Alternative Technologies for MSW

Ramsey/Washington County Resource Recovery Project Board

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Presented by Warren.Shuros@foth.com

651-288-8596

Presentation Content

- Context of this report overall
- Purpose
- Waste stream quantities/composition
- Review each technology
- Observations
- Next steps

Context

- Engineering 2013 work includes:
  - Alternative Technology Scan
  - Preliminary Technical Review of Newport and Xcel combustion facilities
  - Detailed Feasibility Study
  - Comparison Analysis

Purpose of Technology Scan

- Broad look at what is happening with waste processing – An update
- General overview based on published information
- Observations on applicability to R/W
- Provide information to select one or more for additional analysis

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Waste Stream

- Applicable to what is left after reduction, recycling, composting – the hierarchy
- Consider changes over time – both to quantities and composition
- Quantities affect facility size
- Composition may affect technology

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Waste Quantity Projections

Year	Estimated Tons
2012	390,591
2017	410,000
2022	430,000
2027	450,000
2032	470,000
2037	490,000

Alternative Technologies Covered

- Gasification
- Pyrolysis
- Plasma Arc
- Mass Burn
- Anaerobic Digestion
- Mixed Waste Processing
- Plastics to Fuel

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Gasification

- Thermal process converts MSW to synthetic gas (syngas)
  - Pre-processing
  - Conversion to synthetic gases
  - Cleaning and conditioning
  - Conversion to biofuels & chemicals to sell

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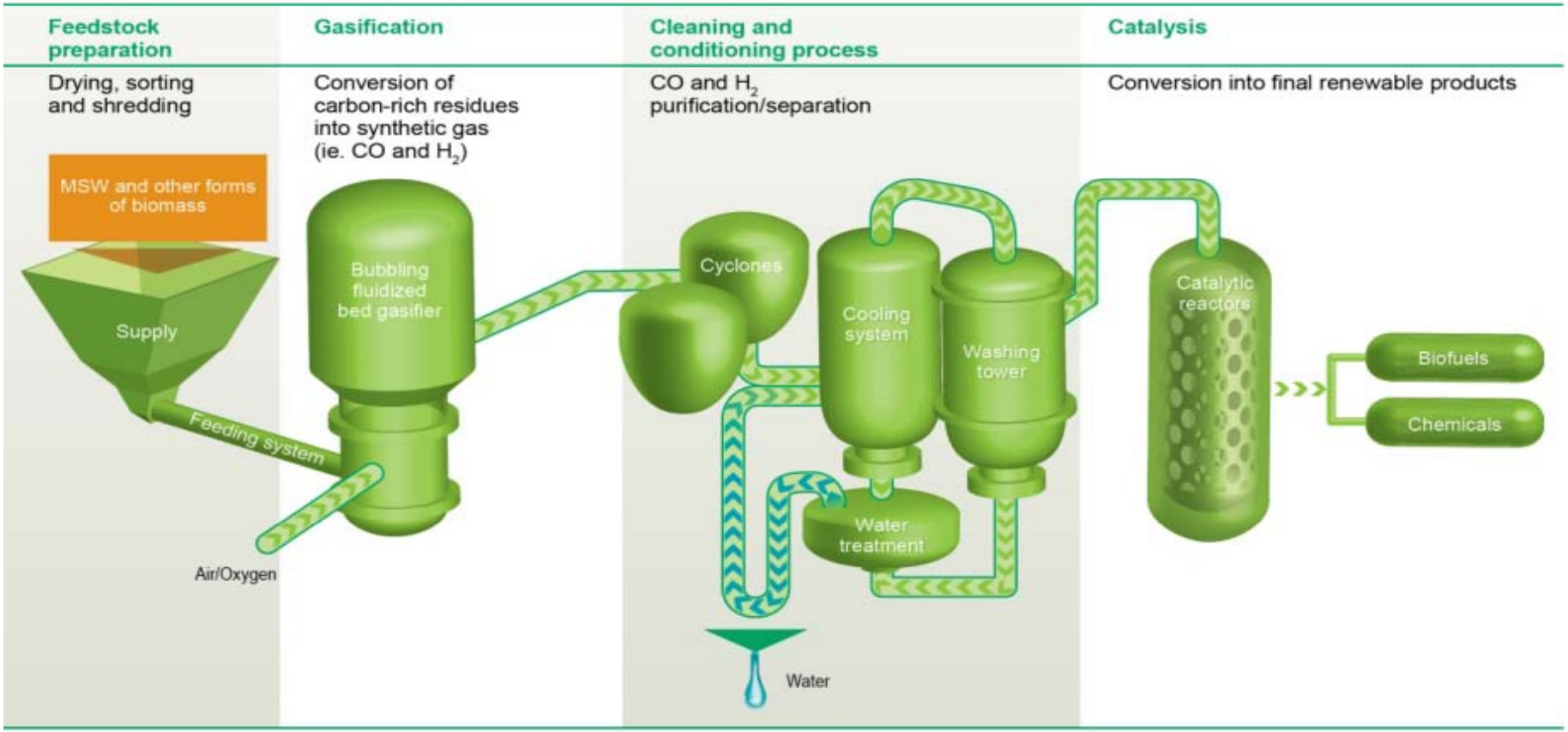
Enerkem Edmonton Facility

