

Cleveland's Energy Future

Municipal Solid Waste To Energy Project Overview

February 26, 2010

Department of Public Service
Division of Waste Collection



CITY OF CLEVELAND
Mayor Frank G. Jackson



Agenda

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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*



Introduction

- The Municipal Solid Waste to Energy facility will be the first of its kind that fully integrates the system outputs, maximizes recycling, minimizes the use of landfills, and creates jobs.
- *Cleveland will become a leader in Advanced Energy!*

Where does the process begin?

A new way to think about MSW

- Waste to Energy in Cleveland would not start at the landfill, the transfer station, or even at the curbside for waste pickup
- The process would start in the home as the resident is required to take steps to sort the MSW as recyclable and non-recyclable materials

City-wide Recycling

- Societal change/ community-wide behavioral change
- New rules that would define and identify targeted recyclables
- Provide two carts one for comingled recycled waste and one for non-recyclable waste

1. MSW to Electric Power

The Concept and Technology is Not New

- The waste-to-energy incineration plant in Saugus, Massachusetts, was the first plant in the United States
- Incineration is popular in countries such as Japan where land is a scarce resource, incineration takes less space than a landfill
- Japan has 30 years of experience with Waste to Energy facilities including municipal, industrial, hazardous and medical waste

The St. Lucie County Gasification Project

Plain Dealer – August 2, 2007

Harnessing the power of trash

A plasma torch gasification device will be built in St. Lucie County in Florida. When fully operational, it will turn 3,000 tons of trash into electricity every day. It is expected to open in 2010, and initially will process 1,000 tons of waste a day. The plant should be fully operational by 2013.

1 Trash

Trash is fed into the gasification chamber.

2 Gasification chamber

Trash is mixed with oxygen, then vaporized by a 10,000-degree plasma arc flame. Gaseous exhaust and inert solid waste result.

Plasma torch

The arcs produce an electric plasma flame that is hotter than the surface of the sun.

SOURCE: GeoPlasma of Atlanta

Heat exchangers

Particle filter

3 Exhaust gasses

Exhaust gasses are cleaned and combined to create a combustible gas used to power steam turbines to generate electricity.

4 Waste

Inert pellets used for road paving.

5 Steam-powered turbines

The steam-powered turbines will produce 160 megawatts of electricity a day, of which 120 megawatts will be sold for the electrical power grid. The 120 megawatts can power 75,000 homes each day. The other 40 megawatts are used to run the plant.

Steam-powered turbine generators

Electric grid

120 megawatts

40 megawatts

The plant site

The first plasma torch gasification plant in the United States is scheduled to begin operation in 2010 in Florida.



JAMES OWENS | THE PLAIN DEALER

Other Waste to Energy Projects

See the best pictures of the week from the Plain Dealer photography staff at cleveland.com/pdmultimedia

METRO

SUNDAY, NOVEMBER 23, 2008 | SECTION B

THE PLAIN DEALER

NEWS TIPS?

Call 216-999-4800 or
800-688-4802 when
you see news happening.



Akron turns waste into watts

Methane-fueled sewage plant is a first

ELLEN JAN KLEINERMAN
Plain Dealer Reporter

It's basic biology. Tiny bacteria at the sewage plant eat organic waste and emit methane gas. The gas is captured and converted to electricity. The electric-

ity is used to power the sewage plant.

Akron put a system like this online last December to process one-third of the sludge going through its wastewater treatment plant and is finding success: The city is saving about 15

percent on its electricity bill.

Akron's methane-powered sewage plant is the only system of its kind in the United States. But other cities, including Solon and Canton, now are looking to follow Akron's lead.

Use of this biological process

to create energy from waste should gain momentum within the next five to 10 years, predicted Jim Currie of Ohio State University. That's because conventional ways of disposing of waste are becoming too expensive and our appetite for new fuel sources is increasing, said Currie, program director of Bio-Hio at OSU's Agricultural Re-

search and Development Center in Wooster. "The hurdle is showing people how well the system works," Currie said.

Ohio's abundance of farms, ethanol companies, and food and beverage processing plants like Anheuser-Busch make it a prime spot in which to root this technology, Currie said.

SEE METHANE | B7

Other Waste to Energy Projects

A Second Look

THE WALL STREET JOURNAL.

