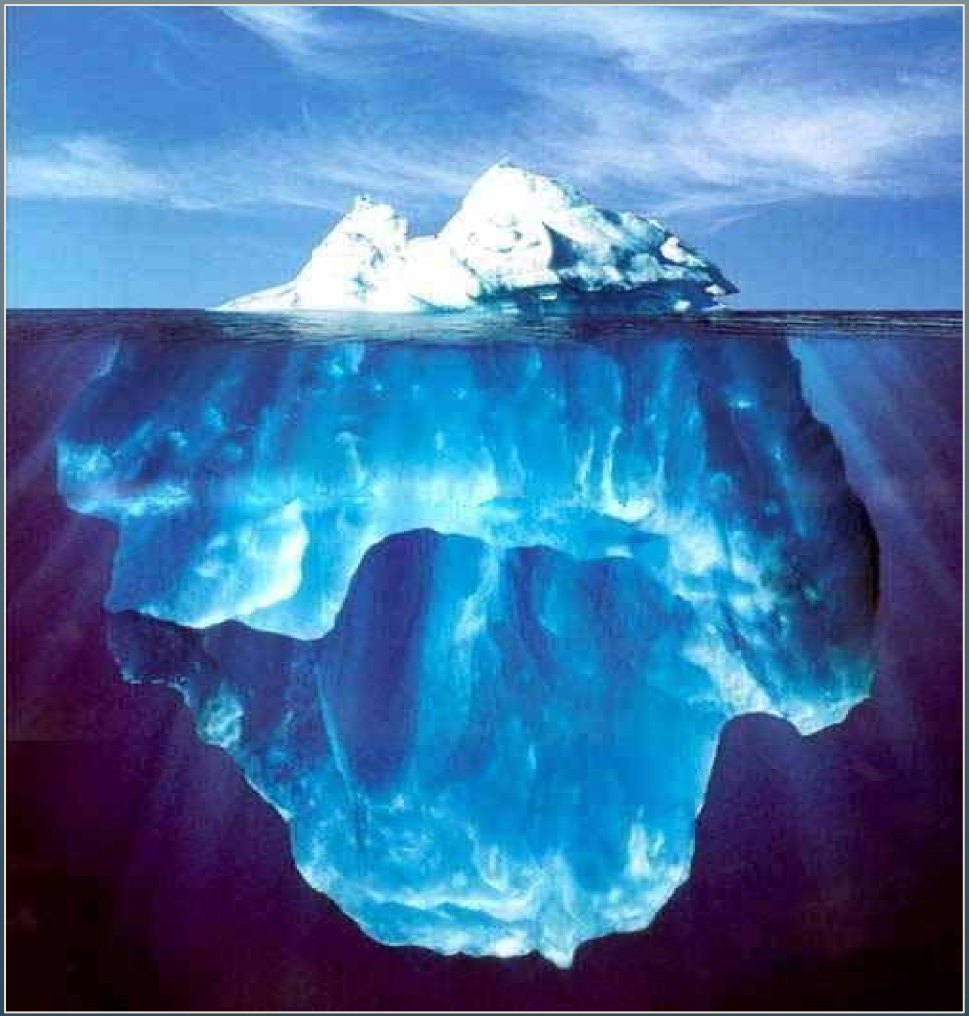
  "…continuous work to reduce the quantity and toxicity of our waste to the maximum extent feasible, so that we only dispose of the irreducible minimum."

  "Residents, businesses, institutions, and all levels of government must take increased responsibility for reducing, reusing, and recycling waste"

- Revision Process Underway

Tackling the "Wasteberg"

