

ARIZONA
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ASSOCIATION

Waste to Energy Technologies

Presented by:
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Gershman, Brickner & Bratton, Inc. (GBB)

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Outline

- Introduction
- MSW Management Overview
- Waste Conversion Technologies
- Representative Projects

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INTRODUCTION

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Steve Simmons

- Senior Vice President and owner in GBB
- Over 35 years of experience in MSW and biomass conversion technologies
- Has developed, designed, built, and operated multiple waste conversion systems




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Waste to Energy Facility Experience


- 15 years with the American Ref-Fuel Company (now a part of Covanta)
- Had a variety of engineering, project development and business management roles
 - ✓ Project Engineer for the American Ref-Fuel team that built the 2,750 tpd Essex County Facility
 - ✓ Business / P&L Manager of the 3,300 tpd Delaware Valley Facility




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GBB Quality – Value – Ethics – Results



- Established in 1980
- Solid Waste Management and Technology Consultants
- Helping Clients Turn Problems into Opportunities



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GBB's Waste Consulting Services

- Economic, technical and environmental reviews
- Procurements
- Due diligence third-party reviews
- Waste characterization and sourcing
- Process planning and conceptual designs
- Independent feasibility consultant

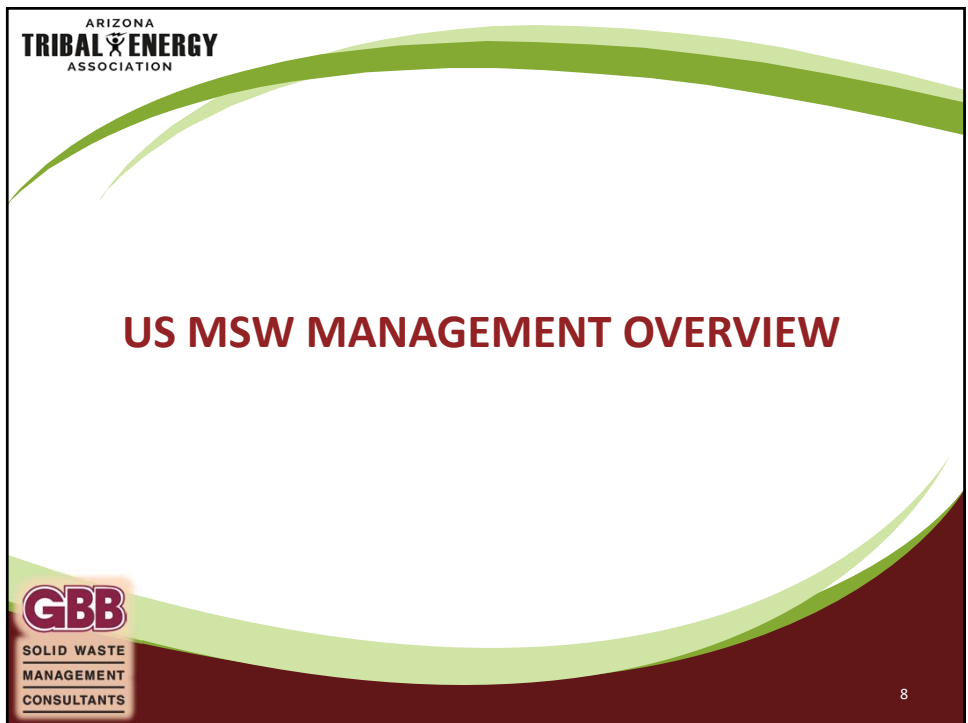


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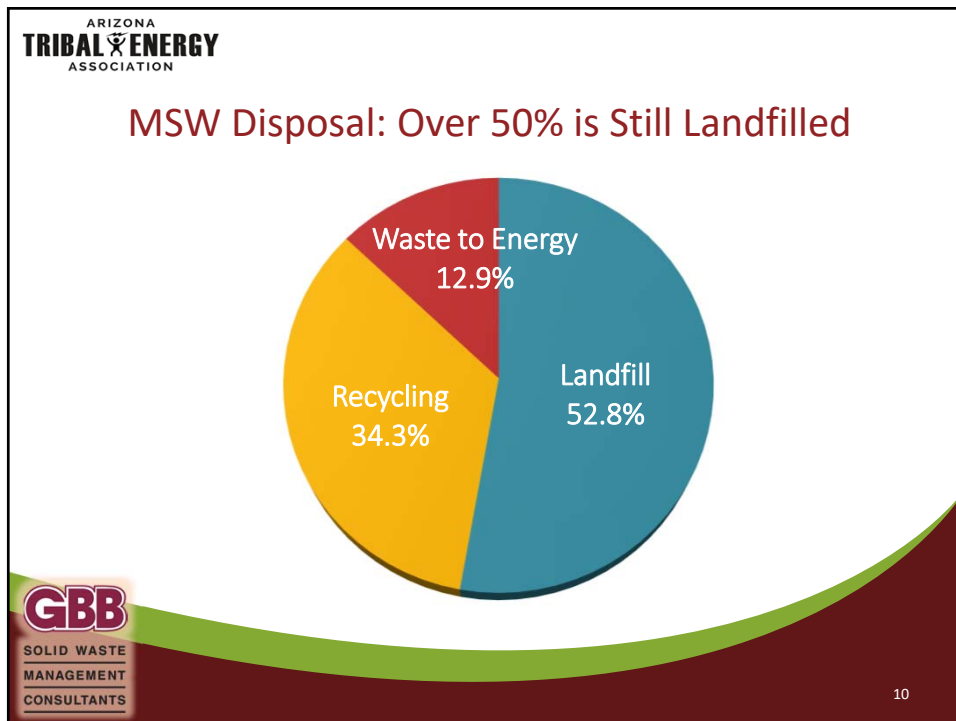
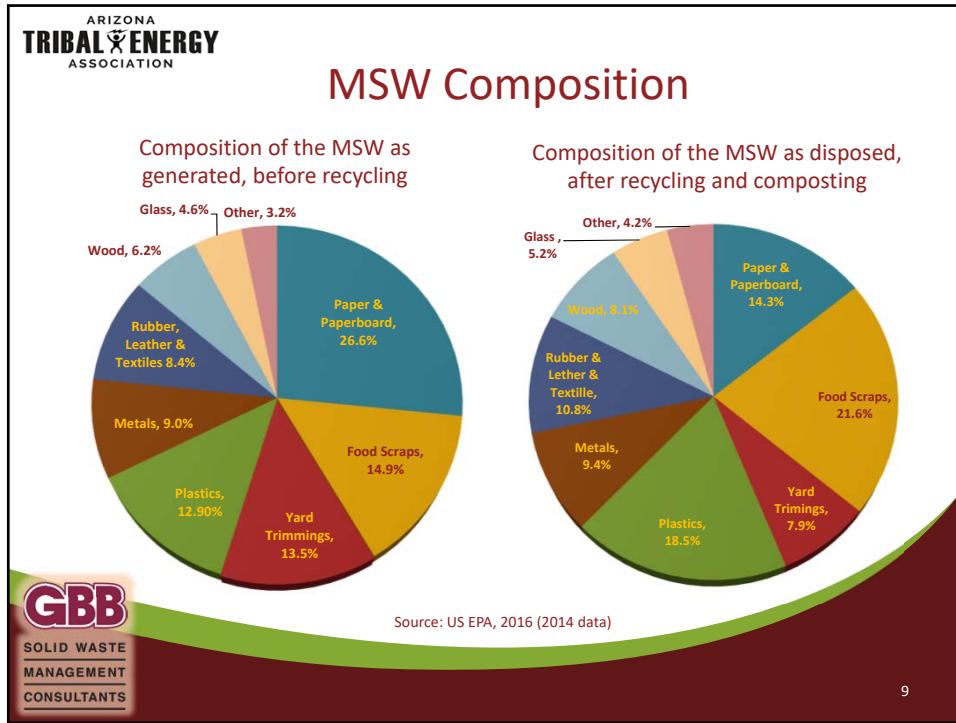
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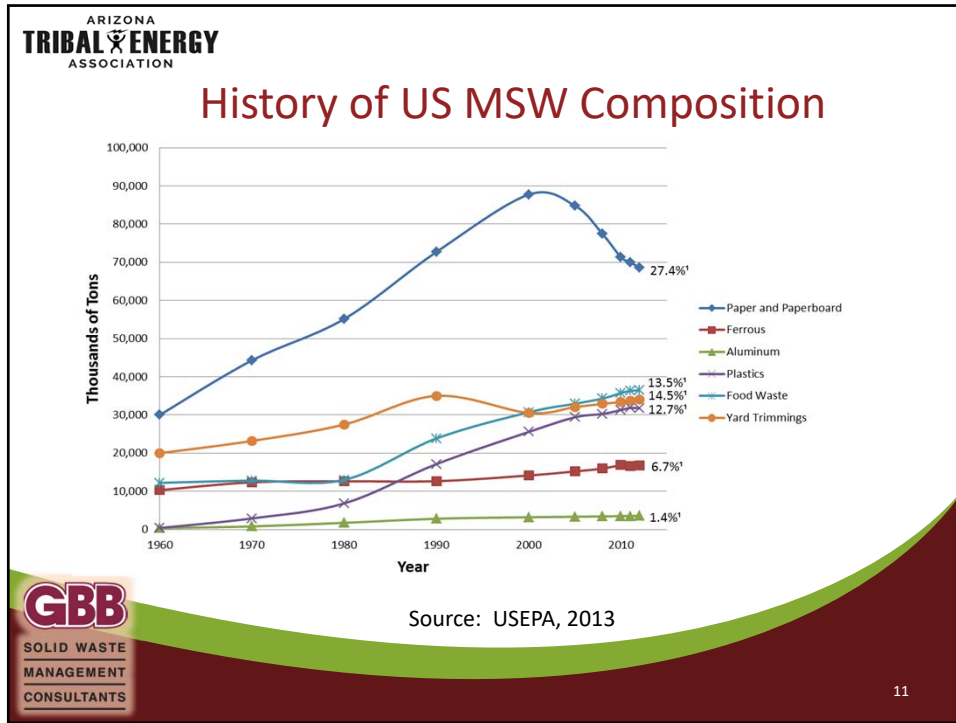
US MSW MANAGEMENT OVERVIEW



