

Waste Conversion Technologies for Pennsylvania

Presented by:
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Pennsylvania Waste Industries Association Conference
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Steve Simmons

- Senior Vice President
- Over 35 years of experience in conversion technologies
- Has developed, designed, built, and operated multiple conversion systems
- Has investigated 40+ waste/biomass plants worldwide



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Waste to Energy Experience

- Project Engineer for the American Ref-Fuel team that built the Essex County Facility
- Business Manager for the 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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Suppose

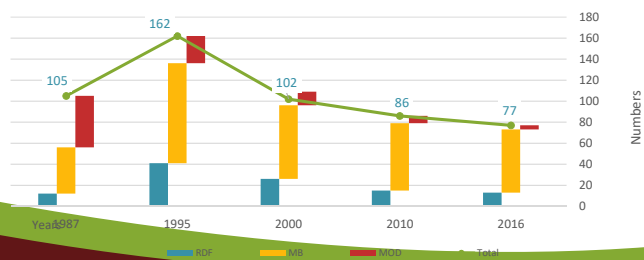
- You represent a Pennsylvania community that already recycles / diverts 30+% of its waste stream,
- But your citizens / community leaders want to divert more, maybe 70% or more,
- What are options that are viable over the next 5+ years



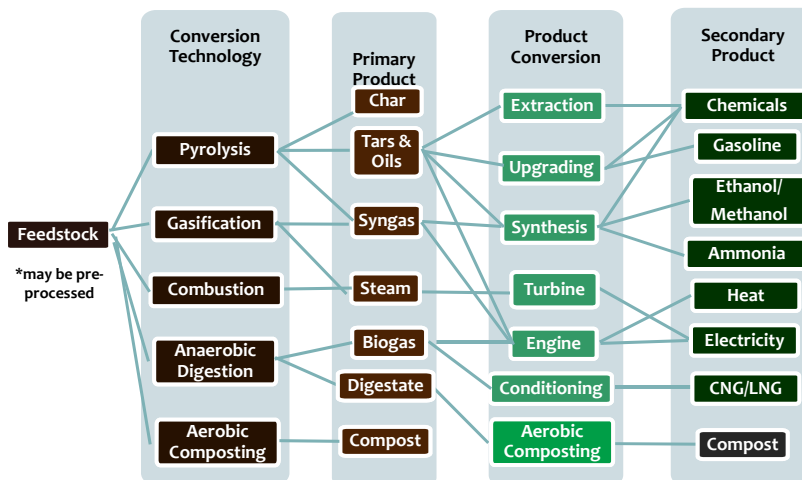
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Traditional Mass Burn Combustion is on the Decline

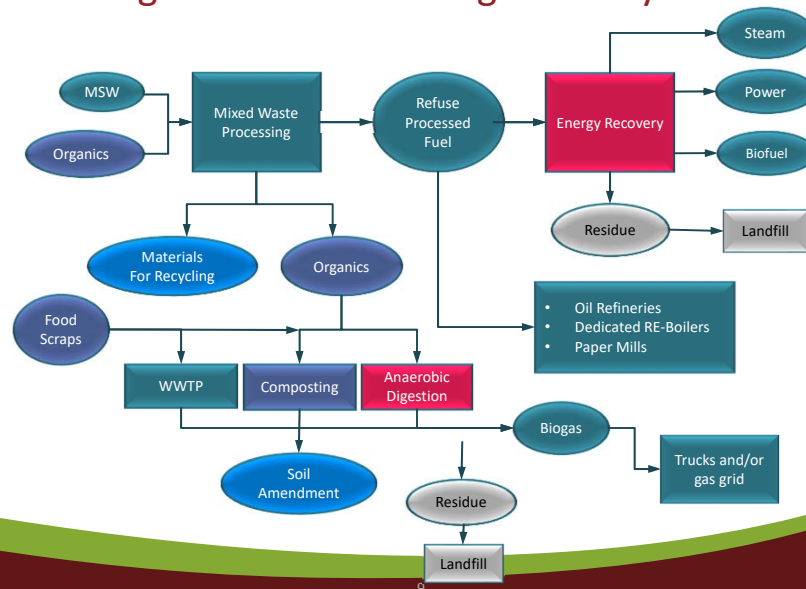
Year	Numbers of Plants			Total	Reference
	RDF	MB	MOD		
1987	12	44	49	105	EPA. (2006). An Inventory of Sources and Environmental Releases of Dioxin-Like Compounds in the United States for the Years 1987, 1995, and 2000.
1995	41	95	26	162	J.V.L. Kiser and J. Menapace. (1995). <i>Integrated Waste Services Association, Washington, D.C.</i>
2000	26	70	13	102	Jonathan V.L. Kiser & Maria Zannes. (2000). <i>The IWSA Directory of Waste-To-Energy Plants.</i>
2010	15	64	7	86	Ted Michaels. (2010). Energy recovery council 2010 Directory of waste-to-energy facilities.
2016	13	60	4	77	Ted Michaels. (2016). Energy recovery council 2016 Directory of waste-to-energy facilities.



