

**RENEWABLE Energy**  
FROM WASTE  
CONFERENCE

# Waste Conversion Market Update

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McLean, VA

October 3, 2017

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## Session - Waste Conversion Market Update

- Harvey Gershman, GBB
- Dennis Soriano, BIOHITECH
- Craig Stuart-Paul, FIBERRIGHT
- Dave Robau, National Energy

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## Harvey Gershman



*"Earth Day 1970 first inspired my career to focus on helping do better things with waste. And, I have been able to do just that for the past 40+ years."*

**Harvey Gershman**  
*President and Co-Founder*

Specialties: Strategic thinking and planning; procurement and negotiation assistance; system administration; change management; and project financing coordination.

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Quality – Value – Ethics – Results  
Founded 1980

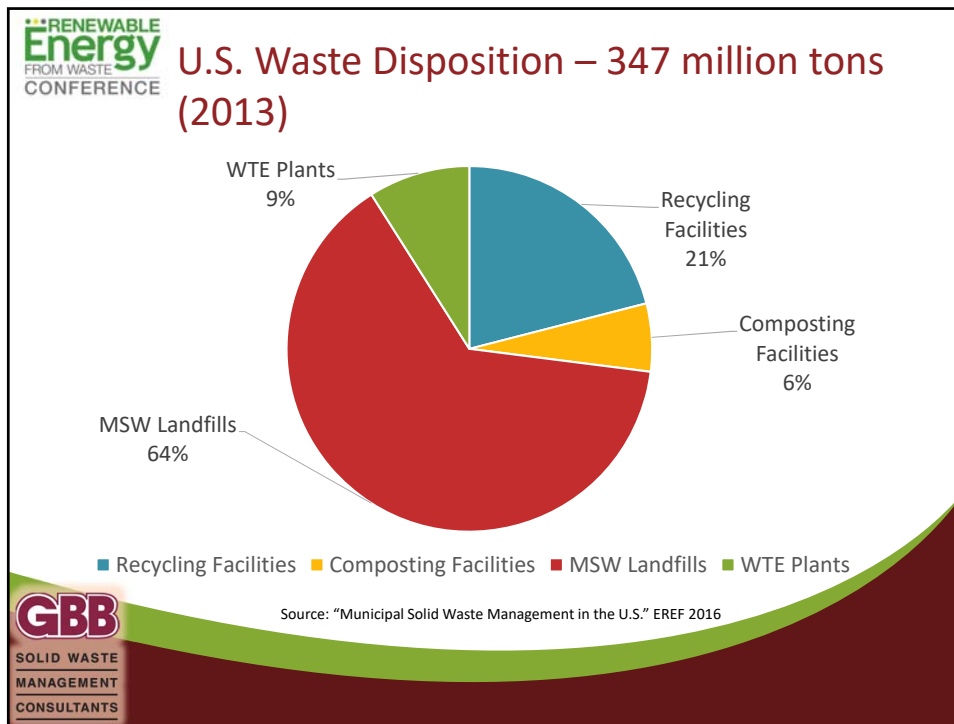
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# WASTE CONVERSIONS IN THE U.S. – 2017 UPDATE

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### U.S. Waste Management Infrastructure

Technology	Number
Transfer Stations	3,350
Material Recovery Facilities (MRF)	586
Curbside Recycling Programs	9,000+
Mixed Waste Processing Facilities & Hybrid MRFs	70*
Composting	2,300
Anaerobic Digestion (Stand-alone)	25
WTE	76
Landfills	1,908

\*Excludes facilities that solely produce RDF  
Source: GBB


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## U.S. Waste Disposition Methodology (2013)

- EREF estimates 347 million tons MSW managed in 2013 using “bottom up” approach
- EPA estimates 254 million tons MSW in 2013 using “material balance” approach
- Approximately 220,000,000 total tons (~600,000 TPD) of MSW disposed at landfills in 2013... diverting this material would provide...
  - Nation-wide *investment opportunity of \$120 billion*
  - *50,000 jobs created across the country*



