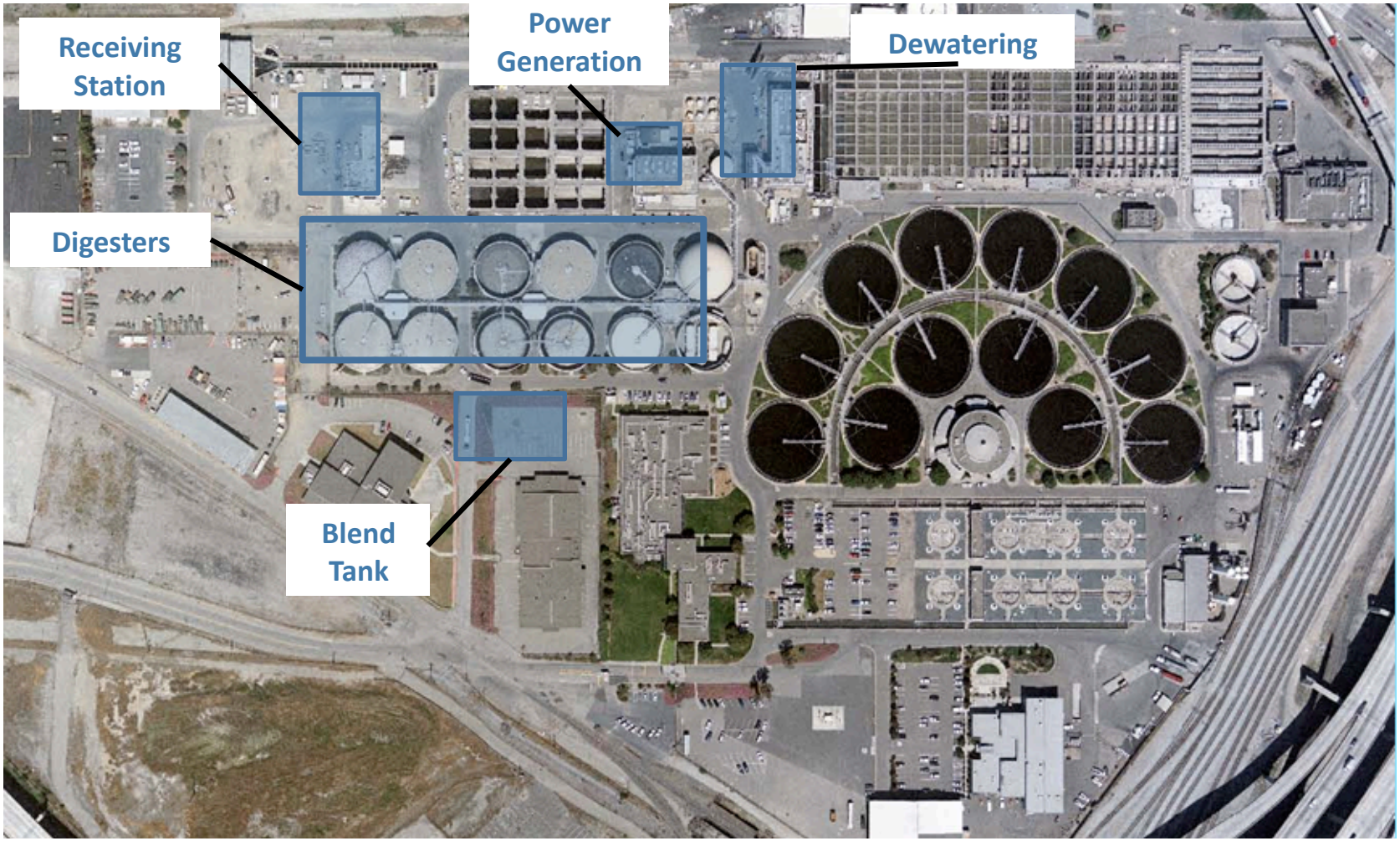
Food Waste Digestion at East Bay Municipal Utility District, Oakland, CA

