

Cleveland's Energy Future

Municipal Solid Waste To Energy Project Overview

April 8, 2010

Department of Public Service
Division of Waste Collection



CITY OF CLEVELAND
Mayor Frank G. Jackson

Cleveland **PP** PublicPower
Count on it



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Introduction

A New Way To Think About Municipal Solid Waste (MSW)

- Think of MSW as a valuable resource that must be mined, processed, recycled and sold
- This resource will take careful planning and investment to extract, but the end result is new jobs, tax revenues, an environmentally friendly alternative energy source, and increased control of *Cleveland's energy future*



1. MSW to Electric Power

- Cleveland's approach would not be based on *incineration* but would be based on *gasification* and technology called *steam compression*.



a. Gasification Technology

- Cleveland's MSW to Energy Facility will use thermal gasification rather than incineration.
- **Incineration vs. Thermal Gasification**
 - Incineration of MSW is through combustion of organic materials in an oxygen rich environment that produces complex hazardous oxides in the process
 - Thermal gasification of MSW is through high temperature conversion of organic materials into synthetic gas (composed primarily of H₂ and CO) in a controlled oxygen and heat environment.
 - Thermal gasification breaks down hazardous organic substances such as dioxins and furans

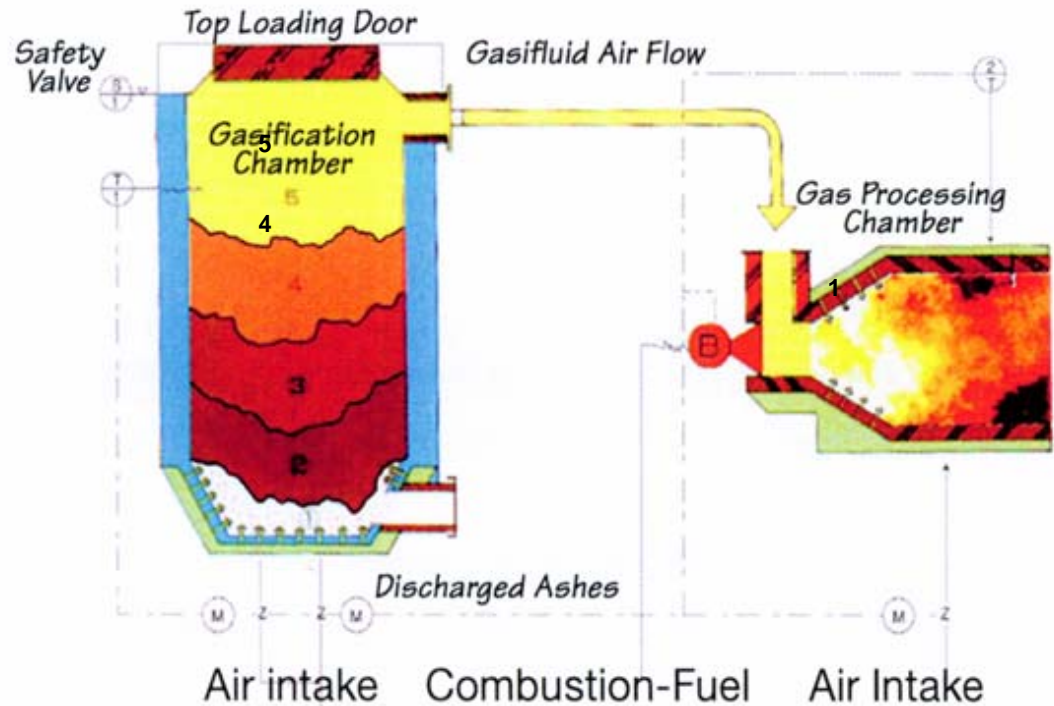
Gasification Technology

The outcome of the gasification process is a product called Syngas. Syngas is combustible and can be used as a fuel much like natural gas.



b. Gasification Process

- **Gasification Process:**
System will be ignited at 80° and rapidly increased to 800°. Through precision temperature and air flow control, system restrains formation of toxins. 6-8 hr process.
- After gasification, ash remains are reduced to 5% of initial input volume. Furnace can reduce ash to 1-2%.
- Ash discharges are reported at 99% non-organic and non-toxic. This “silicon” can be sold.