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## Cost of Collection and Disposal

- Collection
  - Residential solid waste : \$10 - \$40 USD\$ per month per household
  - Residential recycling \$2 - \$4 per month per household
- Commercial waste
  - Charged on a per month per box basis, and may include a separate pass-through cost for disposal charges.
  - 2 cubic yard box serviced once per week = \$60 - \$140 per month
  - 6 cubic yard box serviced once per week = \$130 - \$280 per month
- WTE tipping fee: \$68 per ton
- Landfill tipping fee: \$50.60 per ton
- Costs and revenues affected by:
 

Community size

Government structure

Politics

Facilities used

Waste supply agreements

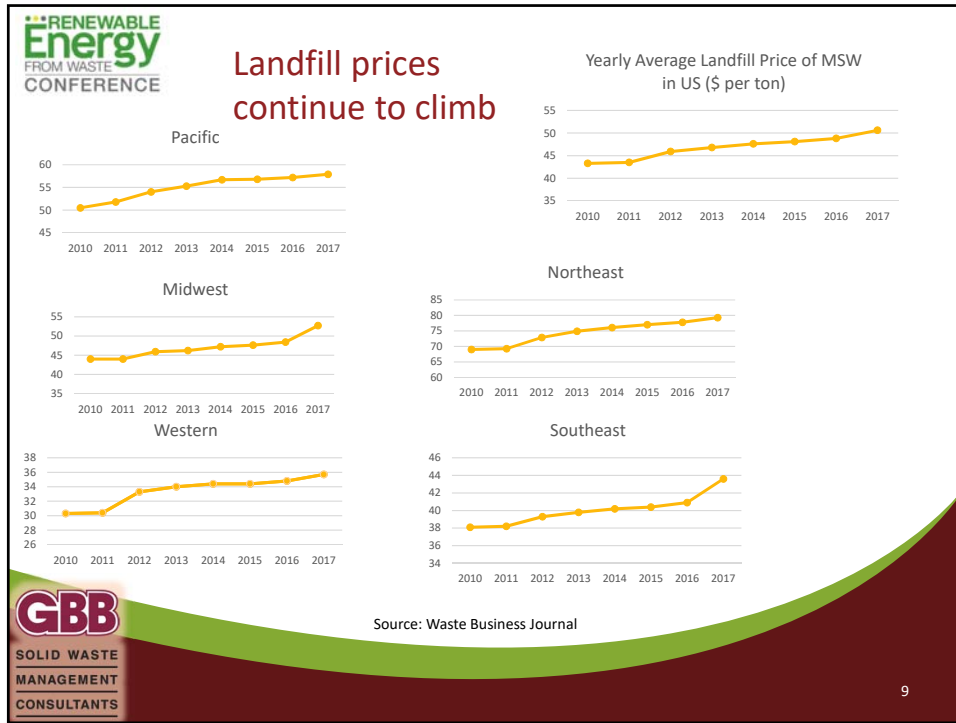
Revenue sharing back to customer



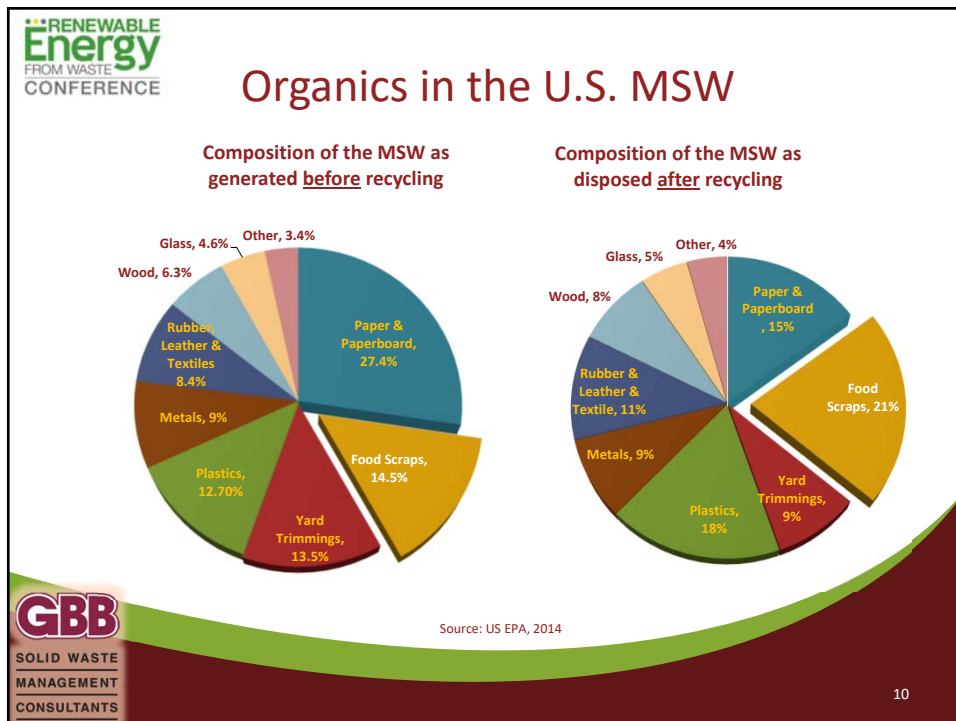
Cost of collection and disposal broken down by service



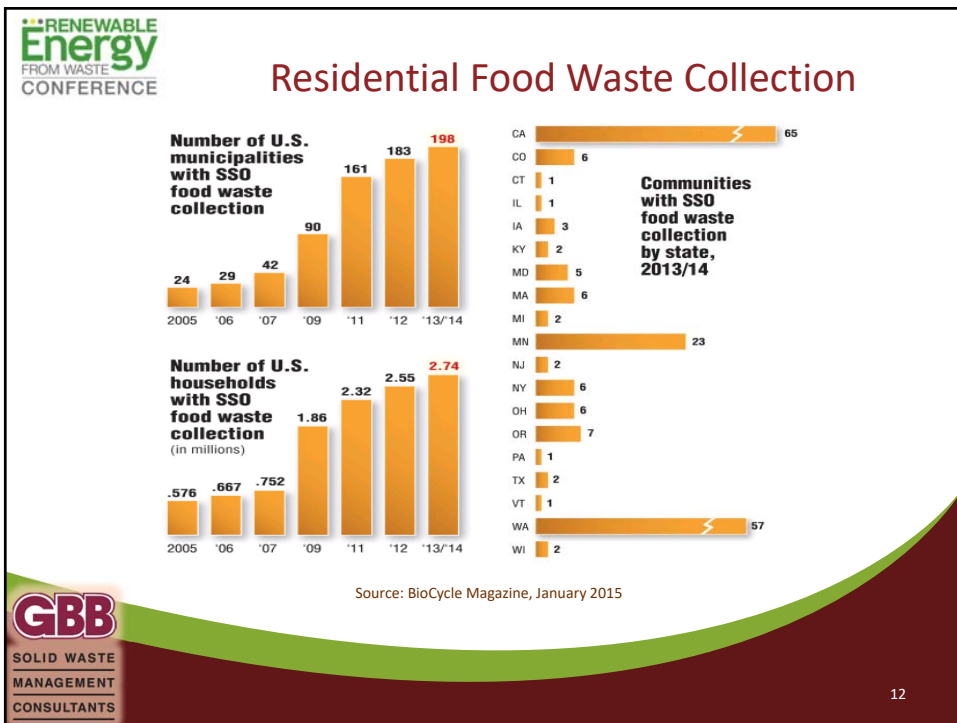
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### State Legislative Highlights