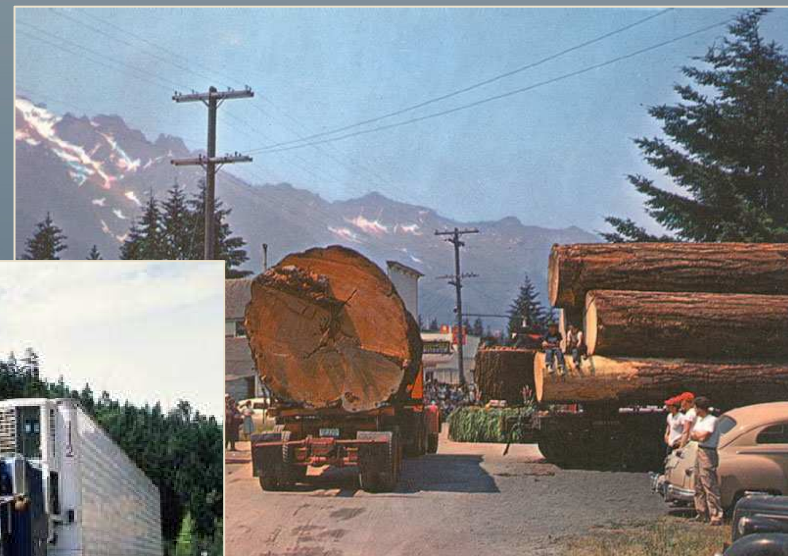
Downstream Waste



Upstream Waste

71 Tons of Upstream Waste per 1 Ton of Municipal Solid Waste

Sources of Upstream Waste



Local Solid Waste Management Programs Primarily Affect Downstream Waste

- Upstream
  - Mining, Drilling, Logging
  - Manufacturing
  - Building
  - Transporting
  - Consuming
- Downstream – Post Consumer
  - Reduce
  - Reuse
  - Recycle
  - Processing
  - Disposal
  - Post Disposal Resource Management

Downstream

- Ensure the **highest and best use** of products and packaging at the end of their useful lives
- **Reuse** products and packaging, retaining their **original form and function**
- Recycle, compost, convert materials that are not reduced or reused
- Manage Residuals

What is Zero Waste?

Zero Waste is a goal that:

- – Recognizes that “waste” is not inevitable
- – Discarded materials are potentially valuable resources
- – Goes beyond “end of the line” strategies
- – Maximizes recycling and composting
- – Reduces consumption
- – Designs “waste” out of the system

Local Zero Waste Programs Include:

Reduce
Reuse
Recycle
Process (Convert)
= Zero Waste

Pieces of Zero Waste Initiative

- Comprehensive recycling programs
  - Multi-material
  - As convenient as trash
  - Available to all generators
- Organics diversion
  - Yard trimmings
  - Food scraps
  - Compostable paper
- C&D diversion
  - Generator-based
  - Hauler-based
  - Facility-based
- Zero Waste Infrastructure
  - Neighborhood scale
  - Reuse and recycling
  - Materials recovery
  - C&D processing
  - Organics processing
- Residual Waste Management
  - Alternative technologies
  - Residual waste transfer
  - Residual waste disposal

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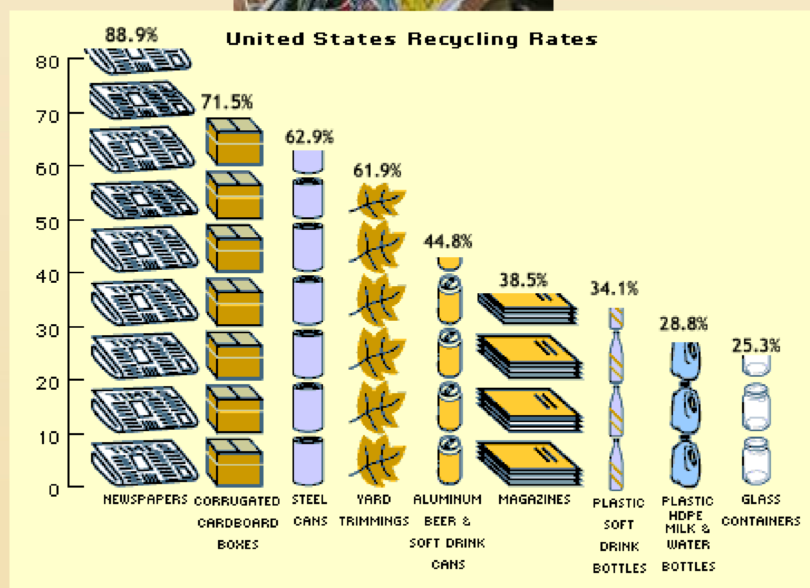
Post Consumer Waste Processing (Conversion)

