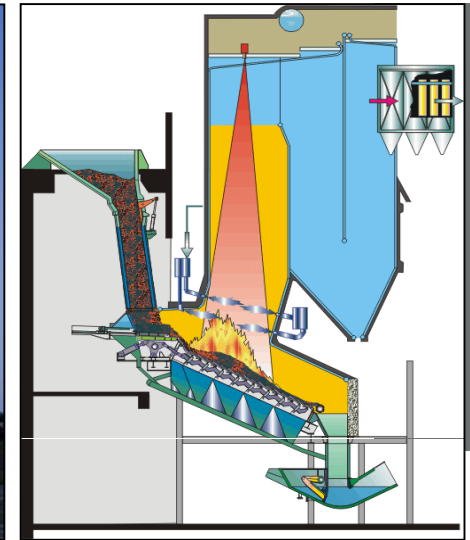
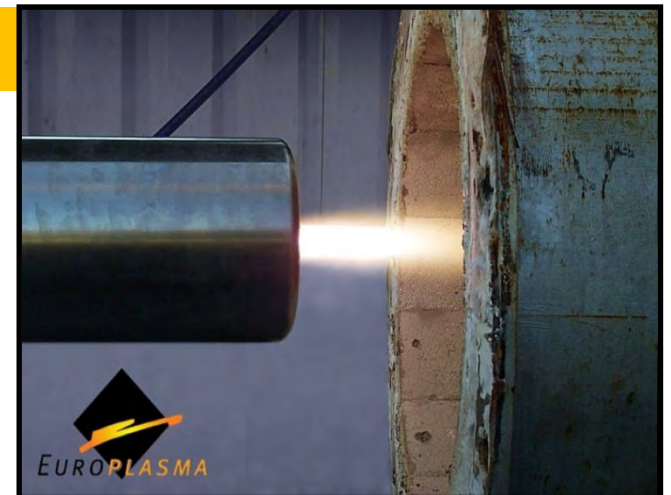


INTRODUCTION TO WASTE CONVERSION TECHNOLOGY



SC SWANA
Fall Technical Session

November 10, 2010




EUROPLASMA

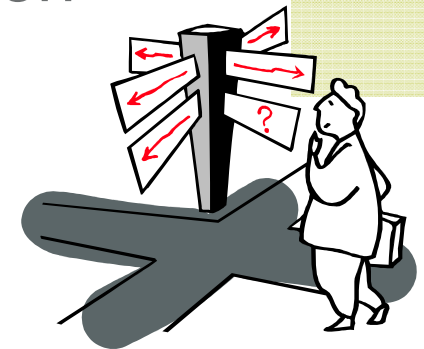
HDR

Objectives

- Why Waste Conversion
- Types of Waste Conversion Technologies
- State of the Industry
- Proven vs. Emerging Technologies
- Environmental Concerns
- Summary

Why Conversion Technologies

- Communities adopting greater diversion goals
- Landfill capacity and costs
- Favorable economic climate
- Climate impacts & environmental impacts
- Vendors offering “risk free” approaches
- Looking for the silver bullet solution



Technology Categories

Biological Treatment

- Process that utilizes chemical reactions to change the composition of the organic fraction of municipal solid waste (MSW)

Thermal Treatment

- Process that utilizes significant quantities of heat to change the composition of MSW