- Minnesota** – State goal of 75% diversion; Hennepin County, populations greater than 10k must divert food from landfill
- Oregon** – Metro County voting to require schools/commercial food operations to divert food waste from landfill starting 2019.
- California** – SRF/RDF does NOT count as diversion; \$24M grants to organics; 75% diversion target
- New Jersey** – S-3027: Reduce FW 50% by 2030; S-771: Large FW generator within 25 miles of authorized organics recycling facility must divert material for processing.
- Massachusetts** – ban on disposal of food and yard waste, policies to encourage growth of AD
- New York** – NYC Voluntary residential organics collection rollout, \$34 million RFP issued for compost operations in NYC
- Vermont** – Universal Recycling Act requires diversion of food waste, yard waste, and wood debris from landfill, continued EPR and e-waste laws
- Rhode Island** - beginning Jan. 1, 2016, required separation of organic waste including food scraps and composting or other beneficial reuse
- Connecticut** - Ban of commercial food waste from landfills for generators of two or more tons of food waste
- Florida** – Waste-to-energy is considered recycling

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## Energy Transitions

- Shift from Coal to Natural Gas
- Newly installed natural gas infrastructure can benefit existing WTE
- Biogas-electricity (Anaerobic Digestion)
- Big question: Will governments continue to treat RDF/SRF and WTE as “Renewable Energy”?

**U.S. electric generating capacity increase in 2016 was largest net change since 2011**

U.S. utility-scale electric capacity additions and retirements (2002-16)  
in gigawatts

**UK Monthly Coal Consumption**

**Natural gas pipeline projects lead to smaller price discounts in Appalachian region**

Daily natural gas spot prices at selected hubs (Jan 2014 - Jul 2017)  
dollars per million British thermal units

**TWh of Electricity**

Gas this year will supply 35% of U.S. electricity, compared to 30% for coal. This is a dramatic reversal, considering that in the mid-2000s coal accounted for over 50% of U.S. electricity and gas was under 20%.