1. **Gasification Processing Chamber**
2. **Heating Chamber**
3. **Fluidization Chamber**
4. **Heat Transfer Chamber**
5. **Gasification Chamber**

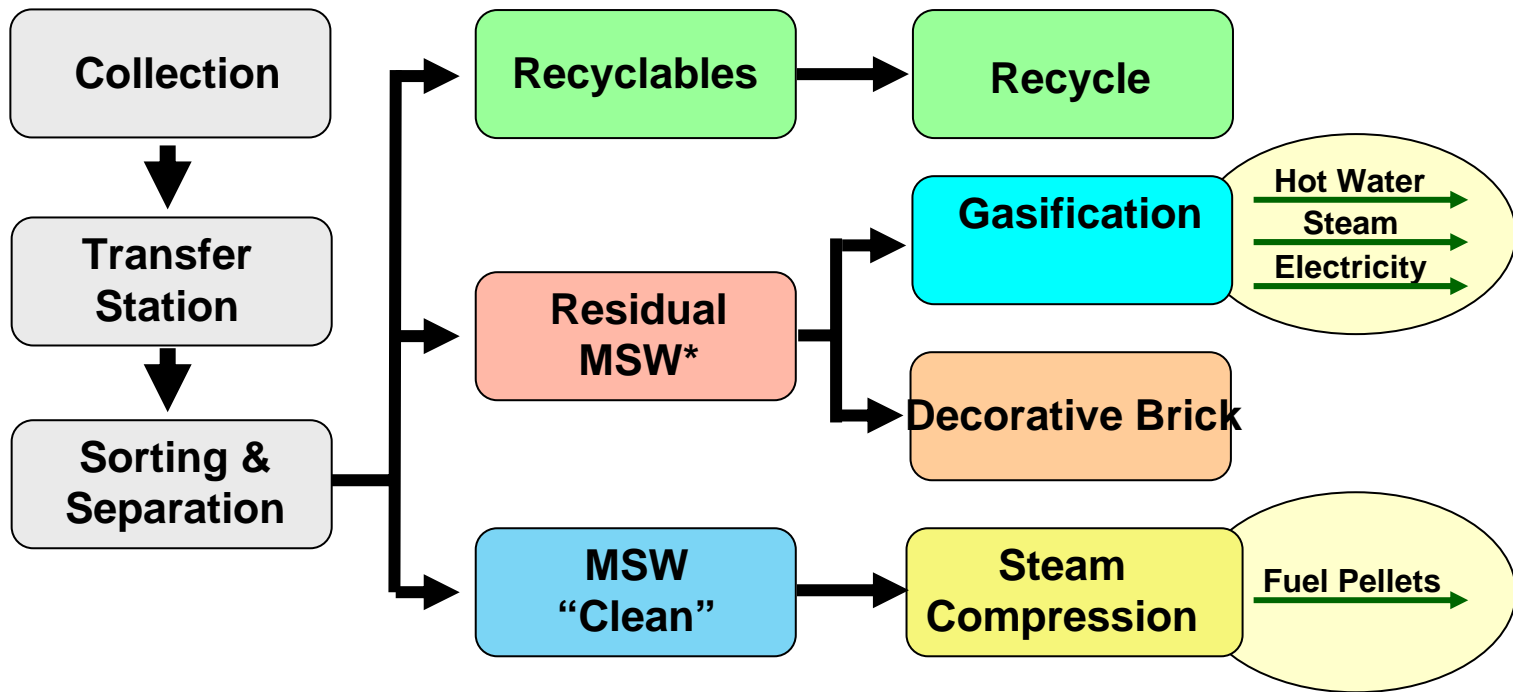
2. Cleveland's System Design Requirements

- True Sustainable System
- MSW Recycling to meet recycling goals
- Minimize waste sent to landfill
- Electric Power generation to minimize market dependence
- Electric Generation that helps meet Cleveland's AEPS goals
- Environmentally friendly generation fuel source
- Maximize all system outputs
 - Bricks from ash
 - Fuel pellets from "yard waste"