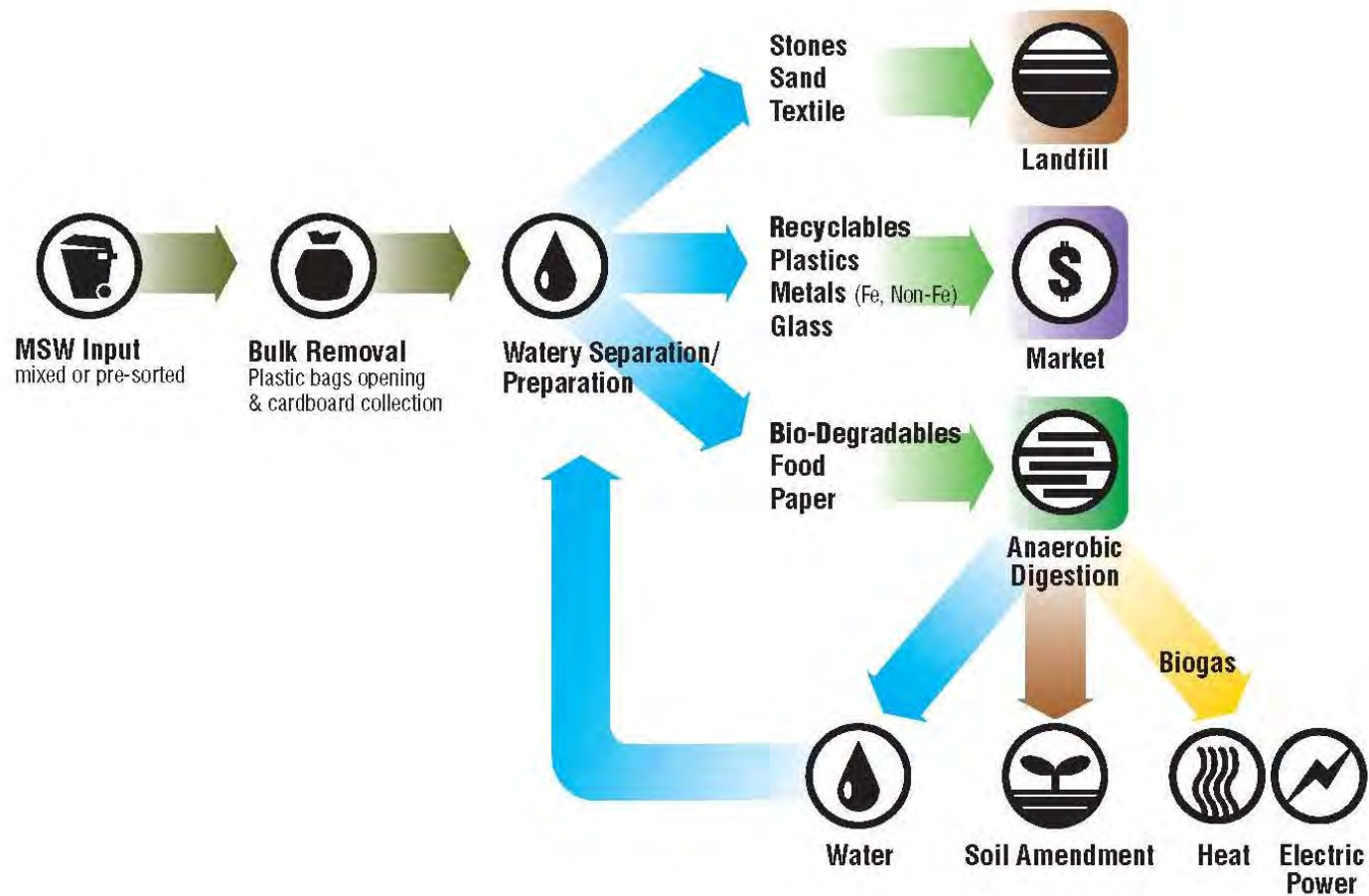
Technology – Biological

Biological Treatment

- Examples of biological treatment technologies
 - Anaerobic Digestion
 - Composting
 - Hydrolysis

Technology Overview

Anaerobic Digestion Process



Technology – Biological

Biological Treatment

■ Advantages

- Produces methane gas that can be used to generate electricity, steam, hot water, and compostable “digestate”
- Feedstock – Biodegradable MSW

■ Disadvantages

- Compost product quality can be an issue with contaminants
- Requires significant pre-processing of mixed waste (MSW)
- Odor issues