Established Technologies

- Material Recovery Facilities
- Composting
- Waste-to-Energy (WTE)

Clean Material Recovery Facilities (MRF)

- Collection of Source Separated Material
- Paper, Metals, Glass, Plastic
- Single Stream vs. Multiple Stream
- Bottle Bill



Springfield MRF – Operating Since 1990

Dirty Material Recovery Facilities (MRF)

- Process Mixed MSW
- Involve screening and sorting
- May include both manual and mechanical sorting
- May include recovery of organic fraction used for combustion, composting or in-vessel anaerobic digestion, gasification.

General Observations on Dirty vs Clean MRFs

- Mixed Experience
- Only Limited Success
- Reduced Collection Costs and Emissions
- Successes Often Combined with other Processes such as Refuse Derived Fuel WTE Facilities
- Lower Quality Recyclables vs. Clean MRF
- Several Facilities Built in the U.S. have Been Shut Down

Composting



Rikers Island Food Waste Composting Facility

Mixed Waste Composting Facility in Nantucket, MA

- Separated Organic Streams vs. Mixed MSW
- Yard Waste, Food Waste, Sewer Sludge, Other Organics
- Static Pile, Windrows, In-Vessel
- Over 200 Active Composting Sites in MA
- Only 2 process Mixed MSW

Only 13 Mixed Waste Composting Facilities in U.S.

- Gilroy, CA
- Mariposa, CA
- Cobb County, GA
- Marlborough, MA
- Nantucket, MA
- Truman, MN
- West Yellowstone, MT
- West Wendover, NV
- Delaware County, NY
- Medina, OH
- Rapid City, SD
- Sevierville, TN
- Columbia County, WI

Waste-to-Energy

- Generates Steam or Electricity for Sale
- Advanced Pollution Air Pollution Control
- Greater Than 90% Volume Reduction

- Approximately 3.1 million tons of MSW in Massachusetts Processed at 7 WTE
- Predominant Waste Processing Option in Europe and Asia

408 Ton per Day WTE Facility in Agawam, MA.

Worldwide Experience with WTE (2004)

Location	Number of Facilities	Percent MSW vs. Total MSW
United States	89	8 to 15%
Europe	400	Varies by Country
Japan	100	70 to 80%
Other Nations	70	Varies by County

Source: Integrated Waste Services Association

Bioreactor Landfill

- A bioreactor landfill operates to rapidly transform and degrade organic waste.
- The increase in waste degradation and stabilization is accomplished through the addition of liquid and air to enhance microbial processes.
- Bioreactor landfills can be run as an aerobic process with air addition and as an anaerobic process without added air.
- By efficiently designing and operating a landfill, the life of a landfill can be extended

Potential Advantages

- Decomposition and biological stabilization in years vs. decades in “dry tombs”
- Lower waste toxicity and mobility due to both aerobic and anaerobic conditions
- Reduced leachate disposal costs
- A 15 to 30 percent gain in landfill space due to an increase in density of waste mass
- Significant increased LFG generation that, when captured, can be used for energy use onsite or sold
- Potential Reduced post-closure care

Sample of Bioreactor Landfills in the US

- California
  - Yolo County
- Florida
  - Alachua County Southeast Landfill
  - Highlands County
  - New River Regional Landfill, Raiford
  - Polk County Landfill, Lakeland
- Kentucky
  - Outer Loop Landfill
- Michigan
  - **Clare county**
- Mississippi
  - Plantation Oaks Bioreactor Demonstration Project, Sibley
- Missouri
  - Columbia (in development)
- New Jersey
  - ACUA's Haneman Environmetnal Park, Egg Harbor Township
- North Carolina
  - Buncombe County Landfill Project
- Virginia
  - Maplewood Landfill and King George County Landfills
  - Virginia Landfill Project XL Demonstration Project

Emerging (Innovative) Technologies

- In-Vessel Anaerobic Digestion
- Autoclaving
- Gasification
- Plasma Arc Gasification

Why Consider Emerging Technologies?