The proposed Cleveland MSWE facility

- Utilize patented Kinsei gasification and steam compression technology
- Facility to process MSW to generate electricity
- Facility to also produce additional marketable by-products such as recyclables, refuse derived fuel (*RDF*) pellets, steam and bricks
- Facility would process MSW in a 7 step process identified as:
 1. **Collection**
 2. **MSW handling and process**
 3. **Recycling**
 4. **Sorting and shredding**
 5. **Steam compression**
 6. **Gasification and electricity**
 7. **Decorative bricks**

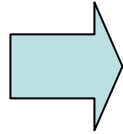
3. Cleveland's Approach and Facility Design



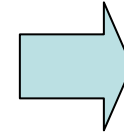
*A small percent would go to landfill.

Operation Overview

Curbside Collection



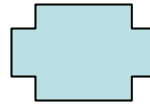
Transport to Waste Handling Facility



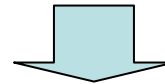
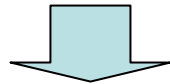
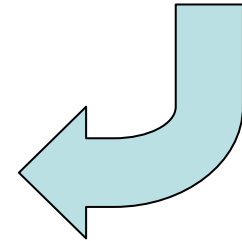
Transfer Station



Automated Sorting



Manual Separation



MSW



Industrial Waste



Scrap Tires



Construction Materials



Yard Waste

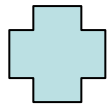


Recyclables

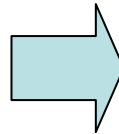


Operation Overview

Industrial Waste



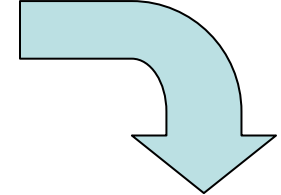
Scrap Tires



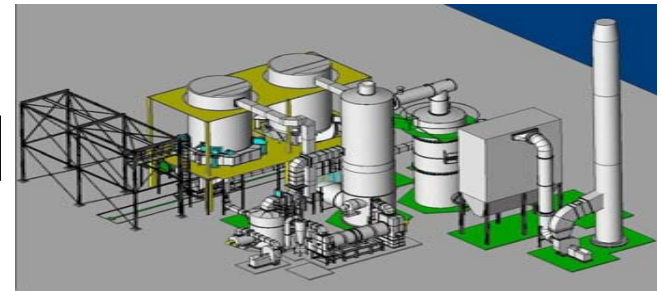
Shred to Uniform Size



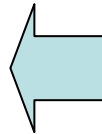
Shredded Waste In



Princeton
GB Gasification System



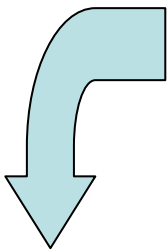
Waste Heat
Boiler



Turbine Generator



Energy Production



Steam (AC/Mfg.)



Heat / Hot Water



Electricity



Ethanol / Methanol



Bio-Diesel



Electric Power Program Components

Energy production

- Electricity: two steam turbines at 10 MW each for a total of 20MW
- Industrial steam: one or two steam boilers producing >200,000 lb/hr



CPP Avoided Cost

- Local generation of 20MW would reduce MISO transmission dependence
- Reduce transmission cost \$3.00/MWh
This yields monthly savings of \$41,000.00
Annual Transmission savings \$500,000.00
- Generation savings at \$65/MW is \$9.69 Million annually



4. About Kinsei Sangyo Co.

● Company Information:

- Company founded 1967
- Privately owned by President Masamoto Kaneko
- Patents on “dry distillation gasification”
- >200 gasifiers in operation (mainly in Japan)

● Headquarters:

- Management and engineering offices
- Small (10 cubic meter) demo plant
- Assembly/fabrication of gasifiers (basic metal-working)



Masamoto Kaneko during Q&A with translator Urano Hidekasu



Kinsei Facility



Kinsei Gasifier Technology

- Gasification of waste occurs in separate chamber from combustion
- Burners at bottom of gasification chamber to produce heat
- Air is modulated into bottom of bed to maintain precise temperature (patented system)
- Material bed “shrinks” as it gasifies, leaving residue of ash
- Syngas rises to top during gasification, ducted off for later combustion and clean-up
- Full gasification of waste batch occurs in 3-12 hours (depending upon chamber size and waste characteristics)