Technology – Thermal

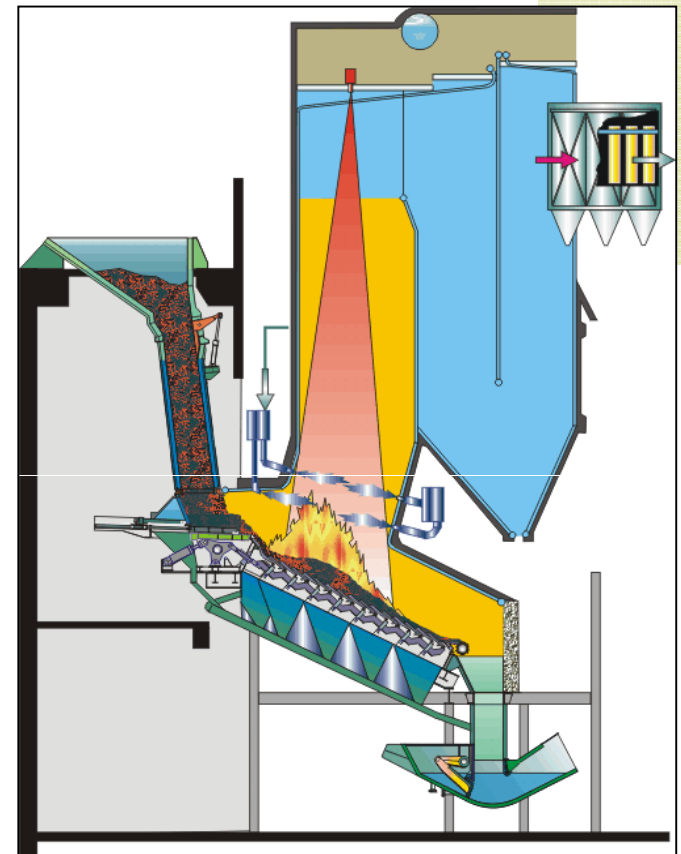
Thermal Treatment

- Examples of thermal treatment technologies
 - Advanced Thermal Recycling
 - Gasification
 - Plasma Arcs
 - Pyrolysis

Technology – Thermal

- Types of Advanced Thermal Recycling
 - Waste-to-Energy, (US term)
 - Energy-from-Waste, (European term)
 - Mass Burn Waterwall, Excess Air**
 - Rotary Waterwall, Excess Air
 - Modular Mass Burn, Starved Air
 - Refuse Derived Fuel Units
- Typically European Designed
 - Martin GmbH (Germany)
 - Von Roll (Switzerland)
 - Fisia Babcock (Italy)