Saturday/Sunday, December 6 - 7, 2008

U. S. NEWS

Cities Give Waste-to-Energy Plants a Second Look

Higher U.S. Landfill Costs and Uncertain Oil Prices Drive an Expansion of Existing Trash Incinerators, Plans for New Ones

BY ILAN BRAT

Turning refuse into energy, first seen as a kind of environmental alchemy, fell out of favor in the 1990s as protests mounted against trash-burning plants.

But spurred by growing landfill costs and demand for energy, local governments have been spending hundreds of millions of dollars expanding existing waste-to-energy plants, and proposing new ones.

Of the 87 U.S. incinerators that currently convert trash into electricity, one in Florida completed a \$120 million project to expand by 50% last year. Another expansion in the Sunshine State and two others in Pennsylvania and Minnesota are in the works.

Most incinerators feed garbage into a chamber, where natural gas is used to set it afire. The heat creates steam that turns a turbine to produce electricity. The burned trash shrinks to a tenth in volume, leaving ash.



Garbage is fed into furnaces after being dropped at a loading bay at a Covanta plant in Westbury, N.Y. New incinerators are being considered in Maryland, California and Florida.

What Option is Best for Cleveland?

- Incineration is recognized as a practical method for disposing of certain hazardous waste materials (such as biological medical waste), though it remains a controversial method of waste disposal due to issues such as emission of gaseous pollutants.
- Cleveland's approach would not be based on *incineration* but would be based on *gasification* and a proven technology called *steam compression*.

Why This Option for Cleveland?

- Traditional fuel types available in other parts of the State/Country are not available in a “non-attainment” area like Cleveland
 - “Non-attainment” means a geographic area in which the level of certain air pollutants is higher than national air quality standards
- Cleveland must find green/renewable/advanced energy options if it is to generate power locally
- Cleveland is not alone in the challenges it faces and other municipalities will want to duplicate our efforts
- Duplication of Cleveland’s approach will mean manufacturing opportunities and new jobs in Cleveland

Why this Option for Cleveland? Continued

Unlike other municipalities, Cleveland is unique in that it:

- *Owns the MSW*
- *Has a high volume and variety of MSW*
- *Owns the Transfer Station*
- *Rail is proximate to Transfer Station*
- *Has its own electric system with direct access to the electric grid*
- *Manages its own Water System*

Incineration vs. Gasification

- 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 chemical 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
 - 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.

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 Advanced Energy Portfolio Standards (AEPS) goals
- Environmentally friendly generation fuel source
- Maximize all system outputs
 - Bricks from ash
 - Fuel pellets from “yard waste”

MSW to Energy Technology

Princeton Environmental Group's MSWE technology meet the following requirements:

- Treats and recycles MSW in a patented process that presents near zero toxic emissions
- Produces electric power from a process called Gasification
- Produces high value fuel pellets that can be used to generate power and/or be sold commercially as an alternative to coal or other generation fuels.



Princeton
Environmental
Group

MSW to Energy Technology

Princeton Environmental Group

A Full-Service Waste-to-Energy Engineering Company

- Service engineering arm of Kinsei Sangyo Co. Ltd
- Kinsei was founded in Japan in 1964
- Kinsei has 25 years of dedicated research and development in bio-mass gasification
- Over 300 operating facilities in Japan, China and in Asia.
- U.S.A. marketing office established in 2005.
- All systems are guaranteed to conform to U.S.A., EU, Japan and China Emission Requirements.
- 30 patents world wide
- Experts in solid waste processing engineering.

A Princeton/Kinsei Facilities in Japan



Last year a Cleveland delegation traveled to Japan and China to see first hand facilities using Kinsei's gasification technology.



They visited Maratuku and BML.



3. Sustainability

FRIDAY, NOVEMBER 30, 2007 | SECTION C

THE PLAIN DEALER

Jackson wants greener CPP

Seeks increase in advanced, renewable energy sources

HENRY J. GOMEZ
Plain Dealer Reporter

Cleveland Mayor Frank Jackson wants advanced and renewable energy sources — from landfill gas to the wind and sun — to represent at least 25 percent of the city-owned electric company's power supply by 2025.

Jackson said his proposal, which he plans to submit to City Council next year for approval, would promote a cleaner environment and a friendlier business climate.