- Sorting/Pre-Processing includes:
  - Mechanical/manual sorting
    - Organic materials conveyed to composting
    - Cardboard/metals sorted for recycling
    - Non-recyclable, non-compostable wastes are shredded into RDF for feedstock in biofuels facility

Enerkem Biofuel Process Steps



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Gasification Pros/Cons

Pros

- Fuels production may be economically superior to electrical production
- Recycling enhanced by up-front sorting
- Efficient energy production
- “Not incineration”

Cons

- Unproven commercial scale for MSW in US
- Requires MSW pre-processing
- Permitting – no clear path

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Pyrolysis

- Thermal process converts MSW to synthetic gas (syngas)
- No air or oxygen enters/there is no burning
  - Pre-processing/Drying
  - Conversion to synthetic gases
  - Recovery/refinement of oils, gases & solids
  - Power generation or combustion on-site

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Pyrolysis

- This technology has not advanced in the US over the years
- No facilities are in commercial operation
- Majority of plants are in Japan with little known
- Not viable to consider further at this time

Plasma Arc

- Very high temperatures breaks down feedstock into basic elemental compounds
- Pre-processing including 2 inch size
- Conversion to gases such as CO, H2, & CO – Also, glassy residue (slag) and electricity

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Plasma Arc

- Areas of concern:
  - Ability to process US MSW
  - Preprocessing requirements and costs
  - Scale up and demonstration on a commercial basis
- Substantial portion of electricity used internally

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Plasma Arc

Pros

- Superior thermal destruction
- Limited pollution
- Potential to expand to include other non-MSW streams such as hazardous materials

Cons

- Not proven for MSW in US
- High initial capital cost
- Requires extensive pre-processing
- High power requirements

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Mass Burn

- Process that burns MSW in a combustion chamber, without pre-processing and recovers heat energy
- Two types – water wall and modular with water wall more common
- There are 99 mass burn facilities in the US with 6 publicly owned in Minnesota