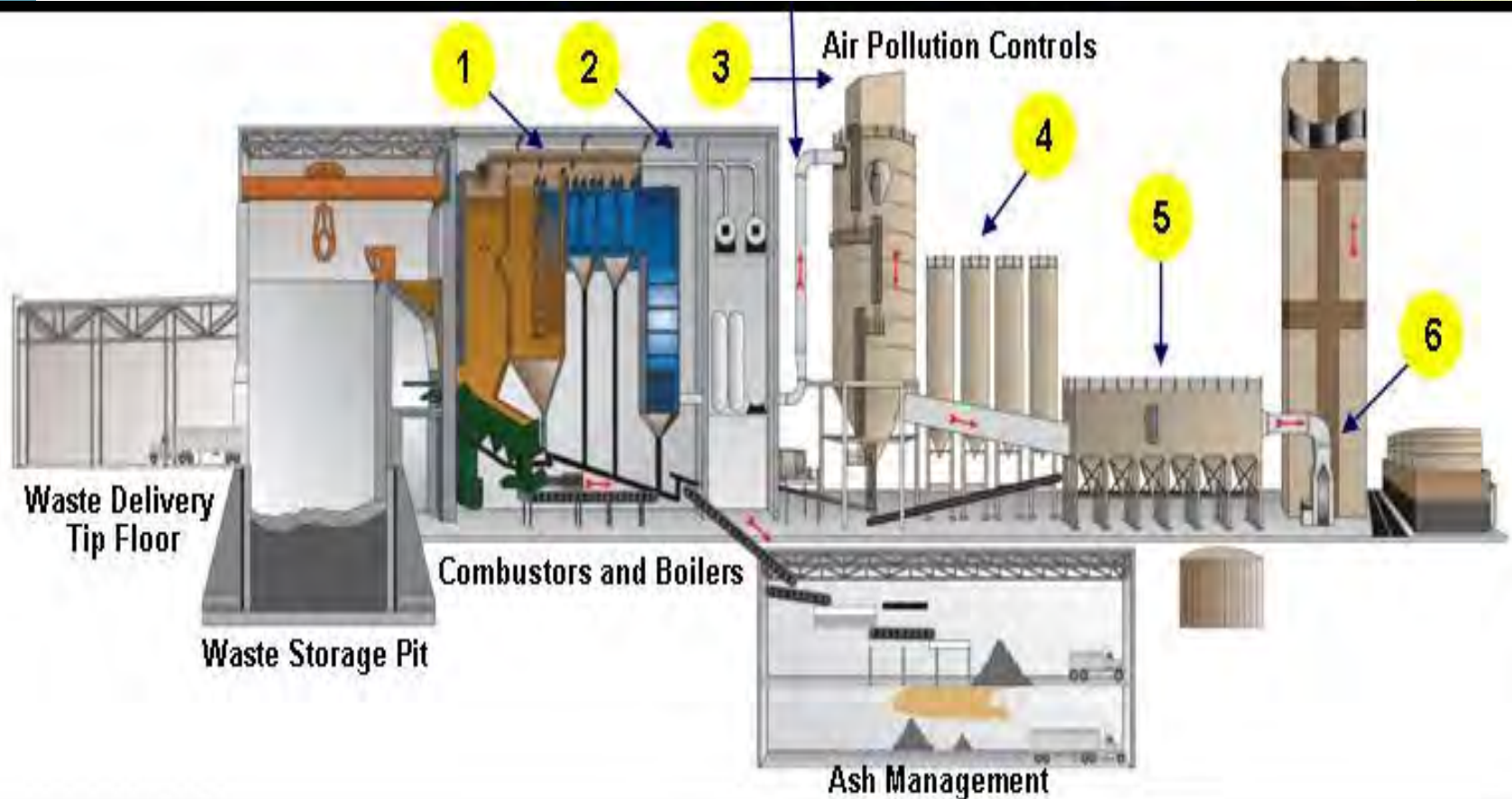
** Most common in U.S.



Section View:
Mass Burn Waterwall unit (courtesy Martin GmbH)

Technology Overview

Advanced Thermal Recycling



Technology – Thermal

Advanced Thermal Recycling

- Advantages
 - Proven
 - Reliable
 - Reduces GHG emissions
- Disadvantages
 - Public Opposition
 - Cost