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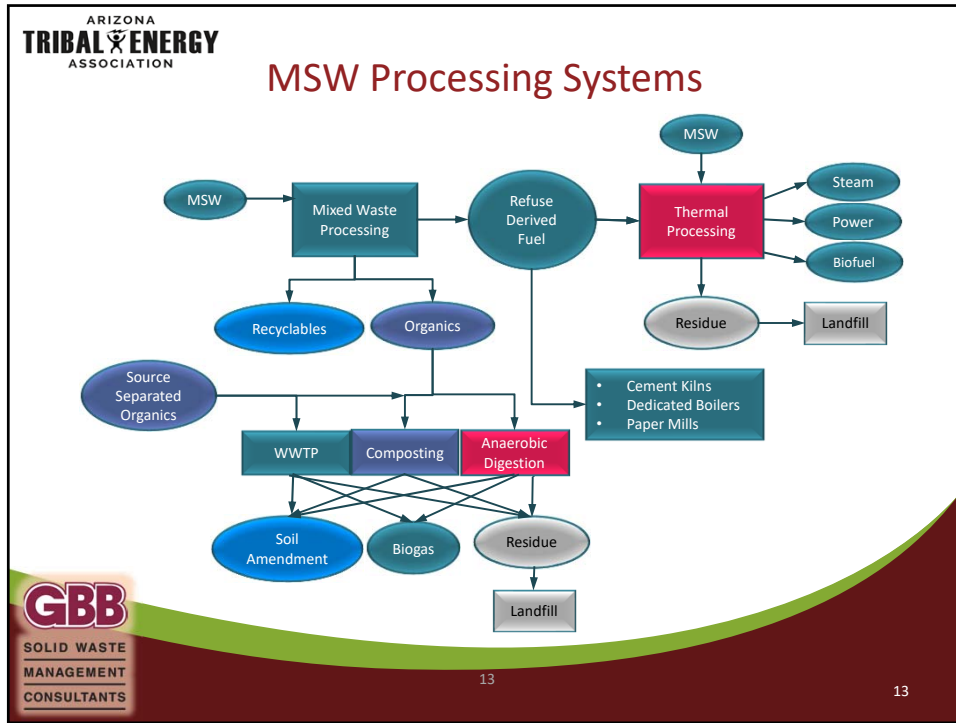