Conversion Systems may have Multiple Technologies, Pathways and Products



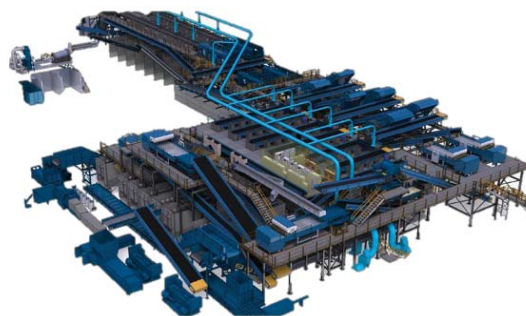
Modern Integrated Waste Management Systems are Complex



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Almost all Advanced Conversion Processes Start with Mixed Waste Processing

- Recovers additional recyclables from mixed waste
- Focus on additional containers and removal of organics
- Residual stream suitable for energy recovery



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Technology in MWP has Evolved

Heavy-Light Air Separator



Ballistic Separator



Optical Sorting Enhances Potential for Fuel Products



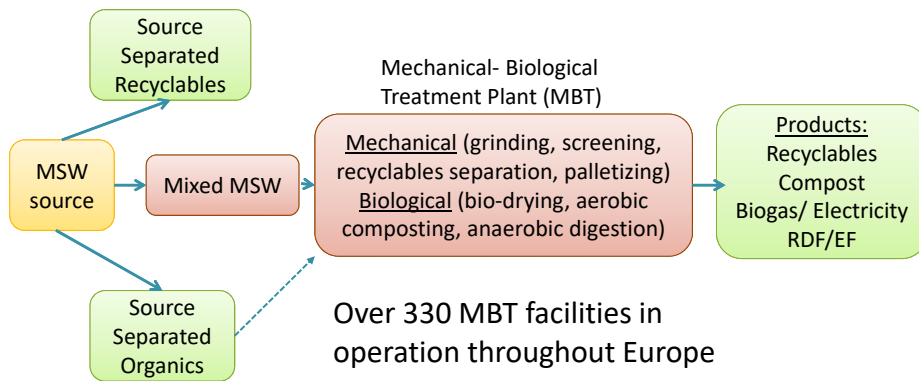
Sunnyvale, CA sMaRT Station – Mixed Waste Processing



Increases recycling but residuals go to the landfill



Mechanical Biological Treatment (MBT)



Fiberight – Hampden, Maine

- Construction started Spring 2017
- 600 ton per day design capacity
- Will serve the needs for residential and commercial waste disposal for 83 communities
- Products include recyclables and biogas
 - Soluble organics (food waste) process through AD
 - Cellulosic organics processed via hydrolysis and AD
 - Lignin, non-recyclable plastics processed to an engineered fuel
- Privately financed, \$72 per ton tipping fee
- Start up, Spring 2018



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Instead of Landfilling Residuals, Make an Engineered Fuel

- ✓ Fuel heating value over 8,000 BTU/LB.
- ✓ Chlorine content less than 0.3%, 3,000 PPM
- ✓ Moisture less than 15%
- ✓ Ash less than 15%
- ✓ 50% or greater biogenic carbon



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PA Examples: SpecFUEL® Faculty in Philadelphia

1,000 tpd of post recycling waste to 450 tpd of fuel



Consumers: Cement kilns in the Lehigh Valley



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PA Example: Evergreen Community Power – Reading

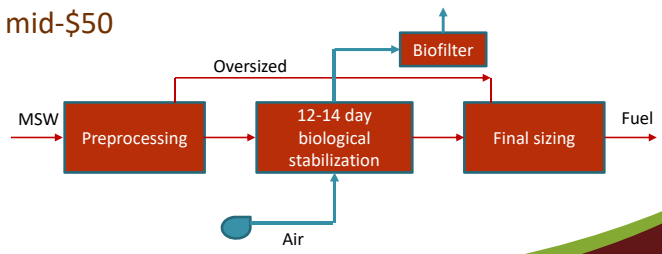
- Combined Heat and Power facility providing steam and electricity to an associated 600 tpd OCC mill.
- Fluidized bed boiler
- Up to 1,000 tpd of processed construction and demolition debris.