MacArthur Resource Recovery Facility, Islip, NY

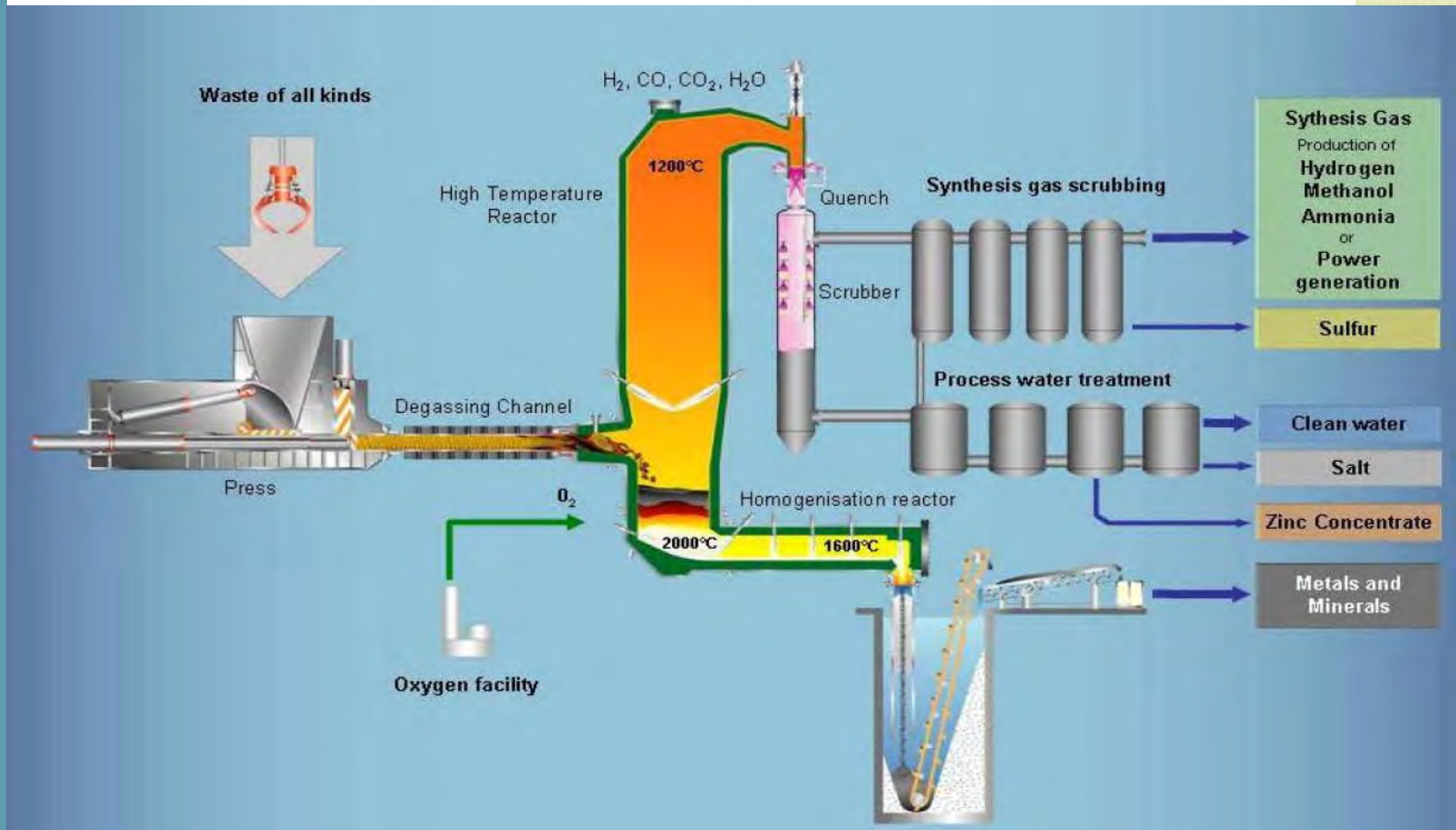
Technology – Thermal

Gasification

- Design Principles
 - High temperature destruction of MSW without the presence of oxygen
 - Most require significant front-end processing of waste
 - Generates marketable products