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MUNICIPAL SOLID WASTE CONVERSION TECHNOLOGIES

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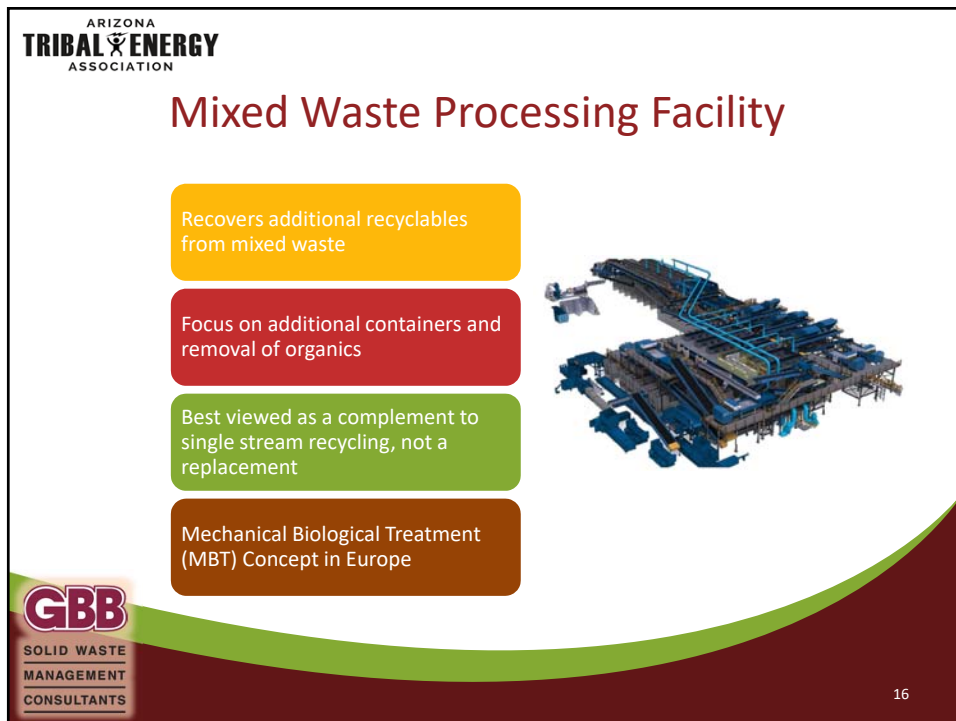
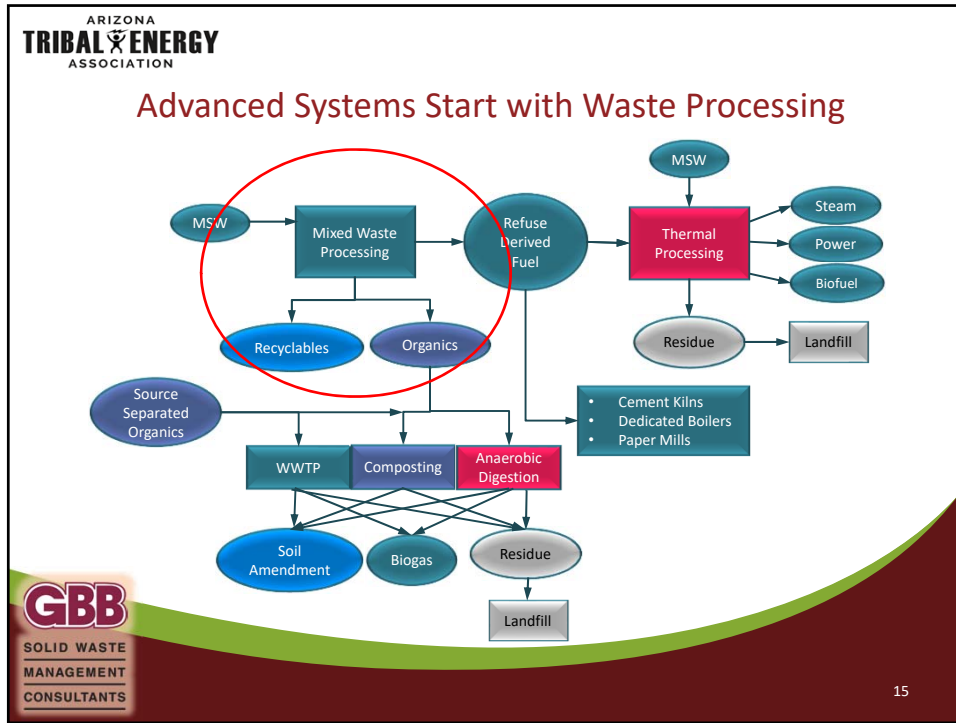