A German solar outfit already is planning to make its U.S. headquarters here. And local officials are awaiting a study on the best locations



Jackson



GREEN INC. *A look at how companies are embracing "sustainability" — prospering in the*

Sustainability

Cleveland's Advanced Energy Portfolio Standard ("AEPS")

- Cleveland Public Power will produce and/or purchase generation from Advanced Energy Sources to meet the following goals and time lines:

<u>AEP</u>	<u>Target Year</u>
15%	2015
20%	2020
25%	2025

Sustainability

CPP's Fuel Diversity and Renewable Energy Sources

Advanced Energy Resources:

- Renewable resources
 - Waste to energy generation
 - Biomass (fuel pellets)
 - Low-impact hydro
 - Wind power
 - Landfill gas
 - Solar PV
 - Solar thermal
- Cogeneration
- Distributed generation
- Fuel cells from sustainable and non-sustainable resources





Sustainability



Health & Environment

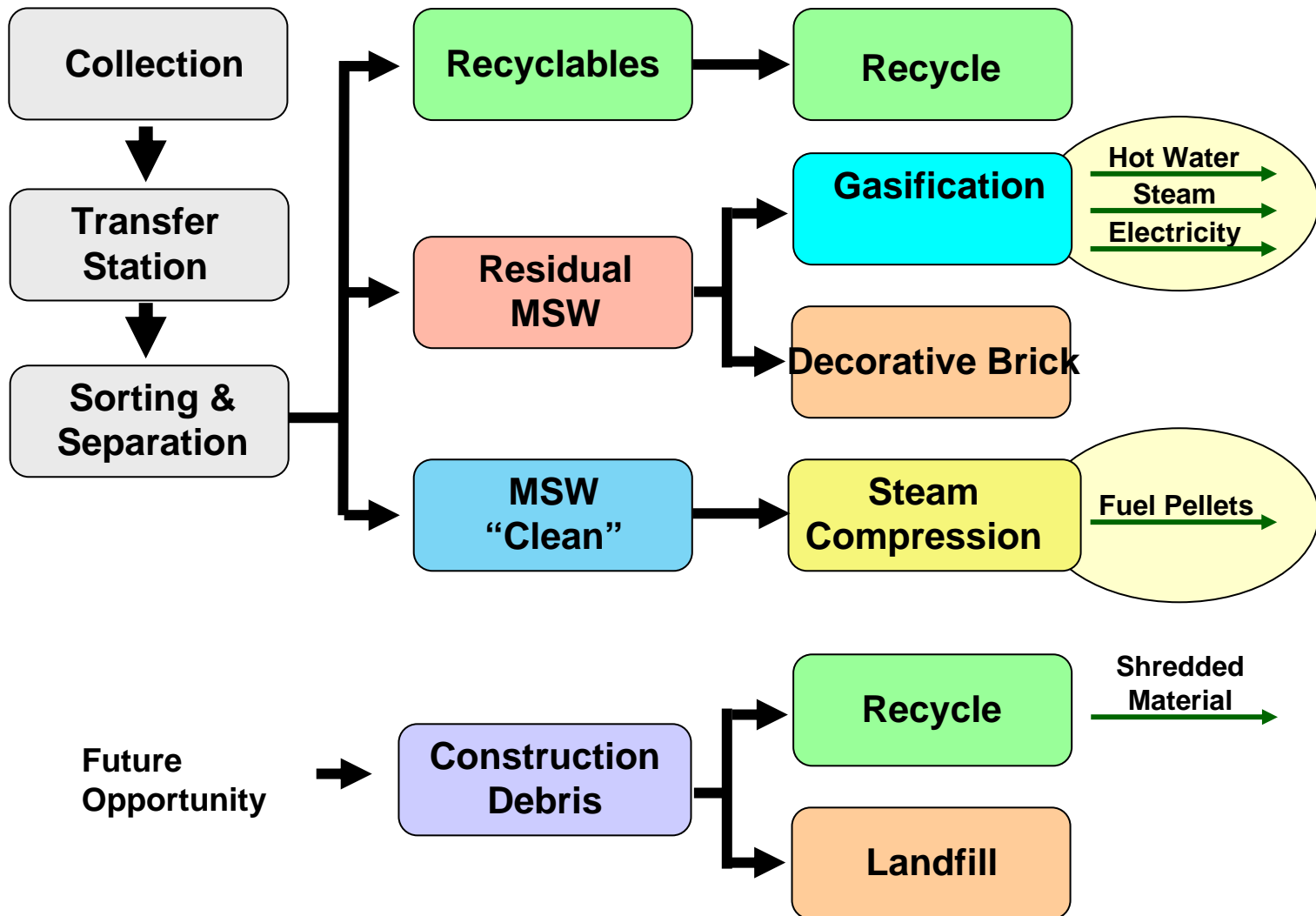
● **Land:**

- Reduced land area used for MSW landfills
- No mining is involved in resource extraction of fuel source for energy production

● **Air:**

- Will not add to City's regulated emission problem
- Fuel pellets can be used to reduce local emission generators' air pollution