Natalie Sierra / Ned Beecher



Overview: EBMUD food waste digestion

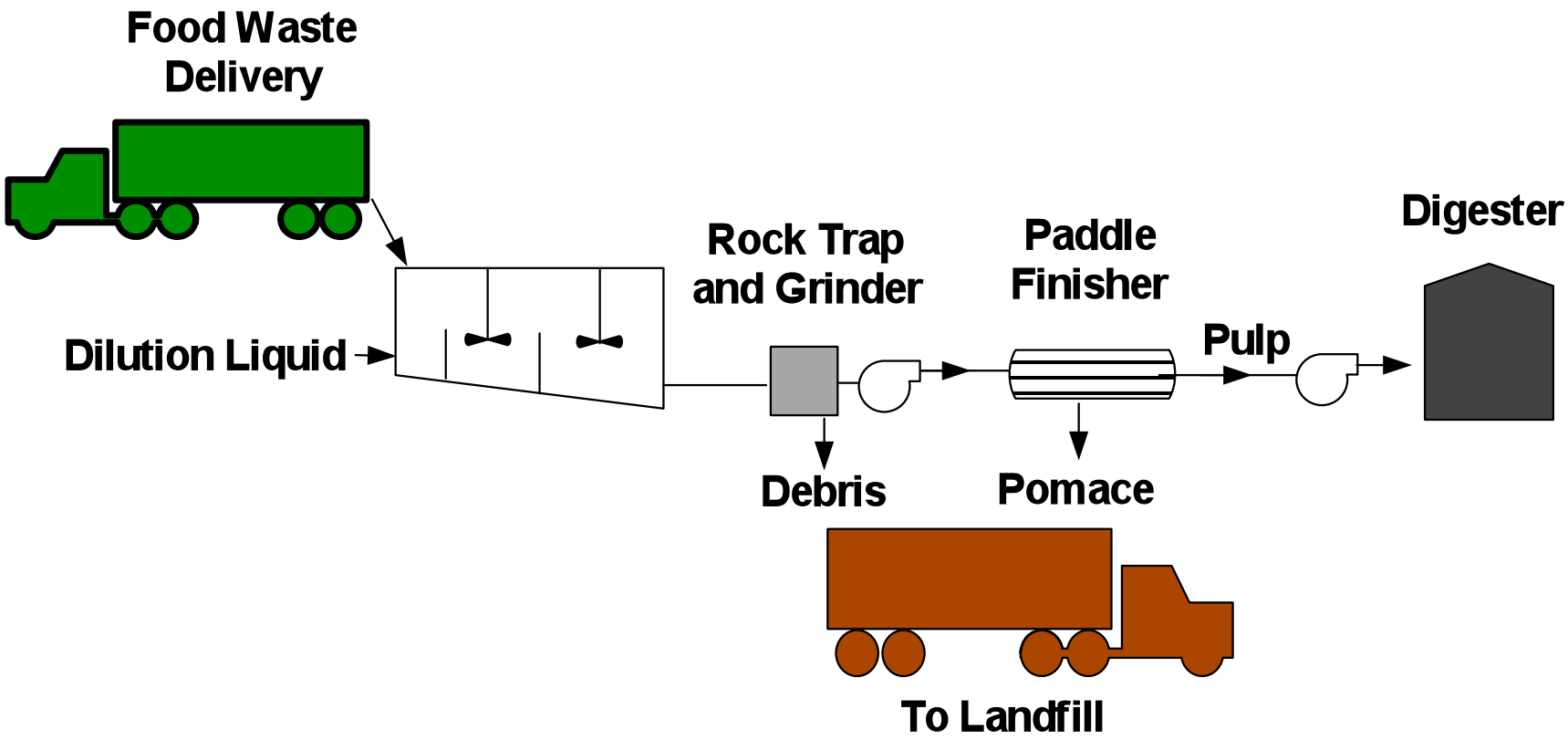
- EBMUD treats wastewater from 7 cities
- Food waste, FOG, and other high-strength wastes are trucked in and co-digested with primary & secondary wastewater solids
- In 2010, at the EBMUD wastewater facility
  - 90% of electricity needs provided from EBMUD biogas
  - Almost $3 million saved in electric power demand
- Winter 2012: EBMUD wastewater facility became a net electricity producer, (new turbine went online).
- EBMUD also has solar & hydropower installations

http://www.ebmud.com/our-water/wastewater-treatment/wastewater-energy

2010 EBMUD Net Renewable Power Production

144,818 MWh	Hydropower generated
640 MWh	Solar power generated
36,900 MWh	Biogas power generated
182,358 MWh	**Total renewable energy produced by EBMUD**
81,500 MWh	Power purchased from the grid by EBMUD
100,858 MWh	**Net renewable energy produced by EBMUD**