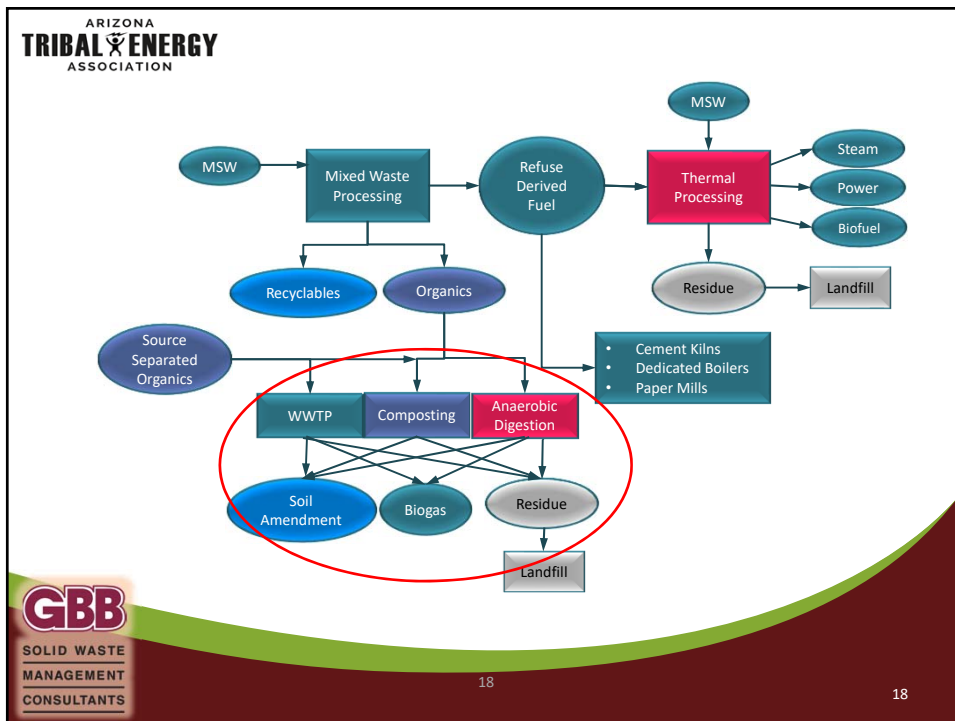
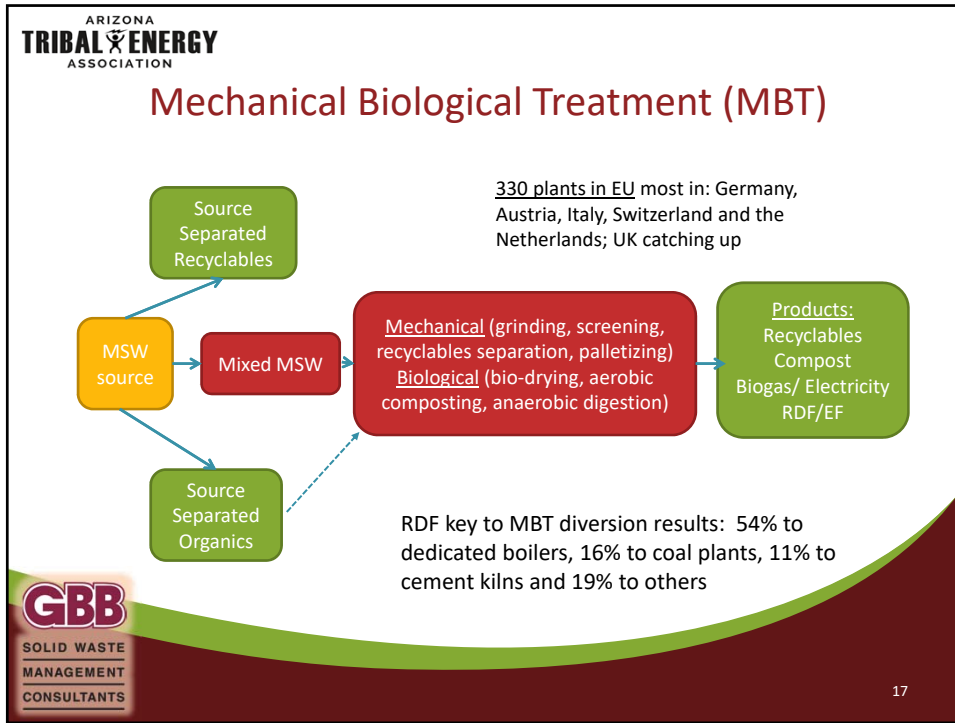
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MIXED WASTE PROCESSING (MWP) TECHNOLOGIES