- Energy resource has a lower carbon footprint
- Reduced carbon footprint and air pollution from waste hauling to landfills. > 40 miles each way!

4. Cleveland's Approach and Facility Design



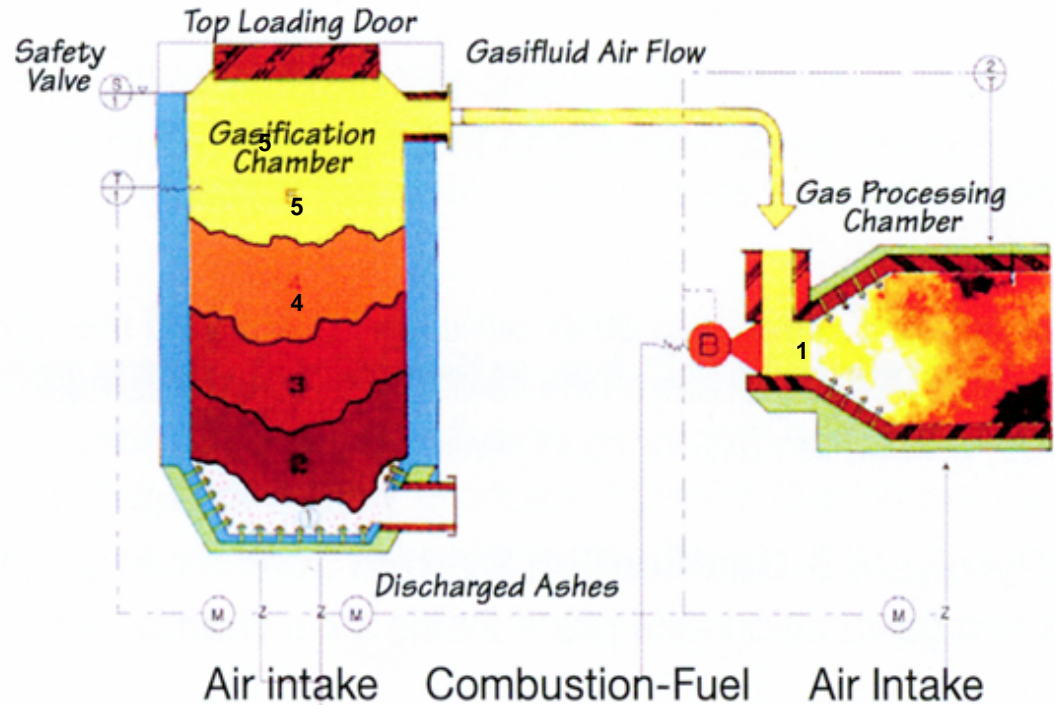
Uses of MSW

The 3000 ton per day facility will consist of the following:

- **900 tons of recyclables** – to be separated, baled and sold for cash (30%) Some higher, some lower depends on whether the city has already established a recycling program
- **900 tons of non-recyclable material** – to be processed by gasified (30%)
- **1200 tons** of waste stream used for RDF pellet (40%)
- The primary waste stream for gasification could include industrial waste.

a. 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**

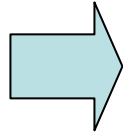
Gasification Process Continued

Princeton's Technology

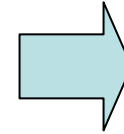
- **PEG Gasification**- Processes MSW with high temperatures in separate stages and restrains the formation of toxic substances (Dioxin, CO, NO_x, Sox).
- Removes more than 97% of airborne odor
- Primarily water vapor emissions (no black/gray smoke)
- No increased or high volume noise effects
- Used abroad in residential areas