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Source: EIA, Carbon Brief

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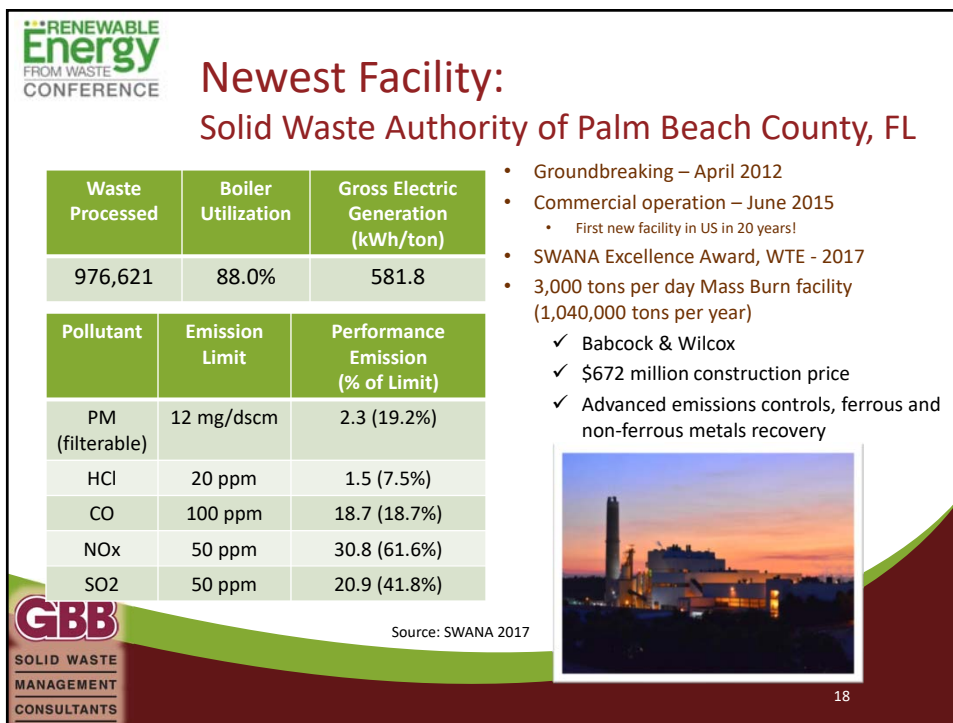
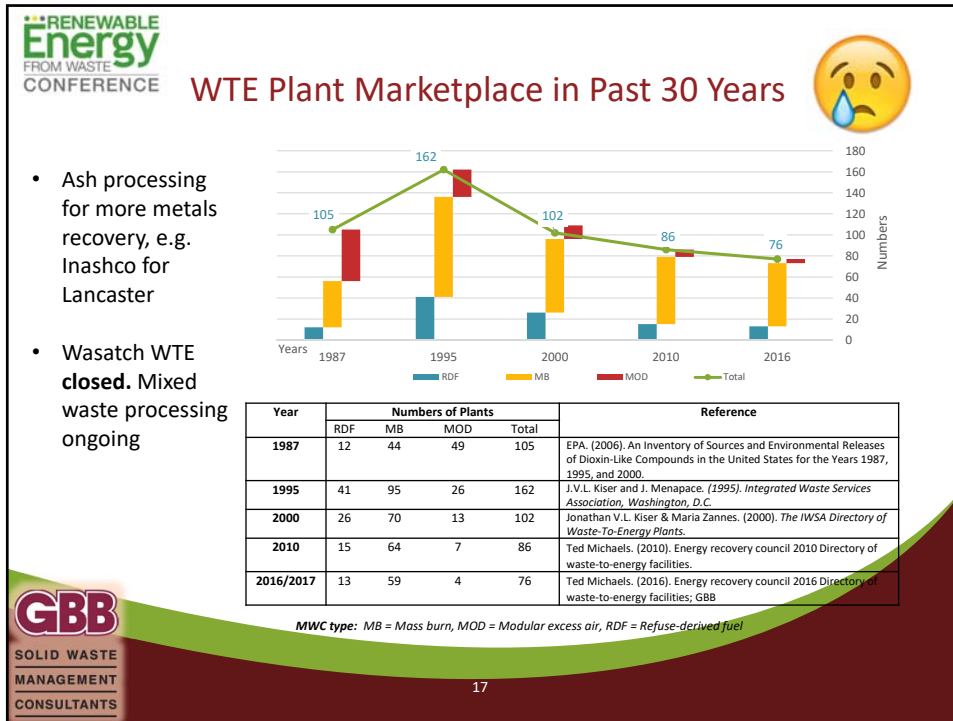
## Mass Burn/Dedicated Boilers

- Excess air for complete combustion
  - Starved air with some modular mass burn
- Products: steam, power, hot water, and/or chilled water; also metals, aggregates, and ADC
- Feedstocks
  - MSW
  - Special wastes
  - Biosolids

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## Anaerobic Digestion/Composting

- Biological decomposition of the organic material in absence of oxygen
- >20 commercial plants that take source separated organics
- Feedstock: Commercial food waste, residential SSO, co-digestion at WWTP and farms
- Two main type: high solids AD and low solids AD




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### CR&R – Perris, CA Anaerobic Digestion

- \$100 million facility
  - 84,000 TPY operating;
    - 335,000 TPY planned capacity
  - High solids anaerobic digestion system
  - Feedstock: residential food scraps and yard waste, and commercial food waste
  - Generating CNG to fuel truck fleet



### Blue Sphere – Charlotte, NC Anaerobic Digestion

- \$27 million facility
  - Operational in Q4 2016
  - 156,000 TPY capacity
  - Food waste and animal waste
  - Generating electricity and soil amendment



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Source: GBB





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## Gasification

- Partial combustion in an air-controlled environment
- Product: Syngas for production of electricity, chemicals/ fuels (ethanol)
- Feedstocks
  - Engineered fuel from MSW
  - Biomass
  - Agricultural waste