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Martinsburg, WV - Entsorga

- To produce 500 tpd for MSW derived fuel for use in ARGOS cement facility
- Privately developed by Apple Valley Waste
- Construction commenced fall 2016
- Operational Spring 2018
- Estimated tipping fees mid-\$50



Entsorga Wilshire, UK



Regulatory Considerations

- PADEP General Permit for Beneficial Use of Waste
 - WMG027 – C&D waste, Pre-consumer plastics, textiles, waste wood,
 - WMG037 – Municipal solid waste,
 - WMGR106 – Types 4 – 7 plastics from a MRF and residual waste generators,
- EPA Non Hazardous Secondary Materials
 - Certain waste streams are categorically exempt
 - C&D, tires, creosoted wood, papermill residuals
 - Seek a “Comfort” letter specify the fuel is not a regulated waste



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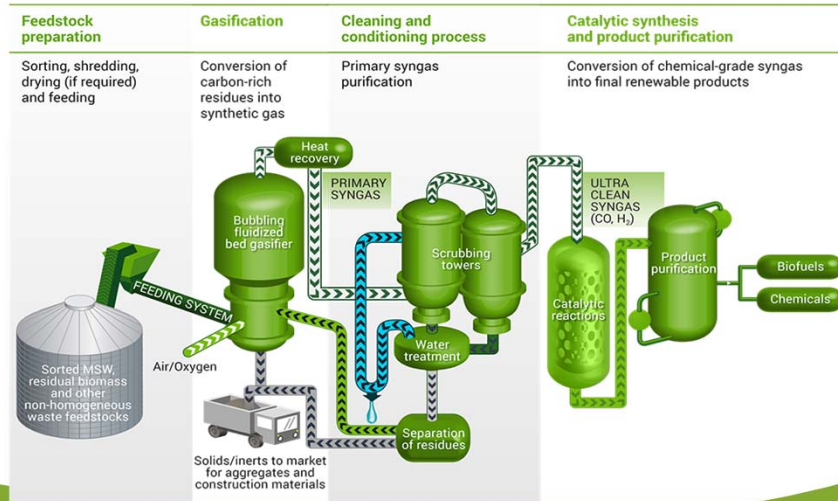
Waste-to-Biofuels: Enerkem, Alberta, Canada

- Refuse derived fuel for gasification
- Produces 10 mm gallon / year of ethanol and chemical intermediates
- City of Edmonton’s Waste Management Centre:
 - Refuse Derived Fuel production facility
 - Enerkem Waste-to-Biofuels Facility
 - Advanced Energy Research Facility



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Enerkem Process



* Municipal solid waste

Project Status - Edmonton Waste-to-Biofuels Facility, Alberta, Canada

Financing	Owner/operator	Waste Stream
<ul style="list-style-type: none"> Privately financed by capital and ownership investments Waste Management of Canada EB Investments Alberta Innovates City of Edmonton 	<ul style="list-style-type: none"> Public-Private Partnership: Enerkem Alberta Biofuels LP Builds, owns, and operates Waste-to-Biofuel facility City of Edmonton and Alberta Innovates own/operate co-located facilities 	<ul style="list-style-type: none"> City of Edmonton provides 110,000 tons MSW annually 25 year contract Pre-processed in RDF facility Tip fee \$45/Ton



Sources: Biofuelsdigest.com/bdigest/2014/10/22/enerkem-alberta-municipal-waste-to-fuels-juggernaut-in-pictures
http://www.durhamyorkwaste.ca/pdfs/project/complaint/20140822_July2014DYECProjectTeamLog.pdf

Biofuel Subsidy

- Federal Renewable Fuels Program highly incentivizes the production of advanced cellulosic biofuels via tradable credits called RINS (Renewable Identification Numbers)
- MSW is considered a cellulosic feedstock RINS
- EPA proposes 2018 requirement of 238 million gallons of cellulosic biofuel in 2018, of that volume landfill gas projects are expected to produce 221 million gallon equivalents.



Energy/Fuel Product Values Versus Capex

	Product	Yield from 1 Ton MSW	Value Per Production Unit	Revenue Per Input Ton	Capital Investment for 1,000 tpd facility
Converting MSW to...	Power	500-650 kWh	@ \$0.05 / kWh	\$25-\$33	\$300 -400 million
	Engineered Fuel	8 -16 MMBTU	@ \$1.50 / MMBTU	\$12 - 24	\$50 – 100 million
	Ethanol (w subsidies)	50 gallons	@ \$4.00 / gallon	\$200	\$300 - 400 million



Conversion Technologies have Different Risk Profiles

Alternative	Risks/Liability	Risk Summary
Processing for Recyclables and Fuel	Proven commercial technology	Low
Composting	Proven commercial technology	Low
Mass Burn Combustion	Proven commercial technology	Low
RDF Combustion	Proven technology; limited U.S. commercial experience	Moderate to Low
Anaerobic Digestion	Proven technology; limited U.S. commercial experience	Moderate to Low
Pyrolysis and Gasification	Previous failures at scale; no operating experience with large -scale operations in the U.S.; full-scale demonstrations nearing operation	High

Source: Gershman, Brickner & Bratton, Inc. 2017



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Summary

- Technologies capable of recycling / diverting up to 90% of MSW generation are available and operating today
- Private sector development and financing are available
- Indicated tipping fees in the \$50 – \$70 per ton range



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QUESTIONS & ANSWERS

What is important to you?



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Thank You !

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