Technology Overview

Gasification Process

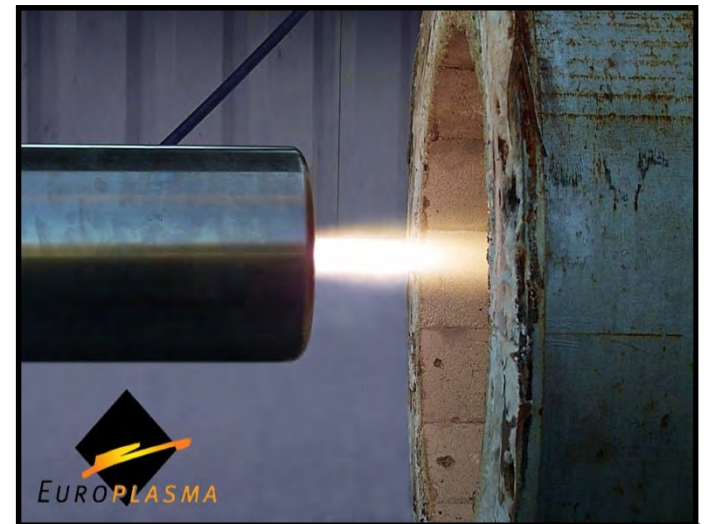
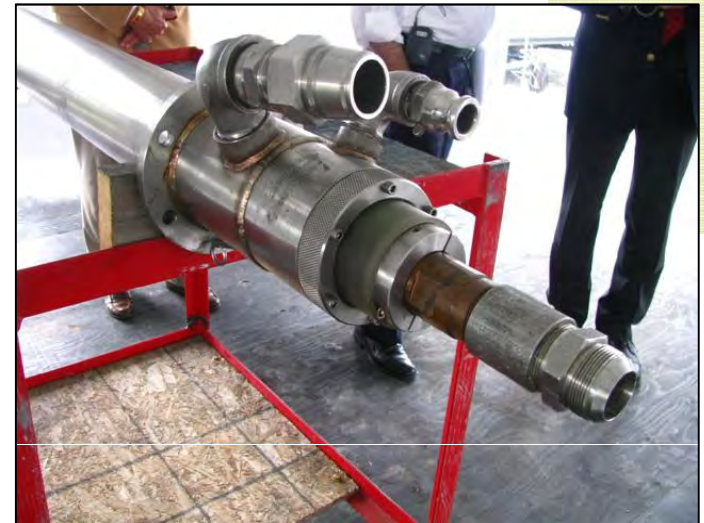