- Mixed Material Recovery Facilities
- Refuse Derived Fuel Facilities
- Mechanical Biological Treatment Approach

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Managing Organic Waste

Source Separated Organics

Aerobic Composting

Anaerobic Digestion

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Detailed description: This diagram illustrates the management of organic waste. It starts with a central image of 'Source Separated Organics' (food and yard waste). Two arrows point from this central image to two different processing methods: 'Aerobic Composting' (shown as a pile of brown compost) and 'Anaerobic Digestion' (shown as industrial blue tanks).

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Anaerobic Digestion (AD)

Decomposition of biodegradable waste in oxygen depleted conditions to biogas and solid residue (digestate)

```
graph LR; OW[Organic Waste] --> P[Preprocessing]; P --> D[Digester]; P --> RL[Residue for landfilling]; D --> Dig[Digestate]; D --> Bio[Biogas]; Dig -.-> Com[Compost]; Bio -.-> EC[Electricity/ CNG]
```

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Detailed description: This flowchart details the anaerobic digestion process. It begins with 'Organic Waste' entering a 'Preprocessing' stage. From preprocessing, the waste can go to 'Residue for landfilling' or to a 'Digester'. The 'Digester' produces 'Digestate' and 'Biogas'. 'Digestate' is further processed into 'Compost', and 'Biogas' is converted into 'Electricity/ CNG'.

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Classification of AD Technologies

Feedstock Introduction

- Continuous flow
- Plug flow
- Batch

Generic Continuous Flow reactor

Solids Content

- Low Solids
- Pumpable material ("wet")
- <15% Solids content
- High Solids
- 25-30%- pumpable ("wet")
- >50%- stackable ("dry")

Eisenmann Plug Flow Reactor

Zero Waste Energy Batch reactors

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AD Feedstock

Grocers

Restaurants and Cafeterias

Urban Farms

Food Processing Industries

Curbside Collections

Source: Getty Images


Source: Seattle Public Utilities

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BioMethane Application

IC Engine/Electricity
and Heat



Renewable Natural Gas
(RNG)