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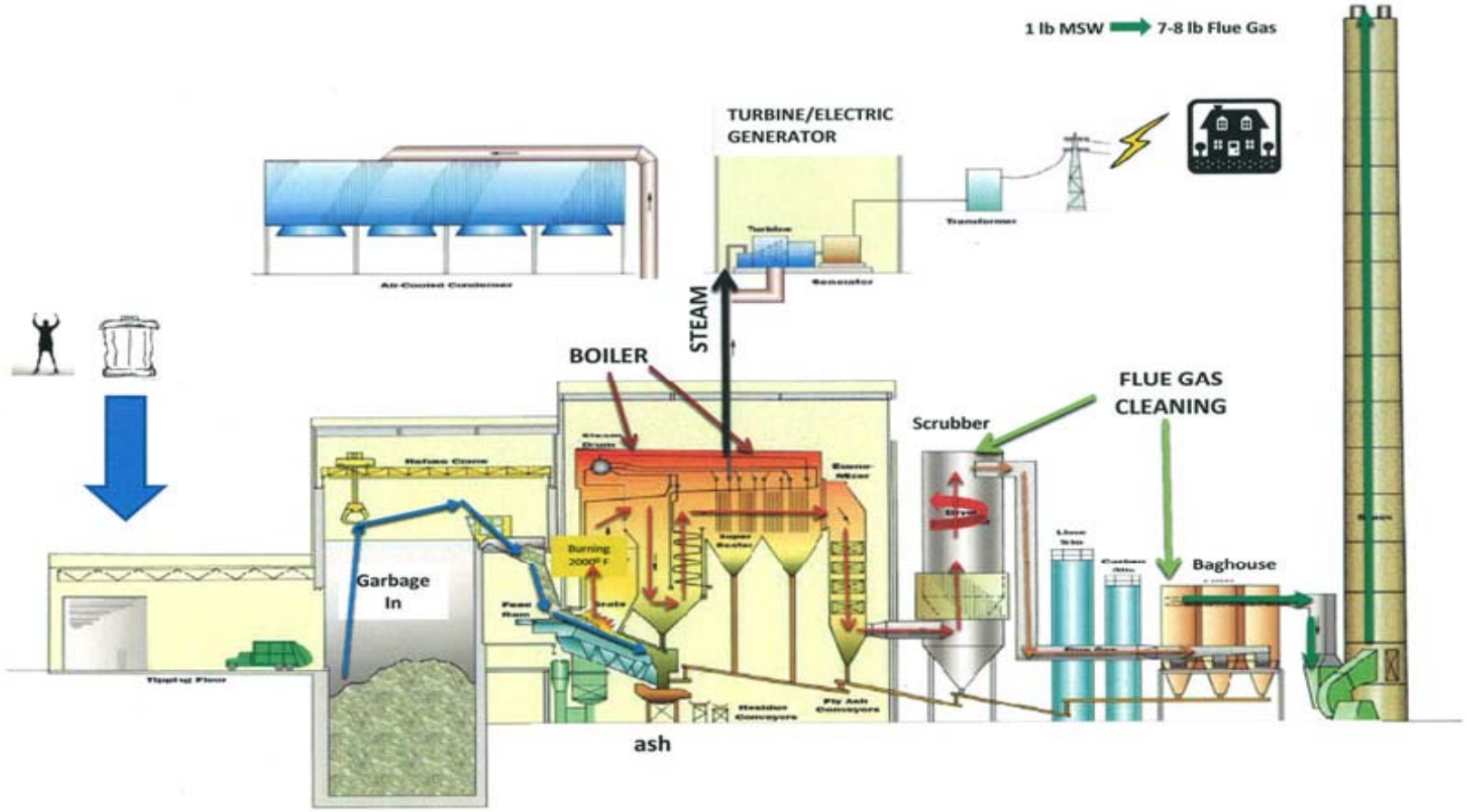
Typical Mass Burn Cross Section



Mass Burn Pros/Cons

Pros

- Proven Technology
- Proven capital and operating costs
- Capable of processing R/W counties waste not reduced, reused, recycled or other wise handled
- Financially stable vendors
- Compliant air emissions

Cons

- Public opposition makes siting and permitting a new facility difficult
- Some concern to size and long term commitment to single facility/approach

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Anaerobic Digestion

- Process that decomposes organic portion of MSW in absence of oxygen producing methane and a digestate
- Applicable to organic fractions of waste stream
- Methane can be used for heat and power, cleaned for natural gas or vehicle fuel (CNG)
- Digestate can be further processed as compost or liquid fertilizer