Operation Overview

Curbside Collection



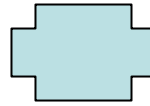
Transport to Waste Handling Facility



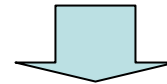
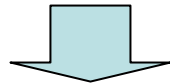
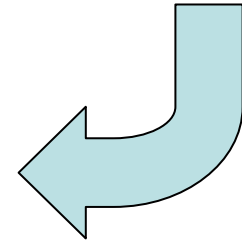
Transfer Station



Automated Sorting



Manual Separation



MSW



Industrial Waste



Scrap Tires



Construction Materials



Yard Waste



Recyclables

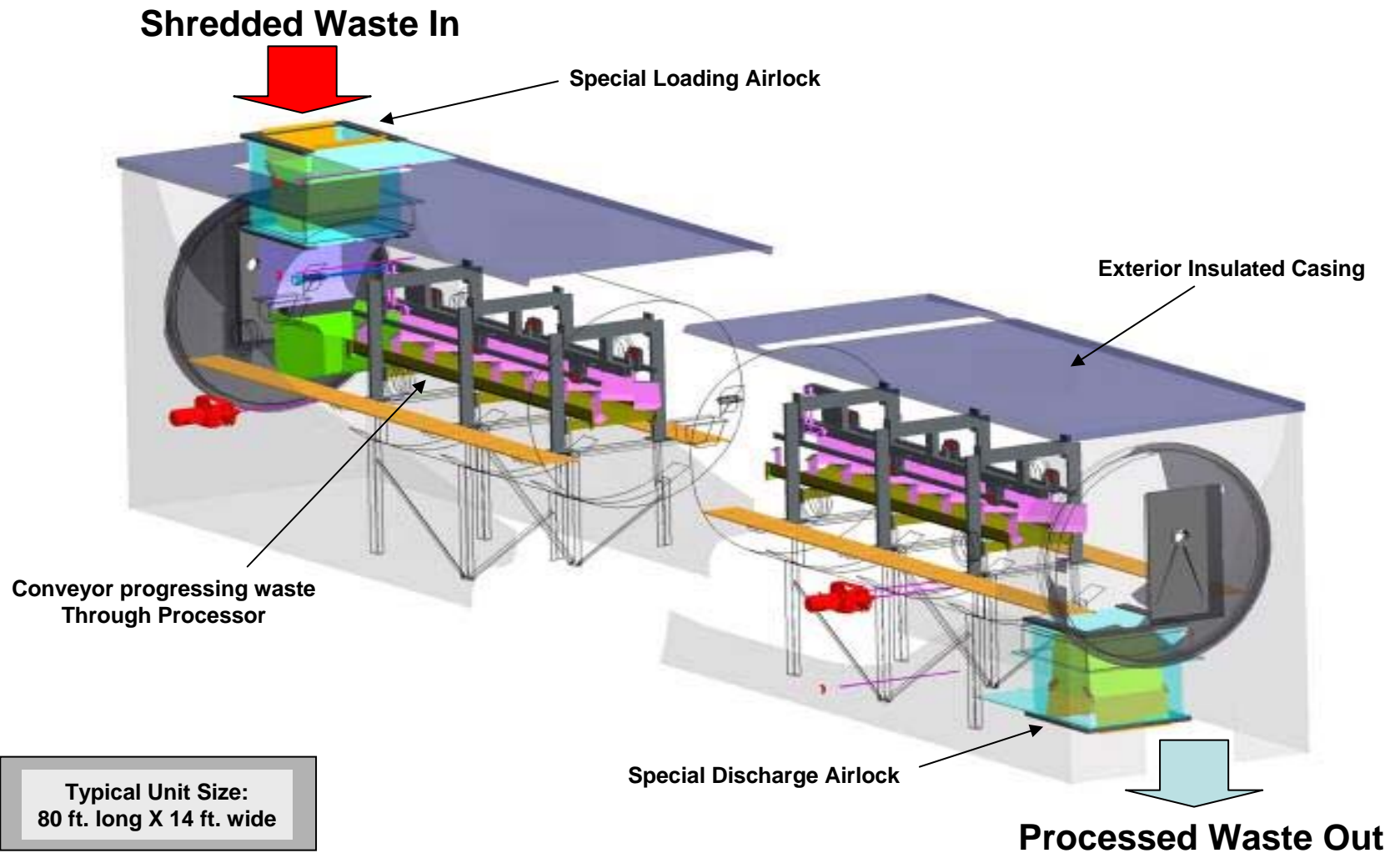


CPP Avoided Cost

- 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



b. Steam Compression Technology



Steam Compression Process

MSW



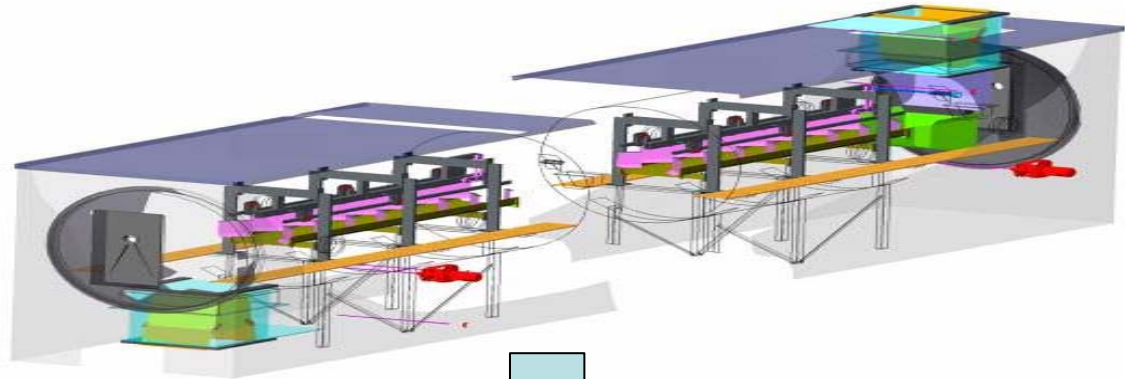
Shred to Uniform Size



Shredded Waste In



Princeton
Steam Compression
System



Fuel Pellets Out

Remote Power Plant



Remote Steam Plant



Refuse Derived Fuel Pellets (RDF)



Fuel pellets

- Derived from MSW through Steam Compression
- Every 1,000 tons of MSW produces fuel cells for 20MW of power
- Dried fiber has a gross heat value greater than 10,000 BTU per pound (Coal has 12,000 BTU/lbs)
- This biomass contains minimal sulfur and is much cleaner when burned than fossil fuel
- This is approximately 10% of the sulfur content of coal
- Fuel pellets can be sold to local electric generators to enable them to produce more power under their existing EPA Air permits.

c. Decorative Bricks

- Decorative and landscape bricks made from the gasification ash will be environmentally friendly and a commercially viable product.