- Many communities adopting greater diversion level goals
- Landfill capacity concerns and increasing costs
- Favorable economic climate (renewable energy, tax credits etc)
- Climate impacts & Environmental impacts
- Vendors offering “risk free” approaches
- Looking for the silver bullet solution

Five International Technology Tours in Three Years

- Travel to witness first hand what is state of the art in other countries
- Meet with technology developers, facility operators, elected officials and industry trade associations
- Ask the detailed questions and come away with the facts

Anaerobic Digestion | Tel Aviv

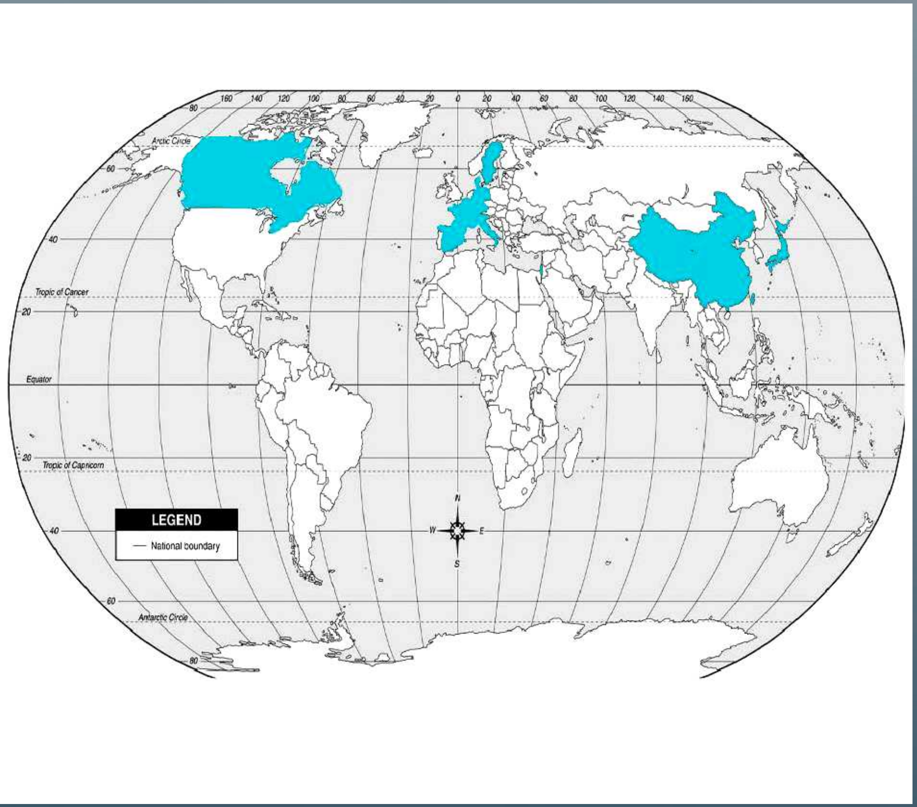
Gasification | Tokyo

Plasma Arc | Ottawa

Technology Tour | Tokyo

Where We Have Been

Japan, China, Taiwan
Israel
Sweden, Denmark
Holland, Belgium
Switzerland, Germany
France, Spain,
Czech Republic
Italy, Canada,
United States



In-Vessel Anaerobic Digestion

- Biological process in the absence of oxygen
- Converts organic fraction to biogas or methane
- Biogas combusted to generate steam or electricity
- Digestate (residual) can be composted

Anaerobic Digestion of MSW
Barcelona, Spain

Anaerobic Digestion of MSW
Tel Aviv, Israel

General Observations on Anaerobic Digestion

- European plants utilizing green waste, also some taking food waste

- Several European plants utilizing MSW, many visited were under construction
  - Significant pre-processing of mixed MSW at up front MRF, feedstock preparation is key
  - When mixed waste used as feedstock materials removed for recycling are often unacceptable

General Observations on Anaerobic Digestion

- Potential negative impacts: odor, air emissions
- Compost product quality can be an issue with contaminants
- Electricity can be sold to grid
- Biogas and thermal need local market
- Unable to obtain long term operational data