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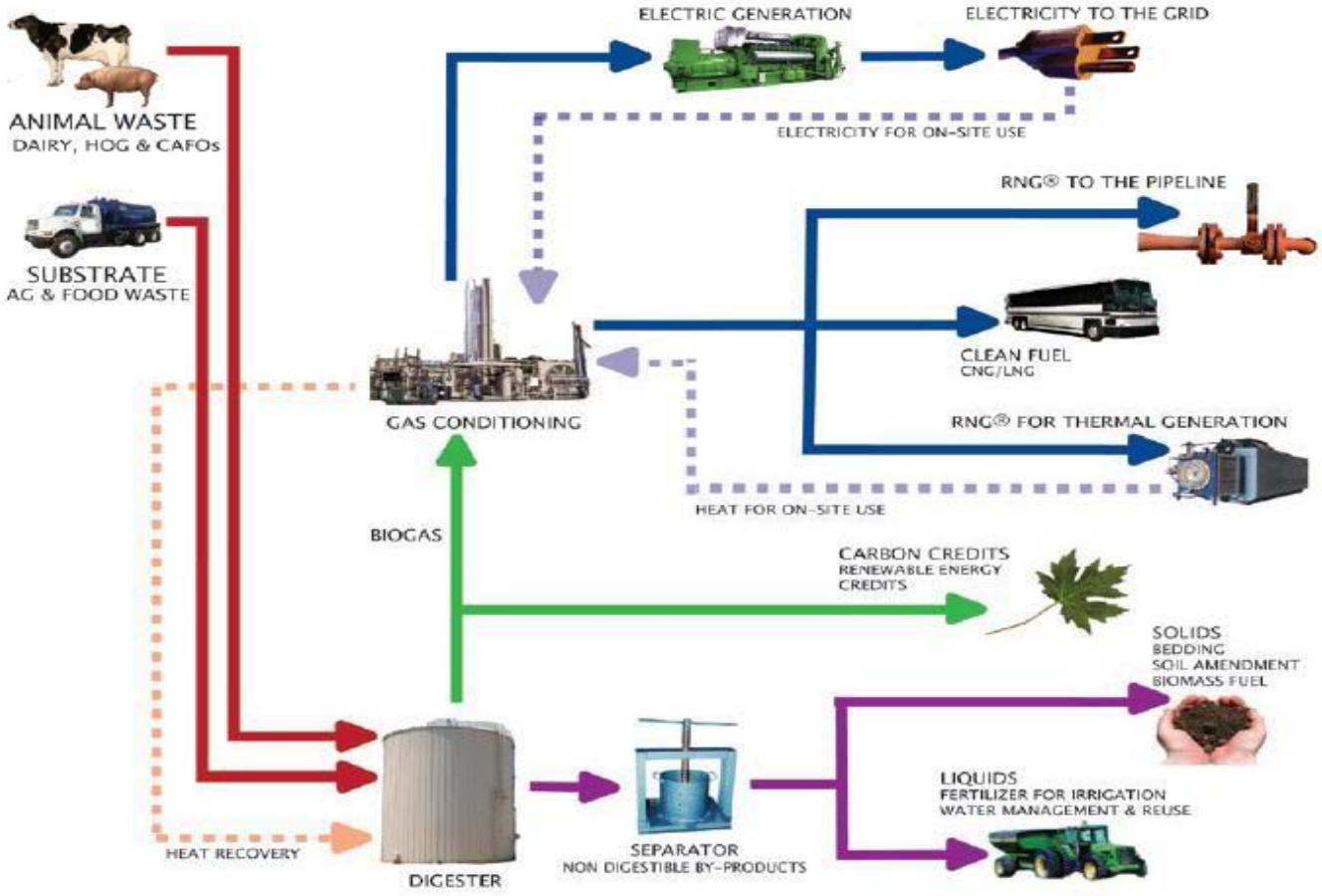
Anaerobic Digestion Diagram



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Anaerobic Digestion Pros/Cons

Pros

- Well understood process in sewage/manure applications
- Can be combined with other technologies
- Marketable end product
- Contributes to GHG reduction