Pictured: IWT/Thermoselect Gasification Process

Technology – Thermal

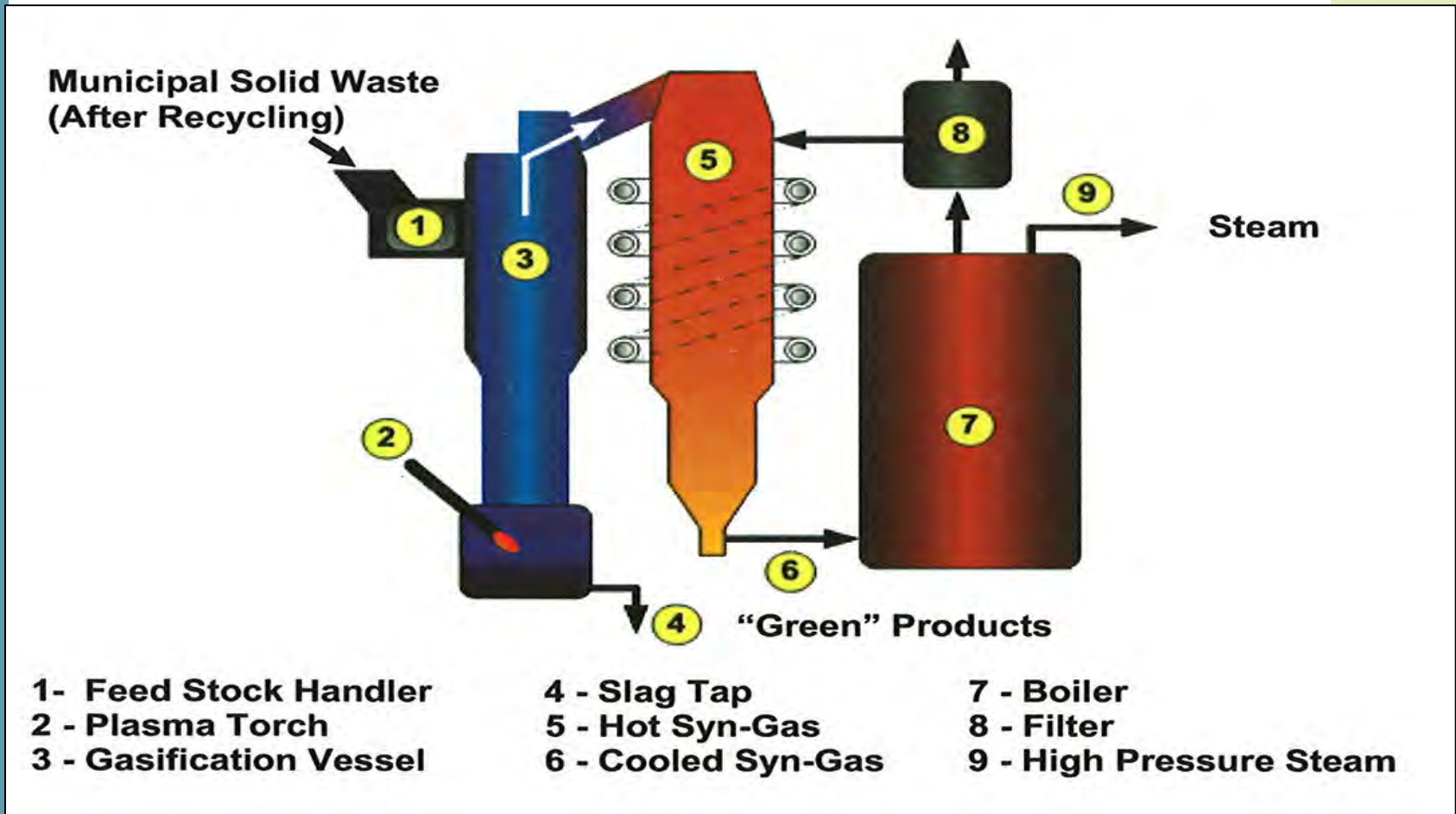
Plasma Arc

- Design Principles
 - Super high temperature destruction of MSW (5,000°F to 8,000°F)
 - Uses Plasma torches located at bottom of reactor
 - Torch requires electricity to generate high temperatures
 - Generates marketable products



Technology Overview

Plasma Arc Process



Pictured: Section view of a Plasma Gasification Process

Technology – Thermal

Gasification & Plasma Arc

- Advantages
 - Ash is melted and vitrified and rendered non-hazardous
 - Lower air emissions than Advanced Thermal Recycling
 - Typically modular design
- Disadvantages
 - Typically requires preprocessing of fuel
 - Works best with a more uniform and select feedstock (plastics, biomass, industrial waste)

Technology – Thermal

Pyrolysis

- Very old technology
- Gas produced from the pyrolysis of wood was used to replace unavailable fossil fuels in times of war
- Pyrolysis of biomass generates three different energy products:
 - coke
 - gas
 - oils

Technology – Thermal

Pyrolysis

- Advantages
 - Produces gas
 - Carbon filtration media
 - Soil amendment
- Disadvantages
 - Requires significant preprocessing of feedstock
 - Required significant input energy
 - Market for by-products

State of the Industry

Technology	US	World
Anaerobic Digestion	0	29
Composting	12	Numerous
Hydrolysis	0	0
Advanced Thermal Recycling	83	650
Gasification	0	38
Plasma Arc	0	3
Pyrolysis	0	12

Notes:

1. Numbers are approximate.
2. This list summarizes facilities that are generally commercial scale and excludes pilot scale projects. Many use a feedstock that is a fraction of the overall MSW waste stream requiring waste segregation and/or processing.