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Source: GBB Visit to Zero Waste –
Monterey, CA

Source: CleanEnergy


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Compost

Source Separated Organics

Maturing Windrows



Screened Final Compost



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Source: GBB Visit to Zero Waste –
Monterey, CA

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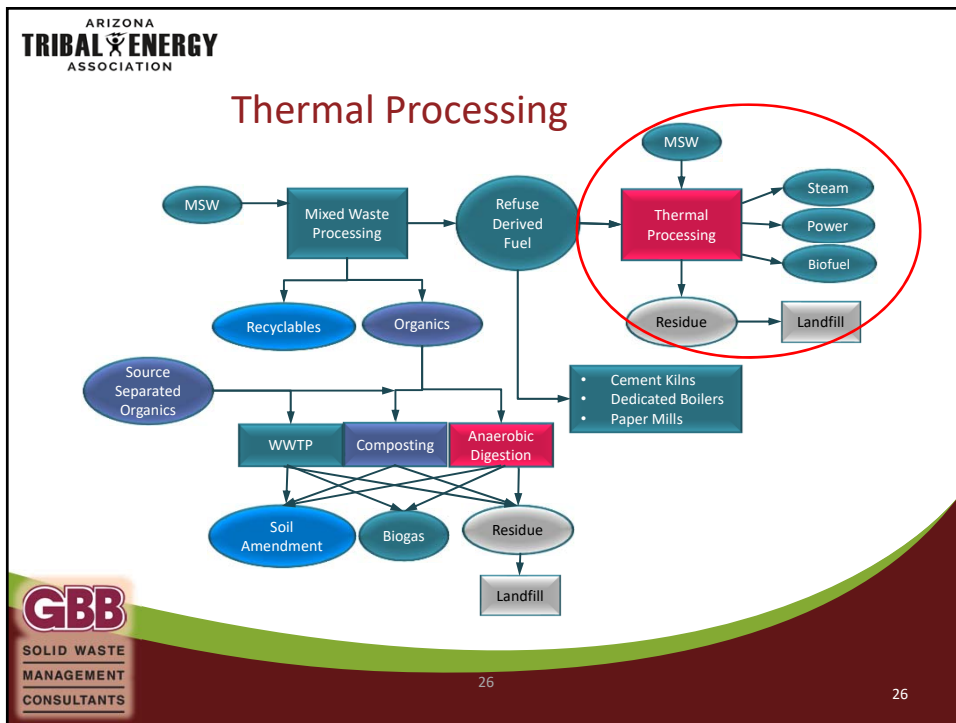
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THERMAL PROCESSING TECHNOLOGIES

- Mass-Burn Combustion
- RDF Combustion
- Gasification
- Pyrolysis

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What is gasification?

Thermal conversion of organic or fossil fuel based carbonaceous materials into carbon monoxide, hydrogen and carbon dioxide in partial combustion with controlled amount of oxygen and/or steam.

```

    graph LR
      MSW[MSW] --> FP[Feedstock preparation]
      FP --> G[Gasifier]
      G --> SR[Solid residue]
      G --> S[Syngas]
      S --> C[Cleaning]
      C --> CC[Chemical conversion]
    
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Gasification Output Pathways

```

    graph TD
      G[Gasifier] --> S[Syngas]
      S --> P[Power Generation]
      P --> B[Boiler]
      P --> GTC[Gas Turbine Combined Cycle]
      P --> ICE[IC Engine]
      P --> FC1[Fuel Cells]
      S --> H[Hydrogen]
      H --> RH[Refinery Hydrotreating]
      H --> TF[Transportation Fuels]
      H --> FC2[Fuel Cells]
      H --> CH[Chemicals]
      H --> F[Fertilizers]
      S --> FT[Fischer-Tropsch]
      FT --> W[Wax]
      FT --> DK[Diesel/Kerosene]
      FT --> G1[Gasoline]
      FT --> N[Naptha]
      S --> M[Methanol]
      M --> DME[DME]
      DME --> G2[Gasoline]
      M --> EP[Ethyl Propylene]
      EP --> PO[Polyolefins]
      EP --> OC[Oxy Chemicals]
      S --> F1[Formaldehyde]
      S --> MA[Methyl Acetate]
      S --> AA[Acetic Acid]
      AA --> AA1[Acetic Anhydride]
      AA --> VAM[VAM]
      VAM --> PVA[PVA]
      AA --> K[Ketene]
      K --> DD[Diketene & Derivatives]
      AA --> AE[Acetic Esters]
    