EBMUD Pretreatment Process



** Patented Process*

Photographs from EBMUD Presentation at www.bacwa.org

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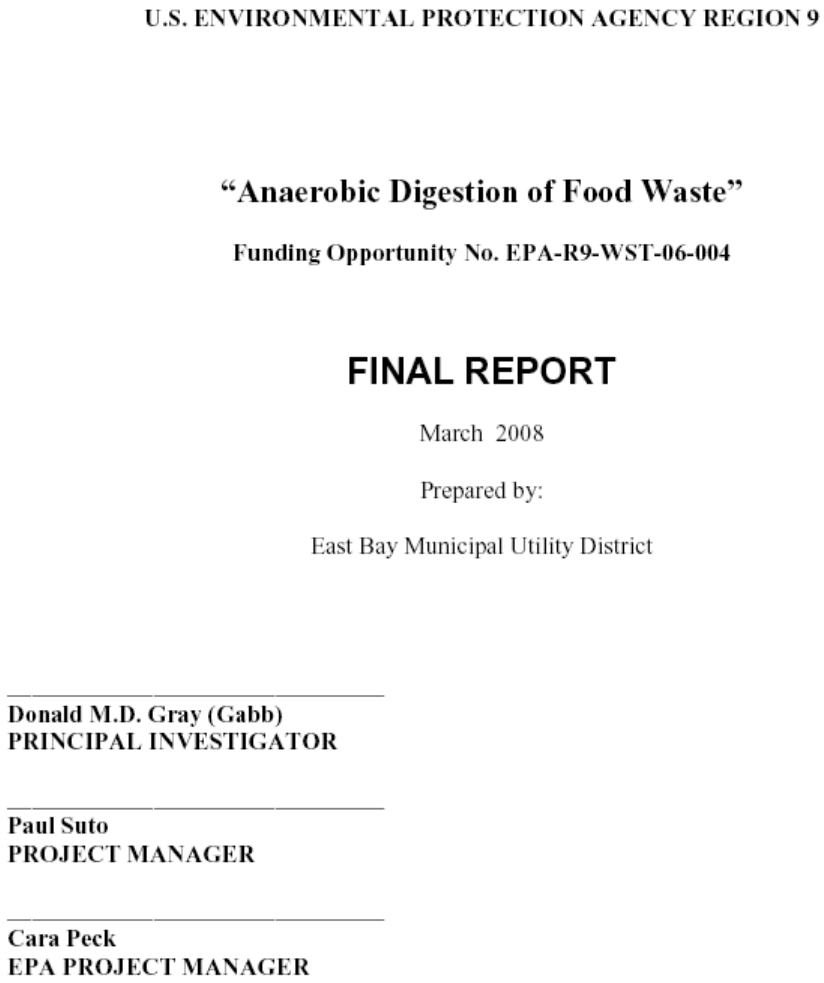
Photograph from EBMUD Odor Control Master Plan, CH2M Hill (2009)

Key for rapid, thorough digestion: consistent pulped waste

EPA-Funded Research on Food Waste Digestion at East Bay MUD

- Evaluation of food waste digestion vs. municipal ww solids digestion
- Bench scale
- Evaluated:
  - Minimum MCRT
  - VS & COD loading
  - VS destruction
  - CH_4 production rates
  - Process Stability
  - Meso & thermo AD operating temperatures



U.S. ENVIRONMENTAL PROTECTION AGENCY REGION 9

"Anaerobic Digestion of Food Waste"

Funding Opportunity No. EPA-R9-WST-06-004

FINAL REPORT

March 2008

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EPA United States Environmental Protection Agency

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Turning Food Waste into Energy at the East Bay Municipal Utility District (EBMUD)

EBMUD Project Home | Food Waste | Food Waste at Wastewater Facilities | EBMUD's Process | EBMUD Study

EBMUD Helps Mitigate Climate Change Through Anaerobic Digestion

Fact: Food Waste Contributes to Climate Change

Food waste is one of the least recovered materials in the municipal solid waste stream and is one of the most important materials to divert from landfills. Food that is disposed of in landfills decomposes to create methane, a potent greenhouse gas that contributes to climate change.