General Observations on Anaerobic Digestion

- No emissions data provided but expected to be low compared to EPA MACT standards
- Significant production of H2S which needs to be controlled (2,500 ppm)
- Service fee projected in range of $120 – $150/ton (includes other technologies in integrated system)
- Biological treatment of organic waste materials resulting in a source of energy and soils amendment can potentially be an effective component of a multi-faceted integrated waste management program

Gasification

- Thermal Conversion with limited or no air or oxygen
- Can produce syngas, liquid fuel, solid char and solid residuals from organic material
- Includes
  - Pyrolysis
  - Plasma Arc

Gasification Plant
Tokyo, Japan

Kazua Clean System Co., Ltd.
Gasification Plant - Japan

General Observations on Gasification

- Mostly prevalent in Japan, not prevalent in other countries we visited
- Commercial scale operating facilities in Japan; very neat and clean facilities
- Seems to work best with a more uniform and select feedstock (plastics, biomass, industrial waste)
- Ash is melted and vitrified and rendered non-hazardous, much of which is sold as a slag material

General Observations on Gasification

- All air emissions reported to be well below permit limits at plants visited (at some plants, real time emission data posted on publicly accessible web sites)
- Need better information on availability of the facilities we visited
- Relatively expensive - tipping fees in the $300 US / ton range

Plasma Arc Gasification

Plasma Arc Gasification
Ottawa, Canada

In-furnace conditions

- Has been used in Japan on incinerator ash to reduce volume and convert to glassy slag
- Plasma is hot ionized gas resulting from electrical discharge
- Gasification occurs at extremely high temperatures
- Potential to convert MSW to electricity

General Observations on Plasma Arc Gasification

- Operational issues due to fuel feed system still being worked out
- No extensive operation at full load to date
- No long duration test runs completed to date
- No stack testing data released to date
- System looks promising but needs more demonstration at full load for longer operating cycles with engines and all systems operating.

Autoclaving

Steam Classification
Salinas, California

- Steam-pressure process using an autoclave
- Converts MSW to sterilized organics and in-organics
  - Recovery of Recyclables
  - Organics used in pulp production, composting or refuse derived fuel

General Observations on Steam Classification

- Three demo projects in U.S.
  - Salinas Valley, Ca.
  - St. Paul, MN
  - Anaheim, CA (closed)
- Environmental concerns: air emissions (VOCs), water pollution

General Observations of Autoclave

- Over 60% reduction in waste volume
- Cellulose recovery
  - Ethanol production feedstock
  - Compost feedstock
  - Digester feedstock for methane production
- Factual performance, emissions and cost information
- When proven feasible, conversion technologies may be an important part of sustainable waste management

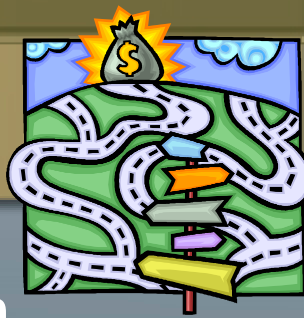
Summary Attributes of Technologies

Technology	Waste Stream	Proven Process	Economic Results
Clear MRF	Source Separated Recyclables	High	Fair – Collection Costs High
Dirty MRF	Mixed Waste	High	Fair – Saves on Collection Costs
Composting	Organic Waste	High	Fair
Waste-to-Energy	Mixed Waste	High	Fair
Anaerobic Digestion	Organic Waste	Medium	Poor
Gasification	Uniform Waste (Possible Mixed MSW)	Medium	Poor
Autoclaving	Cellulose	Low	Fair
Plasma Arc	Uniform Waste (Possible Mixed MSW)	Medium	Unknown