Cons

- Not widely proven for MSW in US, but facilities being developed
- Requires either source separation/collection or processing MSW to remove organics
- AD bacteria have specific requirements and may need a consistent feedstock
- Odor control required

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Mixed Waste Processing

- Purpose is to separate and remove recyclables such as paper, metals, plastics, wood, & organics from MSW
- Can be “stand alone” or a “front-end separation process” at a larger facility
- Tailored to project specific waste stream goals

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Mixed Waste Processing

- Can be combined with RDF, AD, & plastics to fuel facilities
- Range from fairly simple, low-tech to very high tech with optical sorting
- Being more commonly included as “front end processing”

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Mixed Waste Processing Pros/Cons

Pros

- Can be added to the “front end” of other technologies
- Can be flexible to adapt to material market changes
- Can focus on specific waste streams to achieve higher recovery
- May reduce need for separate collection for targeted generators

Cons

- Not appropriate for entire waste stream or as a stand alone facility for R/W counties
- Quality of recyclables may be lower than source-separated programs

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Plastics to Fuel

- Process using heat and distillation to convert various plastics into oil or more refined fuels
- Recently emerging technology
- New vendors entering field
- Typically target lower value plastics, not PET or natural HDPE

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Plastics to Fuel Vendors

Company Name	Location	Pilot (P) Scale, Full (F) Scale, Neither (N)
Green EnviroTech	California	P
Natural State Research	Connecticut	N
Northeastern University	Massachusetts	N
Rational Energies	Minnesota	F
Plastics2Oil (JBI)	New York	F
Polyflow	Ohio	P
Vadxx	Ohio	F
Agilyx	Oregon	F
Agri-Plas	Oregon	P
Recarbon Corp.	Pennsylvania	P
Climax Global Energy	South Carolina	P
Envion	Washington D.C	P

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Plastics to Fuel - Summary

- Emerging technology – too new for defined pros/cons
- Very few vendors commercially operational with one in Plymouth, MN
- Operating in “batch” mode rather than continuous – affects output potential
- Questions but potentially promising for selected plastics
- Could fit with other technologies (MWP, RDF, AD, etc.)

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Comparison Criteria

- Proven technology
- Documented cost databases
- Ease of permitting
- Development period
- Flexibility/Compatibility
- Applicable to R/W MSW
- Viability for further consideration

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Proven Technologies for MSW

- Yes = Mass burn, RDF, Mixed Waste Processing, & Anaerobic Digestion for organics
- Emerging = Gasification & Plastics to fuel
- Not Yet = Plasma arc & Pyrolysis

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Documented Cost Database

- Yes = Mass burn, RDF, Mixed Waste Processing, AD close for organic fraction
- Not Yet = Gasification & Plastics to fuel
- No = Plasma arc & Pyrolysis
  - These “not viable” at this time

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Ease of Permitting

- Currently being permitted in Minnesota = Mixed Waste Processing, Plastics to Fuel, Anaerobic Digestion
- Proven difficult = Mass burn & RDF
- Unknown in MN = Gasification

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Development Period

- 1 to 2 years = Mixed Waste Processing, Plastics to Fuel, Anaerobic Digestion
- 5+ years = Mass burn, RDF, Gasification

Flexibility/Compatibility

- Fits with Other Technologies = RDF, Mixed Waste Processing, Gasification, Plastics to Fuel, Anaerobic Digestion
- Handles All Wastes = Mass burn but size commitment concerns some interests

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Applicability to R/W MSW

- Yes = Mass burn & RDF
- Yes for a portion or part of a “system” = RDF, Mixed Waste Processing, Gasification, Plastics to Fuel, Anaerobic Digestion

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Viability for Further Consideration

- Yes = Mass burn, RDF, Mixed Waste Processing, Anaerobic Digestion
- Yes pending new facility results = Plastics to Fuel & Gasification

Next Step(s)

- Deeper review of:
  - Mass burn
  - Mixed Waste Processing
  - Anaerobic Digestion
  - Plastics to Fuel
  - Gasification
- Applicability to R/W Waste stream


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