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Edmonton Waste-to-Biofuels Facility, Alberta, Canada

- 330 TPD refuse derived fuel
- 10 million gallons/year of ethanol
- Edmonton Waste Management Centre:
 - Refuse Derived Fuel Facility
 - Enerkem Waste-to-Biofuels Facility
 - Advanced Energy Research Facility



Source: SWANA Northern Lights 2013, Bud Latta, Processing and Disposal Waste Management Services, City of Edmonton

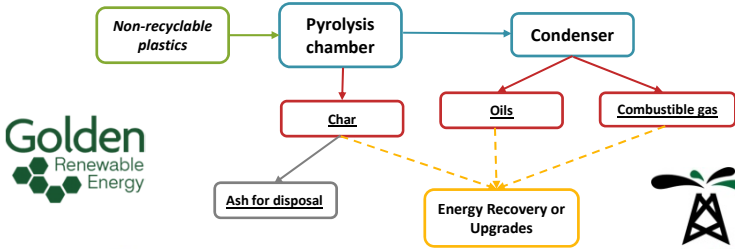
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Pyrolysis Process

Thermal processing of non-recyclable plastics in oxygen-free high temperature chamber to be made into a crude oil like fuel and synthetic gas.



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Plastic2Oil

RES POLYFLOW™
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Newest Traditional WTE: Solid Waste Authority of Palm Beach County, FL



- 3,000 TPD Mass Burn facility (1,040,000 TPY)
- Babcock & Wilcox
- 130 MW renewable power; enough for over 86,000 houses
- \$668 million construction price
- \$20.5 million first year O&M cost
- Advanced emissions controls, ferrous and non-ferrous metals recovery

Source: SWA of Palm Beach County

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Copenhagen, Denmark – Ski Slope Plant



- 400,000 TPY
- Electricity and steam for district heating

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REPRESENTATIVE PROJECTS

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Metlakatla Indian Community Small Scale Waste to Energy Facility

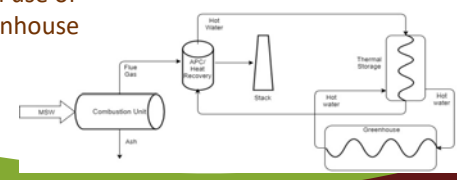

Phase 1: Evaluated three technical solutions

- Waste-to-Electricity
- Waste-to-Heat
- Off-Island Disposal

Phase 2: WTE development

- Project Renderings
- Project Economics
- Architectural Rendering
- Detailed site plan
- Environmental Critical Issues and Permits

Phase 3: Beneficial use of heat options: greenhouse & biomass drying



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Mesa Grande Band of Mission Indians Conceptual Study for a Biomass Facility

Ongoing/
by the end
of 2017



- Conceptual Study
- Feedstock Procurement Plan
- Compost market study

2018

- RFIQ
- Identify the best applicable AD & Composting technologies
- Business Plan
- Preliminary design and renderings of the facility
- Project Implementation Strategy

2019

- Final “go”- “no go” decision




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Us District Court - Guam Consent Decree

- Appointed Receiver of Solid Waste Program on Guam
- Managed Entire Solid Waste System and Engineered 180° Turnaround for island – population 165,000
- Created a self-sustaining system based on Revenue
- Opened first Landfill on island – Subtitle D
- Closed violating 70 year old open dump
- Renovated Residential/Convenience Centers
- Provided all coordination management with Region 9 EPA



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Guam - Closed Ordot Dump




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Guam – New Subtitle D Landfill



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Guam – New Citizen Convenience Centers



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Thank You

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