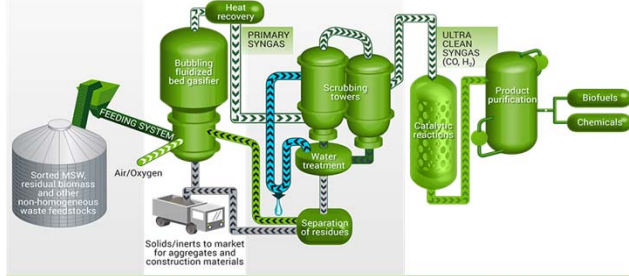


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## Enerkem Process

Feedstock preparation	Gasification	Cleaning and conditioning process	Catalytic synthesis and product purification
Sorting, shredding, drying (if required) and feeding	Conversion of carbon-rich residues into synthetic gas	Primary syngas purification	Conversion of chemical-grade syngas into final renewable products



\* Municipal solid waste



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

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

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## PLASCO CONVERSION TECHNOLOGIES

- Formerly Plasco Energy Group; new owner
  - 2011: contracted with City of Ottawa to build & operate 110,000 ton per year MSW plant
  - Had commercial-scale demonstration, 94 ton per day plant in Ottawa
  - Gasification followed by plasma torches to refine the syngas product
- Now focused on selling technology to municipalities with existing MSW facilities

**Plasco rising from the ashes? Waste-to-energy company looks to make comeback**

VITO FILICEI, OTTAWA CITIZEN  
More from Vito Filice, Ottawa Citizen

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## Plastic to Oil Technologies

- Thermal conversion in the absence of oxygen
- Non-recyclable plastics to oils, fuels
- Plastics-to-Oil Technologies Alliance formed by ACC

Source: RES Polyflow









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## Processing Technology Vendors

















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## Montgomery, AL – Ininitus

- High-tech 80,000 square feet “state-of-the-art” Mixed Waste Processing Facility
- \$35 Million capital cost
- First “One Bin for All” in 21<sup>st</sup> Century in the U.S.
- Bulk Handling Systems Process
  - One-line, 40 ton per hour input for 100,000 tons per year
  - 60 % material recovery guarantee (including organics)
- Commercial operations began April 2014
- Closed October 2015
- Heading to Bankruptcy; City of Montgomery, AL offering to purchase for ~\$625,000




Source: GBB 2014

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## Berkeley County, WV MBT Facility

- Uses High Efficiency Mechanical Biological Treatment (HEBioT) process
  - Front end sorting of MSW to remove high value recyclables
  - Remaining material is processed by mixed waste composting to create Solid Recovered Fuel (SRF)
- SRF marketed to cement kilns valued at ~\$30/ton
  - EPA approved alternative to coal to reduce emissions
- Under Construction -- Commercially operable April 2018

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### Hampden, Maine - Anaerobic Digestion/Enzymatic Hydrolysis Plant

- Mechanically separates MSW for processing into various bio-fuels
  - Front end separation of recyclables
  - Anaerobic digestion of soluble organics produces biogas
  - Enzymatic hydrolysis of cellulose organics produces high value sugars
  - Lignin, non-recyclable plastics → engineered fuel
- Design capacity: 600 tons per day
- Will serve residential and commercial waste stream from 83 communities
  - \$72 per ton tipping fee
- Construction started Spring 2017
- Operational Spring 2018






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### Energy/Fuel Product Values Versus Capex

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



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## State of WTE in Europe

- 400+ WTE plants across Europe processing over 100 million tons
- 27% of waste in EU processed via WTE
- UK plans to phase out coal by 2025; additional WTE projects in planning stage

**UK facility will convert MSW to biogas**  
Baxlund International will provide technology to the waste-to-energy plant.  
September 5, 2017  
Waste Today Staff

**Company plans £200 million waste facility to power 45,000 homes**  
People in Cardiff get their energy being recycled to have their way on plans for a new £200 million waste treatment plant.