Summary of Potential Environmental Attributes of Technologies

Technology	Energy	Air Quality	Carbon Footprint	Impact on Water Quality	Land-Use
Clear MRF	Net Benefits inc indirect	Minor Emissions	Net Benefit	Minor	Minor
Dirty MRF	Net Benefits inc indirect	Minor Emissions	Net Benefit	Minor	Medium
Composting	Minor	Odor (Possible CO_2, Methane)	Net Benefit	Minor Releases	Large
Waste-to-Energy	Energy Production	Regulated Emissions	Net Benefit	Minor	Medium
Anaerobic Digestion	Potential Energy Production	Unknown (Possible Odor GHG)	Net Benefit	Medium	Medium
Gasification **(Including Plasma Arc)**	Potential Energy Production	Unknown	Net Benefit	Minor	Medium
Autoclaving	Unknown	Unknown	Net Benefit	Minor	Medium

Conclusions



- Serious movement towards greater Diversion
- Emerging conversion technologies are becoming a more interesting option
- Factual performance, emissions and cost information difficult to obtain
- Pilot and demonstration projects needed
- When proven feasible, emerging conversion technologies may be an important part of the solution for more sustainable waste management

Required Components to Implement Processing Facility

- Reliable Feedstock (Waste Supply)
- Demonstrated Technology
- Suitable Site
- Energy and Material Markets
- Residuals and By Passed Waste Landfill
- Financing

Risk Transfer with Alternative Delivery Methods

- Design/Build/Bid
- Design/Build/Operate
- Finance/Design/Build/Own/Operate
- Finance/Design/Build/Own/Operate/Transfer

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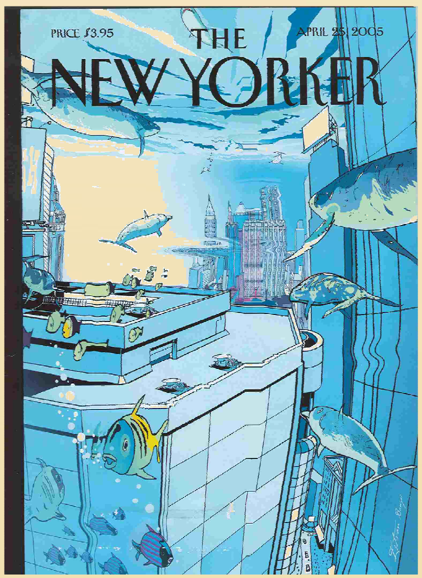
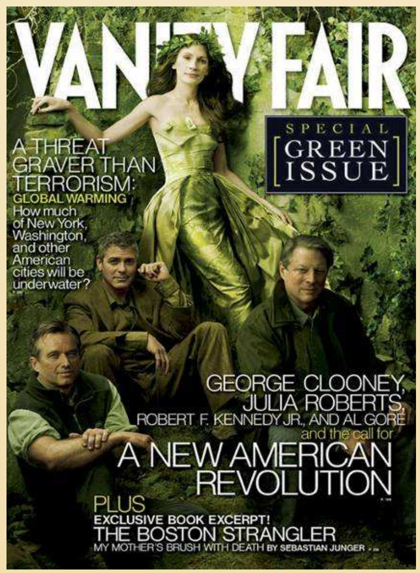
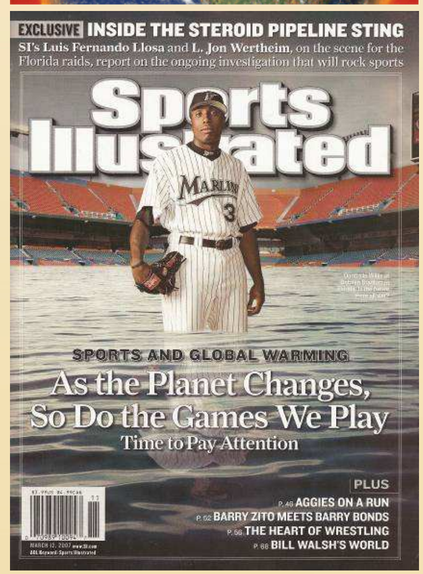
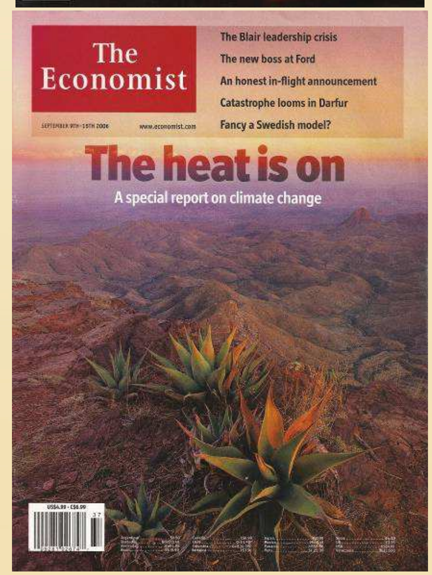
Greenhouse Gases