Kinsei Gasifier Technology

- Temperature slowly increased during gasification process to optimize syngas production
- Auxiliary fuel used in burners for <5 minutes during start-up, then process becomes self-fueling from syngas until waste batch is fully gasified
- Most combustible wastes layered at bottom, densest/wet wastes layered at top (will dry as lower layers are gasified)
- Typically, multiple gasifiers for parallel operation (one processing, another getting readied to process when the other is finished) for redundancy

Demo Gasifier unit with lid open showing feedstock



Ash on Bottom Plate After Gasification



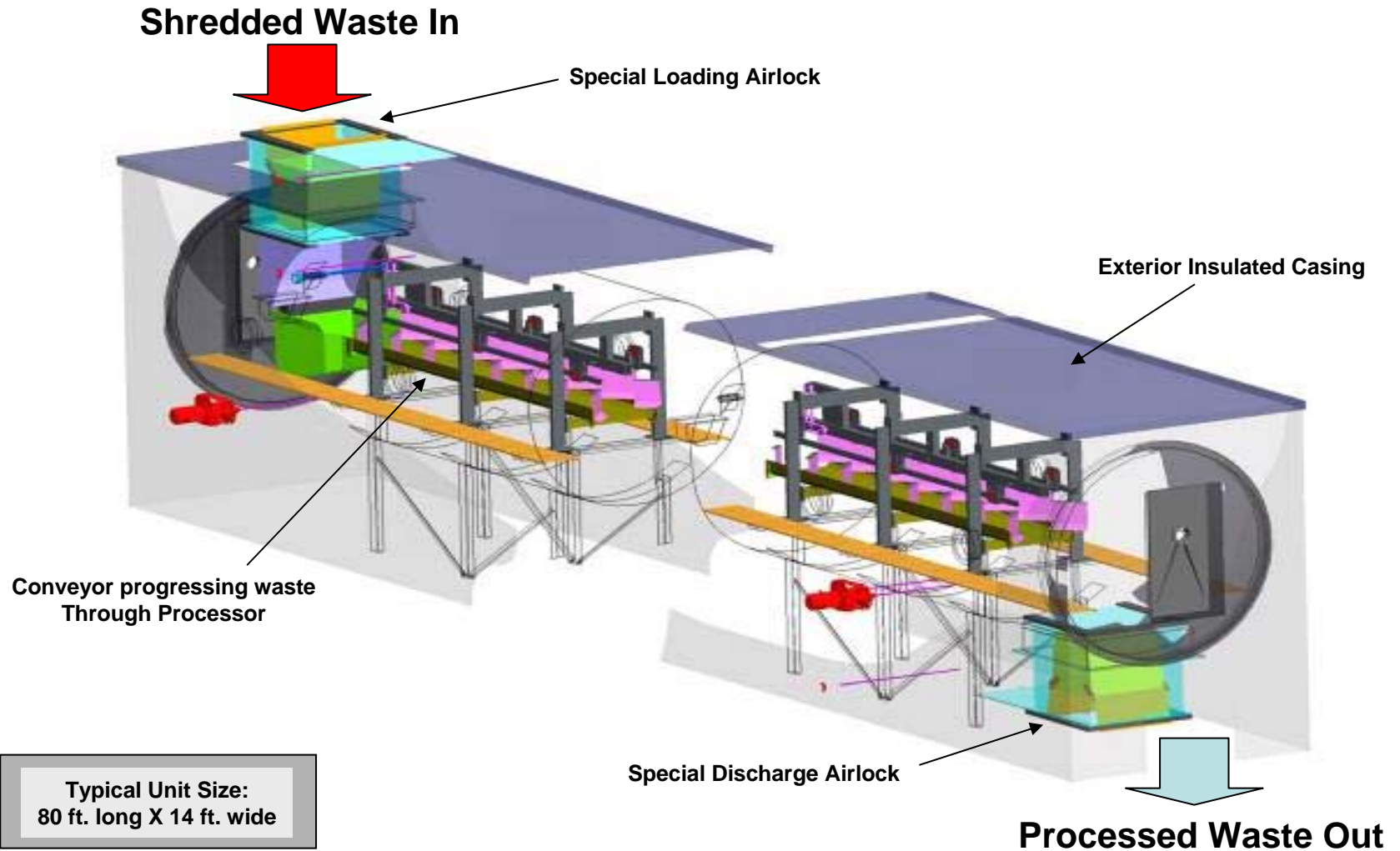
Kinsei Customer Marutoku



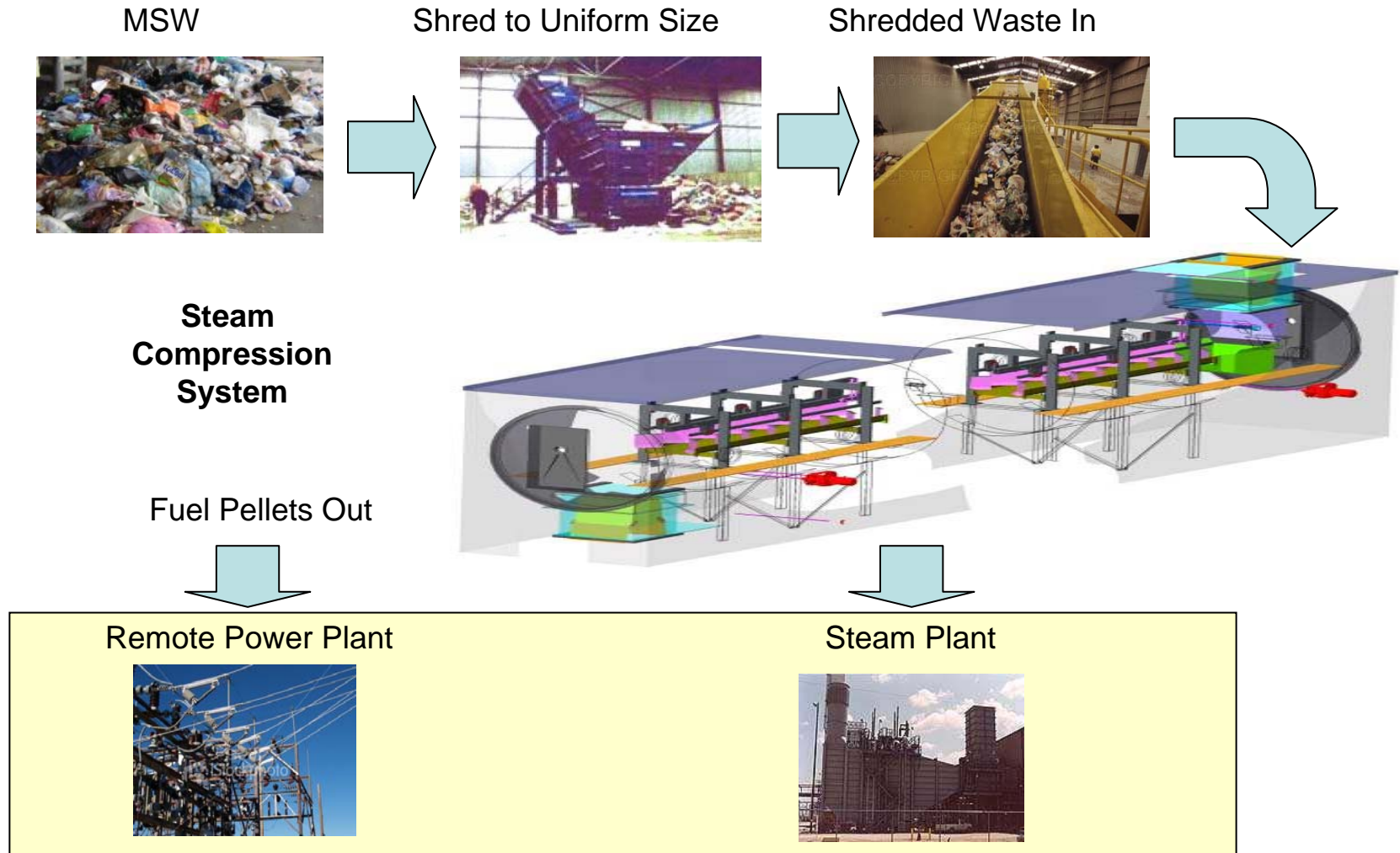
Kinsei Customer BML



5. Steam Compression Technology



Operation Overview (Fuel Cells)