**France: Veolia wins €295m EFW facility deal**  
14 March 2017 Be the First to Comment


**CVW & Veolia Join Forces on 50MW UK Waste to Energy Plant**  
New Jersey based waste to energy firm, Covanta and French environmental services company, Veolia are joining forces, to develop the 50 MW Energy Recovery Facility at Rookery South Pit near Stewartby, Bedfordshire, UK.

**New Cardiff-based Waste Plant Which Creates Green Energy from Food Waste Officially Opens**


**MVV secures permission for Dundee ERF**  
Dundee City Council has granted planning permission for the development of an energy recovery facility to be operated by the Dundee-based waste company MVV Environmental Services.

Country	Number of WTE plants	Tons processed (millions)
Austria	11	2.76
Belgium	18	3.75
Czech Republic	3	0.73
Denmark	26	4.35
Finland	9	1.3
France	126	16.2
Germany	99	27.56
Italy	40	6.72
Netherlands	12	8.35
Portugal	4	1.26
Sweden	33	6.2
Switzerland	30	4.29
Spain	12	2.76
UK	37	9.35

Source: CLWEP, 2016



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## Many WTE Developments in Asia

- Vietnam opens first WTE plant – 7.5 MW (Hitachi Zosen)
- India: RFP for 100 WTE facilities to be proposed
  - Currently 287 MW of WTE installed
- Singapore approved \$470 million loan for WTE
  - 3,600 tons per day, 120 MW
- Israel opens first RDF plant in Recycling Park
- Malaysia, Philippines, Indonesia, many others expressing interest

**Bengaluru may get 2 waste-to-energy plants in two years**  
Aparajita Ray/TNN Updated: May 2, 2017, 12:46 IST


**Karadiyana Waste to Energy Project Inaugurated With Fairway Waste Management**  
2017-08-25 10:44:45

**Cebu City to establish waste-to-energy facility**  
By Odessa O. Leyson (The Freeman) | Updated March 13, 2017 - 12:00am  
CEBU, Philippines - The Cebu City Government is now working on the establishment of a waste to energy (WTE) facility for the controversial Inayawan landfill in order to solve the city's garbage disposal problem.

**Indonesia, Finland Develop Waste to Energy Project**  
TNN Updated: June 21, 2017, 07:00 AM  
#DewiCA - Jairo W. de Neve  
TEMPO.CO, Jakarta - The Indonesian and Finnish governments are exploring opportunity to cooperate in developing waste to energy project. Earlier, Finland has invested in the same program in Jakarta via city-owned PT Jakarta Projectsindo.

**2 companies set to generate 25MW each from waste**  
THE TIMES OF INDIA CITY  
TNN | Updated: Mar 21, 2017, 07:30 IST

**ISRAEL TURNING GARBAGE DUMP INTO ENERGY RESOURCE**  
+ WMO ratings for air pollution levels lists to be as relatively high.  
on Sunday October 1 / October 21, 2017 09:19  
Officials inaugurated a refuse derived fuel (RDF) plant at the Herta Recycling Park - a waste sorting and recycling plant that sits at the feet of the city's towering former garbage dump.



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## Developments in China

- Subsidizing Anaerobic Digestion for farmers
- Asian Development bank investing \$100 million in Chinese WTE projects
- Rapid pace of development
- Rising middle class
- China has had enough of our waste, must now also address their own
  - National Sword
  - NIMBY!

As China Pushes Waste-to-Energy Incinerators, Protests Are Mounting



**This Massive Waste-To-Energy Plant Will Be The Largest In The World**

Stretching nearly a mile across and complete with a visitor's center, the new incinerator will tackle China's growing trash problem.

Locals Fired Up Over China's Largest Waste Incinerator

€1.5 BILLION WASTE TO ENERGY DEAL LARGEST CHINESE INVESTMENT IN GERMANY

**Chinese Investors to Acquire German Firm EEW Energy from Waste**

Global private equity group, EQT Infrastructure II, has reached an agreement in principle to sell German waste to energy firm EEW Energy from Waste (formerly E.ON Energy from Waste) to Beijing Enterprises Holding for nearly €1.5 billion.