International State of the Industry

■ Biological Treatment

Example: ArrowBio (Hidera, Israel)

- February 2009
- Non segregated waste
- 100,000 tons per year of MSW
- 23,000 tons of compost product
- 19,000 tons of residue



International State of the Industry

■ Biological Treatment

Example: Bassano del Grappa, Italy

- 110,000 tons/yr of organic waste
- Originally designed for MSW
- Currently organics fraction only
- Held for 35 days in three cylindrical digesters that are approx 3,000 cy
- Used as compost or fertilizer



International State of the Industry

Advanced Thermal Recycling



WTE Plant – Hamburg, Germany



WTE Plant – Antwerp, Belgium

International State of the Industry

- Gasification, Plasma Arc, Pyrolysis
 - 51 facilities operating worldwide
 - operational issues due to fuel feed system
 - requires significant front-end fuel processing
 - no extensive operation at full load
 - no long duration tests run (MSW)
 - minimal stack testing data released (MSW)

US State of the Industry

■ Biological Treatment

- Cedar Grove Composting near Seattle, WA
 - Energy equivalent to power 400 homes
 - 50,000 tons/yr food waste
 - 275,000 tons/yr yard waste
- Los Angeles Department of Public Works
 - Convert 150 tons/day of post-recycled organic MSW
 - Products: biogas and compost
- None of these facilities process complete MSW waste streams

US State of the Industry

- Advanced Thermal Recycling (Mass Burn)
 - Olmsted County, MN (expansion)
 - Lee County, FL (expansion)
 - Hillsborough, FL (expansion)
 - York, PA (expansion)
 - Islip, NY (expansion)
 - Hempstead, NY (expansion)
 - Peel Region, Canada (expansion)
 - Alexandria, MN (expansion)
 - Durham Region, Canada (new facility)
 - Harford, County, MD (new facility)
 - Frederick County, MD (new facility)
 - City of LA, CA

US State of the Industry

- Advanced Thermal Recycling (Refuse Derived Fuel)
 - Honolulu, HI (expansion)
 - West Palm, FL (expansion)
 - Hartford, CT (expansion)
 - Forsite Development
 - Proposed “ReVenture” energy complex in Mecklenburg County
 - “Biomass” to Energy Facility planned
 - RDF or Gasification considered
 - R3 Environmental
 - Proposed project in New Hanover County, NC
 - “Dirty” Materials Recovery Facility (MRF) to increase recyclables recovery and provide RDF to feed existing mass burn facility

US State of the Industry

■ Plasma Arc

- St. Lucie Co., FL (Received permit in July 2010)
- Ottawa, Canada (pilot)

■ Anaerobic / Pyrolysis / Gasification

- LA County (Summer 2010 approves demo for each)

■ Pyrolysis

- Romoland
- San Diego

0 facilities operating in the US at commercial scale

Proven vs. Emerging in the US

- Commercially Proven for MSW
 - Advanced Thermal Recycling (Waste-to-Energy)
 - Mass Burn
 - Refuse Derived Fuel (RDF)
- Not Commercially Proven for MSW
 - Pyrolysis
 - Gasification
 - Plasma Arc
 - Anaerobic Digestion

International

- Feed Stock
- Political & Public Support
- Environmental
- Financial

How to be Successful in the US

- Demonstrated Performance
- Proof of Scale-Up
- Proper Quality & Quantity of Feedstock
- Political & Public Acceptance
- Environmental & Emission Performance
- Realistic Economics

Environmental Concerns

Technology	Environmental Concern
Anaerobic Digestion	Odors, air emissions
Composting	Odors, air emissions
Hydrolysis	combustion emissions, VOC emissions
Advanced Thermal Recycling	combustion emissions, ash disposal
Gasification	combustion emissions, byproduct use
Plasma Arc	combustion emissions, ash disposal
Pyrolysis	combustion emissions, ash disposal

Summary

- Does not eliminate landfills – extends the life of landfills
- Which one to pick (biological or thermal)
- Understand proven vs. emerging
- Requires pre-processing and sorting



Summary

- Actual performance, emissions, & cost data difficult to obtain since no historical data
- Public opposition exists with regard to any new facility development – NIMBY
- Movement towards greater diversion
- Beneficial products



Questions?

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