Climate Change









Greenhouse Gases

		*Global Warming Potential (**CO_2e**)*
Carbon dioxide	(CO_2)	1
Methane	(CH_4)	25
Nitrous oxide	(N_2O)	296
Hydroflurocarbons	(HFCs)	120-12,000
Carbon tetrafluoride	(CF_4)	5,700
Hexafluorothane	(C_2F_6)	11,900
Perfluorobutane	(C_4F_{10})	8,600
Perfluorohexane	(C_6F_{14})	9,000
Sulfur hexafluoride	(SF_6)	22,200

The Local Challenge

- How do we reduce our carbon footprint and maintain our economy and other environmental protections?
- What and where are the solutions with the greatest benefits?
- How do we weigh benefits beyond climate?

The Link Between Waste Management and Greenhouse Gases

Increased GHG Emissions

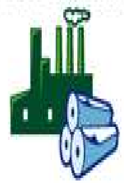
Greenhouse gases are emitted during the harvesting of trees, and the extraction and transport of raw materials.

Extraction

Waste prevention and recycling delay the need to extract some raw materials, lowering greenhouse gases emitted during extraction.

Manufacturing products releases greenhouse gases during processing and as energy is expended during product use.

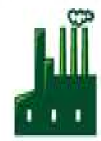
Manufacturing



Waste prevention means more efficient resource use, and making products from recycled materials requires less energy. Both lower greenhouse gases emitted during manufacturing.

Burning some kinds of waste in an incinerator increases greenhouse gas emissions.

Combustion



Waste prevention and recycling reduce the amount of waste sent to incinerators, lowering the greenhouse gases emitted during combustion.

Greenhouse gases are emitted as waste decomposes in landfills.

Landfilling

Waste prevention and recycling reduce the amount of waste sent to landfills, lowering the greenhouse gases emitted during decomposition.

Decreased GHG Emissions

Keys to Balancing the Carbon Footprint

- There is no magic bullet
- All alternatives have impacts
- In weighing the options, the issues to be considered include the nature and level of local and regional impacts
- There are tools available to help quantify these

New Tool: Low Carbon Solid Waste System

- HDR developed a tool called the low carbon solid waste system model to be used to fill the gap between the EPA WARM model and the practical considerations of a local solid waste system.

- HDR recently entered an agreement with SWANA to co-develop and co-brand the model.

SWANA®
SOLID WASTE ASSOCIATION
of North America

HDR

The EPA's WARM Model

- Easy to use high level tool for solid waste managers
- Regularly updated
- Compare baseline to one option
- INPUT
  - Composition data
  - Landfill characteristics
  - Waste Transport Characteristics
- OUTPUT
  - Metric Tons of Carbon Equivalent (MTCE)
  - Metric Tons of Carbon Dioxide Equivalent (MTCO2E)
  - Units of Energy (million BTU)
- Uses national average data

HDR: Bridging the Gap

- Compare baseline to multiple options over time
- INPUT
  - Composition data
  - WTE characteristics
  - MRF characteristics
  - Transfer station characteristics
  - Landfill characteristics
  - Waste Transport Characteristics
  - Local utility mix
- OUTPUT
  - Metric Tons of Carbon Equivalent (MTCE)
  - Metric Tons of Carbon Dioxide Equivalent (MTCO2E)
  - Units of Energy (million BTU)
  - MTCE per person
- Allows for default data or local data

Aspects of Alternatives to be Addressed

- Carbon Footprint
- Other Environmental Impacts
- Economics
- Financing
- Systemic Changes
- Risk Mitigation/Management

Thanks