ENVIRONMENT AUGUST 26, 2017 2:43:08 AM 7 A MONTH AGO

**Energy hogs: China targets farm waste as a 'clean' power source**



EVERBRIGHT'S 36 MW WTE PLANT FIRST TO FEATURE CHINESE BUILT GRATE

**1500 TPD Waste to Energy Project Completed in Wujiang, China**

China Everbright International has completed construction of the 1500 tonne per day Wujiang waste to energy project in Jiangsu Province and commenced operations.

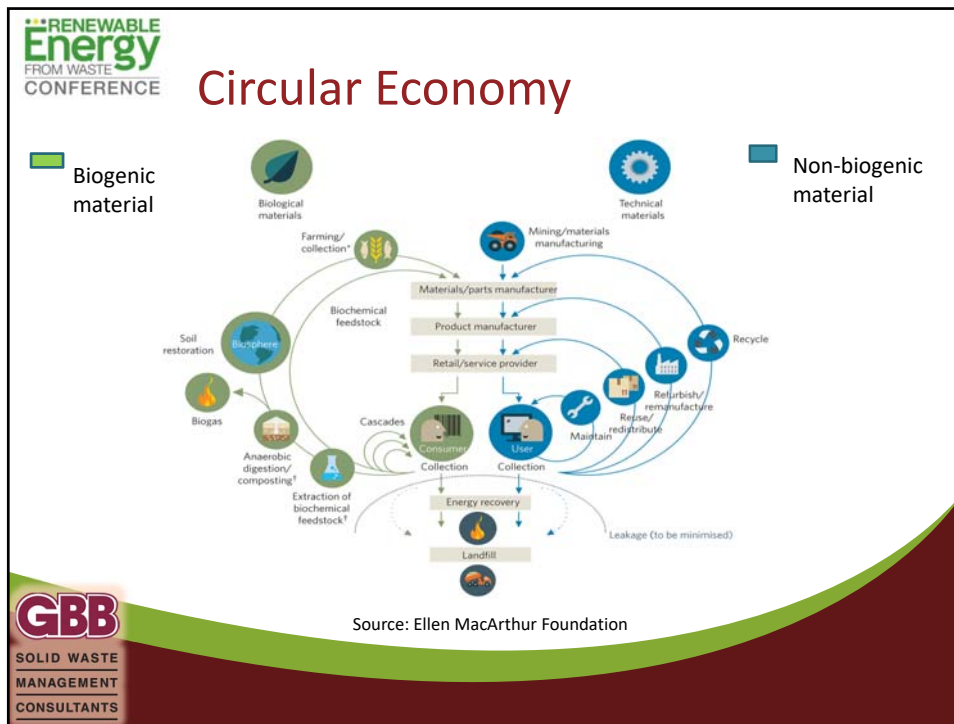
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# TRENDS, EXPECTATIONS, AND OPPORTUNITIES FOR THE FUTURE



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- ## Trends Ahead
- U.S.: boundless landfill capacity at reasonable prices
  - Continued lowering of energy revenues unless subsidies/grants
  - Food waste and organics interest significant – anaerobic digestion and composting expanding
  - Collections changes for efficiency: technology in containers, trucks, and back office; franchising; and bio-CNG and clean diesel fuels
  - Resource Parks added to integrated waste systems for domestic circular economy
  - ‘Environmentalists’ and ‘Zero Waste’ advocates promoting policy and recycling only alternatives
  - International: WTE growing fast, especially in China; China also developing its domestic supply of recyclables will hurt recycling markets in U.S.
- Waste is very recyclable and it is also very renewable!**  
**A lot less waste to landfills is better!**  
 “If it is not recyclable, not organic, *what is it...* It’s fuel!”
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***Thank you!***

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