- More about the importance of diverting food waste from landfills

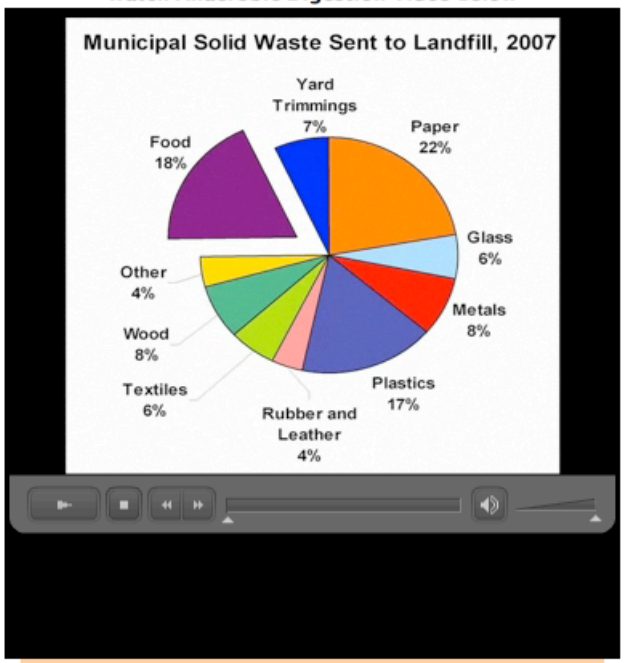
Fact: Food Waste Can Be Transformed Into A Natural Fertilizer

Of the less than 3% of food waste recovered from the waste stream, composting is the prominent diversion method. Composting, either in your backyard or in a commercial facility, creates a natural fertilizer with many beneficial qualities.

- More information on composting

Fact: Food Waste Can Be Used to Generate Renewable Energy

Watch Anaerobic Digestion Video Below



Join the Discussion

Greenversations Question:

http://www.epa.gov/region9/waste/features/foodtoenergy/index.html

Findings

Compared to wastewater solids, food waste…

- produces as much or more energy / ton of processed material fed into digesters
- Food waste digestion happens at a quicker rate
- VSD = 70 to 80% (compared to ~50 – 60% for wastewater solids)
- Food waste AD produces ~1/2 the residuals (by weight)
- MCRT of 15 days for food waste maximizes CH_4 concentration (65 – 70%), but 10 days is OK too
- In short: food waste is more readily biodegrabable

Table ES-1. Energy Benefit Comparison of Anaerobically Digested Food Waste and Anaerobically Digested Municipal Wastewater Solids.

Parameter	Unit	Food Waste 15-day MCRT AVG (Range)	Food Waste 10-day MCRT AVG (Range)	Municipal Wastewater Solids 15-day MCRT AVG (Range) [5]
Methane Production Rate	ft^3/dry ton applied[1]	13,300 (9,800 – 17,000)	9,500 (6,600 – 14,400)	10,000 (7,500 – 12,600)
	ft^3/wet ton delivered[2]	3,300 (2,500 – 4,300)	2,400 (1,700 – 3,600)	NA[6]
	m^3/ dry metric ton applied[1]	420 (300 – 530)	300 (200 – 450)	310 (230 – 390)
	m^3/wet metric ton delivered[2]	100 (75 – 135)	75 (50 – 110)	NA[6]
	ft^3 per day/ 1,000 ft^3 digester volume	2,300 (1,100 – 3,200)	2,600 (1,800 – 3,800)	750 (550 – 930)
Electricity Production Rate[3]	kWh/dry ton applied[1]	990 (730 – 1,300)	710 (490 – 1,080)	750 (560 – 940)
	kWh/wet ton delivered[2]	250 (190 – 320)	180 (130 – 270)	NA[6]
	kWh/dry metric ton applied[1]	1,100 (800 – 1,400)	780 (540 – 1,190)	830 (620 – 1,040)
	kWh/wet metric ton delivered[2]	280 (200 - 350)	200 (140 - 300)	NA[6]
	kWh per year/ 1,000 ft^3 digester volume	43,700 (21,300 – 62,100)	57,000 (43,000 – 73,700)	14,600 (10,700 – 18,000)
Household Energy Equivalent Rate[4]	households/year/ 100 tons/day	1,100 (800 – 1,400)	800 (550 –1,200)	NA[6]
	households/year/ 100 metric tons/day	1,200 (880 – 1,500)	880 (600 – 1,300)	NA[6]
	households per year/ 1,000 ft^3 digester volume	7.3 (3.6 – 10.3)	8.4 (5.8 – 12.3)	2.4 (1.8 – 3)

