Waste-to-Energy: A Look at 2004 and Beyond

WTERT at Columbia University
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Maria Zannes
Integrated Waste Services Association
Washington, D.C.
Zanneswte@aol.com

Waste-To-Energy

- WTE facilities combust solid wastes to reduce their volume, produce energy, and recover materials.
- WTE serves two public needs:
  - Environmentally sound, reliable solid waste disposal
  - Clean renewable power
Trash Disposal

- Percentage of U.S. Waste Managed: 13%
- Annual Disposal Capacity: 28.5 million tons
- People Served: 36 million
- States with WTE plants: 27

Energy Generation

- Homes served: 2 + million
- Total Power Generated: 2500 MW
- Total Steam Exported: 2.6 million lbs/hr
- Percentage of Total National Generation: 0.3%
Waste-to-Energy Technologies

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of Facilities</th>
<th>Annual Throughput (MM tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass burn</td>
<td>65</td>
<td>22</td>
</tr>
<tr>
<td>Refuse derived fuel</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Modular</td>
<td>9</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>89</strong></td>
<td><strong>28.5</strong> million tons</td>
</tr>
</tbody>
</table>

Typical Large Mass Burn Facility
Modernization of WTE

  - Older WTE and incinerators closed
  - New larger WTE built

  - EPA “Maximum Achievable Control Technology”
  - $1 Billion industry & community investment
  - High-emitting plants either retrofit or closed
  - Small units compliance 2005
  - Large unit MACT revisions 2006

Modern WTE Technology

State-of-the-art Pollution Control Design and Equipment

- Combustion Control
- Acid Gas Scrubbers
- Fabric Filters / ESPs
- NO$_x$ Control
- Activated Carbon
- Continuous Monitoring
- Stack Tests
Environmental Aspects of WTE

- Renewable Energy / Fuel Diversity
- Air Emissions
- Greenhouse Gases
- Land Use
- Ash Management
- Recycling

Renewable Energy

*WTE is sustainable, “home-grown” power*

- Waste is ~ 70% biomass
- WTE is recognized as renewable under federal and 16 state laws
- WTE contributes to fuel diversity
- WTE plants are located near power users
- WTE reduces transportation fuel use
Air Emissions

Nationwide WTE facility emissions have been dramatically reduced

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>2000 Actual</th>
<th>Percent Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Emissions</td>
<td>1990 to 2000</td>
</tr>
<tr>
<td>Dioxin (g/yr, TEQ)</td>
<td>12.0 g/yr</td>
<td>99+</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.333 tons/yr</td>
<td>93</td>
</tr>
<tr>
<td>Lead</td>
<td>4.76 tons/yr</td>
<td>90.9</td>
</tr>
<tr>
<td>Mercury</td>
<td>2.20 tons/yr</td>
<td>95.1</td>
</tr>
<tr>
<td>PM</td>
<td>797 tons/yr</td>
<td>89.8</td>
</tr>
<tr>
<td>HCl</td>
<td>2,672 tons/yr</td>
<td>94.3</td>
</tr>
<tr>
<td>SO2</td>
<td>4,076 tons/yr</td>
<td>86.7</td>
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</table>

Source: Environmental Protection Agency, 2002

Air Emissions: Dioxins

WTE emissions now represent less than 1% of known dioxin inventory
Air Emissions: Mercury

WTE now represents less than 3% of U.S. man-made mercury emissions

USA MWC Mercury Emissions 1990-2000

Greenhouse Gases

WTE provides a net Greenhouse Gas benefit

- Numerous “voluntary” programs
- State Cap & Trade programs expected
- WTE: Eliminates methane emissions & Offsets fossil fuel energy with biomass
- Annually, Waste-to-Energy reduces Greenhouse Gases by 11 million metric tons carbon equivalent or 33 million metric tons CO₂ equivalent

Land Use

WTE reduces landfilled waste volumes by 90%

Ash Management

Ash is safe for landfiling and suitable for many reuse applications

- WTE ash is stable and inert
- Normally handled in combined form (bottom & fly)
- Moisture reduces fugitive emissions
- Compacts and hardens in landfills
- RCRA non-hazardous
- Demonstrated low metals leaching
Ash Management - Reuse

- Reuse in 2004: nearly 3 million tons
- Types of reuse:
  - Landfill cover and roadways
  - Landfill closure
  - Mine reclamation and brownfields
  - Road asphalt and concrete construction projects

Recycling

*WTE and recycling do not compete; they are complementary parts of an integrated waste management program.*

*Recycling rate of communities with WTE is 35% vs. 30% in non-WTE communities.*

- On-site ferrous recovery: 700,000 tons/yr
- On-site non-ferrous metals and other materials: 100,000 tons/yr
- Ash reuse: 297,000 tons/yr
Safety & Health

- WTE industry historically reports lower OSHA recordable incidents than similar industries
- 18 WTE plants have achieved OSHA Voluntary Protection Program status

Governmental Authorities Recognize WTE’s benefits:

“Upgrading of the emission control systems of large combustors to exceed the requirements of the Clean Air Act Section 129 standards is an impressive accomplishment. The completion of retrofits of the large combustion units enables us to continue to rely on municipal solid waste as a clean, reliable, renewable source of energy. With the capacity to handle approximately 15 percent of the waste generated in the US, these plants produce 2800 megawatts of electricity with less environmental impact than almost any other source of electricity.”

-US Environmental Protection Agency, February, 2003

“We at the Office of Energy Efficiency and Renewable Energy (EERE) also recognize MSW as a renewable energy resource and include it in our tracking of progress toward achieving the Federal Government’s renewable energy goal, established by Executive Order 13123.”

-Department of Energy, April, 2003
WTE Industry - 1980’s

- Solid waste regulations → landfill closures, rising tip fees
- Communities seeking long-term solid waste solution
- PURPA – favorable energy contracts
- Financial drivers – tax credits, accelerated depreciation

Waste-to-Energy Plant Start-Ups

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Plants</th>
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<tbody>
<tr>
<td>Pre-1980</td>
<td>4</td>
</tr>
<tr>
<td>1980-84</td>
<td>10</td>
</tr>
<tr>
<td>1985-89</td>
<td>53</td>
</tr>
<tr>
<td>1990-94</td>
<td>25</td>
</tr>
<tr>
<td>1995-99</td>
<td>5</td>
</tr>
<tr>
<td>2000-03</td>
<td>1</td>
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WTE Industry - 1990’s

- Falling tip fees – landfill competition/long haul
- Falling energy prices
- Energy deregulation – uncertainties
- MACT investment
- Tax credits eliminated

Industry Consolidation

WTE Industry - 2000’s

- Proven track record – reliability, environmental
- Renewable status / GHG credits
- Federal Tax Credits
- Expiring long-term contracts
- Retiring debt
- Good locations of existing plants

Existing plants continue
Selected new / expansion opportunities