Overview Fuel Pellets



- fiber exits the system at approx 40% moisture content with a gross calorific value of 11 MJ/kg (2629 Kcal/kg or about 11,000 BTU/Lb)



- dried fiber has a gross heat value of <10000 BTU/lb
- this biomass contains minimal sulfur and is much cleaner, when burnt, than fossil fuel
- total sulfur content 0.12% (dry)
- this is approx 10% of the sulfur content of coal

6. Waste Collection and Recycling

Primary MSW to Energy Facility feedstock:

Cleveland's Municipal Solid Waste

- 300,000 tons of MSW annually
- 900 to 1,500 tons daily
- \$9.4 million annual tipping fees
- Potential revenue from recyclables projected at up to \$90/ton



Waste Management Program Components

Waste sorting & separation: on site preparation of waste for processing and/or recycling

Recyclables: include non-ferrous and ferrous metal collection & separation, waste paper collection and bundling, construction debris recycling, etc.

Lessons learned from

- ◆ Cleveland's Waste Collection Recycling Pilot Program



Waste Collection Cost

Tipping fees

- 300,000 tons of MSW annually
- Tipping fee \$31.44 /ton
- Tipping fees expected to increase in the near future
- Other communities in the Cleveland area are also looking for ways to reduce tipping costs



7. Summary of Facility Cost

Estimated Facility Cost:

● City-Wide Recycling (equipment & vehicles)	\$29 million
● MSW Receiving Station	\$21 million
● Recycling Station	\$12 million
● Gasification Equipment	\$21 million
● Power Plant (20 MW)	\$15 million
● Steam Compression Equipment	\$45 million
● Construction	\$21 million
● Civil Engineering	\$ 8 million
● Decorative Brick Equipment	\$ 8 million

Total Estimated Cost	\$180 million

8. Jobs Created

Projected Manufacturing Facility Employment Timeline and manufacturing goals

	2010	2011	2012	2013	2014
Payroll Analysis					
Manufacturing Jobs Created – annually	4	8	8	20	15
Manufacturing Jobs Created – cumulative	4	12	20	40	55
Manufacturing Wages – annually	141,600	424,800	708,000	1,416,000	1,947,000
Total Manufacturing Wages – cumulative	\$141,600	\$566,400	\$1,274,400	\$2,690,000	\$4,637,400

Jobs Created

Management Jobs Created – annually	2	2	4	5	-
Management Jobs Created – cumulative	4	4	8	13	13
Management Salaries – annually	150,000	300,000	600,000	780,000	975,000
Total Management Salaries – cumulative	\$150,000	\$450,000	\$1,050,000	\$1,830,000	\$2,805,000

Total Ohio Jobs Created – annually	6	10	12	25	15
Total Ohio Jobs Created – cumulative	6	16	28	53	68
Total Ohio Wages & Salaries – annually	291,000	724,800	1,308,000	2,196,000	2,922,000
Total Ohio Wages & Salaries – cumulative	\$291,600	\$1,016,400	\$2,324,400	\$4,520,000	\$7,442,400

Jobs Created

Ohio Manufacturing					
System Sales (thru leasing)	2	10	20	36	48
Total System Sales – cumulative		10	30	66	114
System Cost Each (Parts only)	250,000	200,000	200,000	200,000	200,000
Total annual Equipment cost	500,000	2,000,000	6,000,000	7,200,000	9,600,000
% of Ohio Manufacturing	0%	30%	50%	80%	80%
U.S. Manufacturing and Purchasing – annually		600,000	3,000,000	5,760,000	7,680,000
Ohio Manufacturing and Purchasing - cumulative	0	\$600,000	\$3,600,000	\$9,360,000	\$18,960,000

Jobs at Cleveland's MSWE Facility

Facility operation 24/7 in 3 shifts

Full time staffing needs

- Waste Sorting: 24-36
- Waste Processing: 12-18
- Gasification Operation: 18-24
- Steam Compression: 18-24
- Power Plant Operation: 18-24

Total New Jobs: 90-126

Questions?