5. 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 collection: fully implement *Cleveland's Waste Collection Recycling Pilot Program*

Waste sorting & separation: prepare waste for processing and/or recycling

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

Alternate collection method: convert the current manual collection operation to a *Fully-automated system* for solid waste and a *Semi-automated system* for recycling utilizing carts.



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 our Region are also looking for ways to reduce this cost.



Regional Opportunities

A. Reduced Tipping Fees for Participating Municipalities

- Participating communities that enter a long term contract could see reduced tipping fees of 15% or more. This would mean savings of \$500,000 to \$1 million dollars annually.



6. 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

*Cost of Detailed Facility design: \$1.5 million

Economic Development

Princeton Group in Cleveland means: Jobs

MSW to Energy facility operation 24/7 in 3 shifts

Full time staffing needs

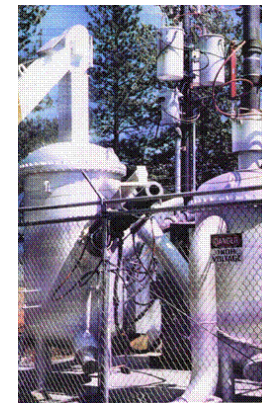
- Waste Sorting: 24-36
- Waste Processing: 12-18
- Gasification Operation: 18-24
- Steam Compression: 18-24
- Power Plant Operation: 18-24

Total New Jobs: 90-126

7. Summary of Cleveland's MSWE Facility

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**



Questions?