Notes:
1. Dry ton applied refers to food waste solids applied to the digesters after processing a wet ton delivered load.
2. Wet ton delivered refers to food waste tonnage (including water) delivered by the hauler prior to processing.
3. Calculated based on 1 ft^3 CH_4 = 1,000 BTUs and 13,400 BTUs = 1 kWh.
4. Calculated based on 2001 EIA residential energy survey for CA where average household energy use is 6,000 kWh annually.
5. Based on data from previous EBMUD bench-scale pilot study. Digesters were fed thickened waste activated sludge and screened primary sludge.
6. Data is not typical of municipal wastewater solids loading to digesters.
7. For annual data, 100 tons/day food waste assumes processing at 5 days per week, 52 weeks per year.
8. For annual data, it is assumed municipal wastewater solids loading occurs 5 days per week, 52 weeks per year.
9. A typical food waste load delivered weighs approximately 20 tons, and has a 28% TS content.
10. Approximately 10% of the delivered food waste as total solids (TS) mass is discharged in reject stream.
11. Data range presented is from stable digester operating periods for both mesophilic and thermophilic digesters.

12 .AVG– Average. NA–Not Applicable.

Food Waste vs. Wastewater Solids Comparison		
Parameter	**Food Waste Pulp**	**Wastewater Solids**
Volatile Solids in Feed (%)	85–90	70–80
Volatile Solids Loading (lbs/ft3–day)	0.60 +	0.20 max
COD Loading (lbs/ft3–day)	1.25 +	0.06–0.30
Total Solid Fed (%)	10 +	4
Volatile Solids Reduction (%)	80	56
Hydraulic Detention Time (days)	10	15
Methane Gas Produced ($meter^3$/ton)	367	120
Gas Produced (liters/liter of digested volume)	58	17
Biosolids Produced (lbs/lbs fed)	0.28	0.55

TIPPING POINT: Resource Center for Converting Wastes into Products and Energy

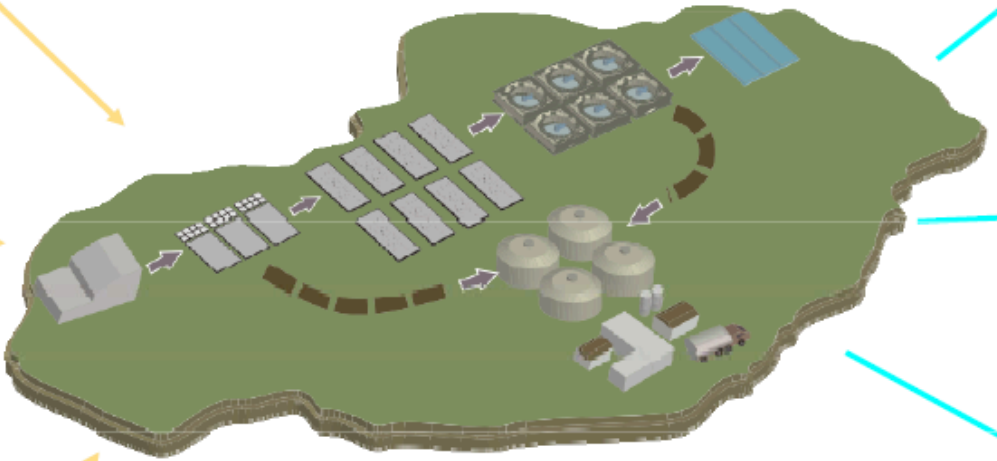
(After D. Parry, CDM)

Fuel

Wastewater

Reclaimed Water

Food Waste



Energy (Heat, Power)

Resource Center

FOG

Other Organic Waste

Biosolids (Fertilizer)