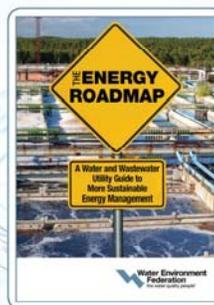


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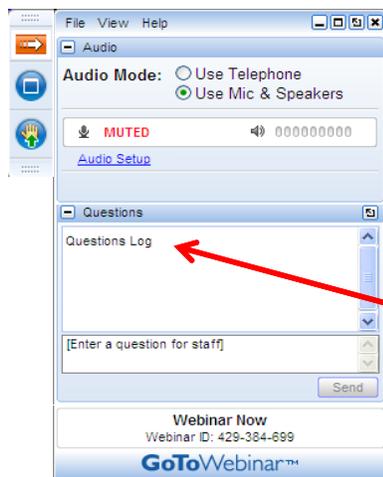


Wasted Food to Energy: How Five Water Resource Recovery Facilities are Boosting Biogas Production and the Bottom Line

April 15th, 2015
1:00 - 3:00 pm Eastern



How to Participate Today



- **Audio Modes**
 - Listen using Mic & Speakers
 - Or, select "Use Telephone" and dial the conference (please remember long distance phone charges apply).
- Submit your questions using the Questions pane.
- A recording will be available for replay shortly after this webcast.



Welcome!



Moderator:
Sarah Deslauriers, P.E.
sdeslauriers@carollo.com

Program Manager, California
Wastewater Climate Change Group

Chair, WEF Residuals & Biosolids
Carbon Resource & Recovery
Subcommittee



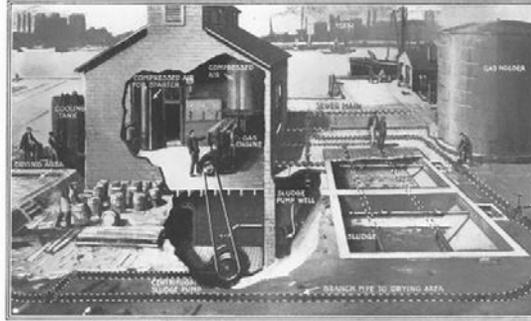
Today's Presentations

- Brief overview of Anaerobic Digestion at Water Resource Recovery Facilities (WRRF)
- Co-digestion case studies
 - East Bay Municipal Utilities District, Sophia Skoda
 - Central Marin Sanitation Agency, Jason Dow
 - Sheboygan WRRF, Sharon Thieszen
 - West Lafayette, Dave Henderson
 - Hill Canyon WRRF, Chuck Rogers
- Q & A



Overview of anaerobic digestion

March, 1922
Gas from Sewage Waste Runs City Power Plant



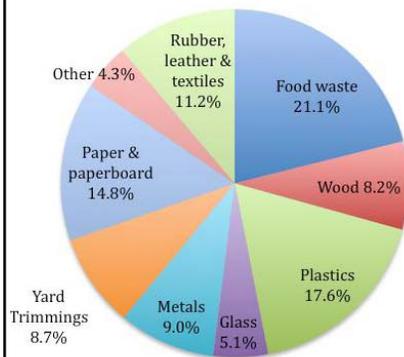
How the sewage disposal plant at Birmingham, England, supplies its own power is described in the illustration. Gas from the sewage drives an engine of 20 brake horsepower, which operates a centrifugal sludge pump.

Biogas to energy project in Birmingham, England (Popular Science Monthly, March 1922)

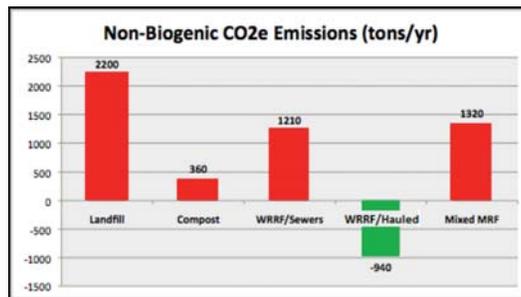
- Wastewater treatment = 0.8% U.S. electricity use
- Electricity is one of the largest \$'s for POTWs
- WRRFs can be net-producers of energy
- 1,238 U.S. WRRFs use anaerobic digestion & 85% beneficially use biogas; 22% generate electricity



Managing waste more sustainably



MSW by percentage after recycling & composting (U.S. EPA, 2014)



Carbon footprint of food waste options (WERF, 2012)



Links to resources

- U.S. EPA's Food Waste to Energy paper:
 - www.epa.gov/region9/organics/ad/epa-600-R-14-240-food-waste-to-energy.pdf
- WEF Webcast site:
 - <http://www.wef.org/WastedFoodtoEnergy/>



Sheboygan Regional Wastewater Treatment Facility



Sharon Thieszen
Superintendent, Sheboygan Regional WWTF



Sheboygan Regional WWTF's Fifty Shades of Green

A Cleaner Ending to a Filthy Waste

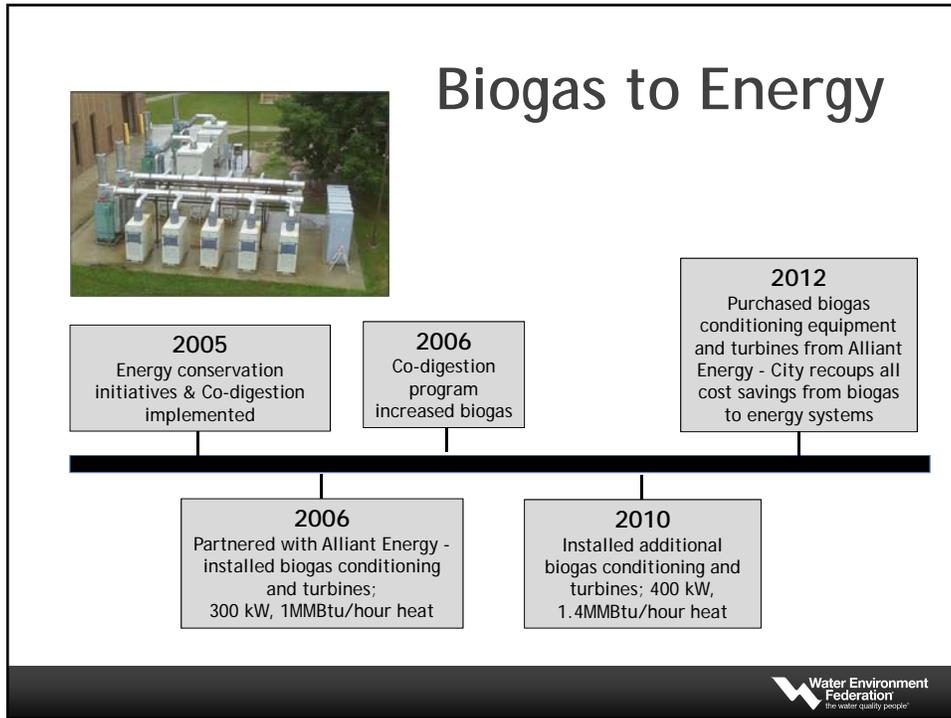


Sheboygan Regional WWTF



- 7 Communities, Western Shore of Lake Michigan
- Population 68,000
- 18.4 MGD Average, 56.8 MGD Max
- 10 MGD Average Daily Flow
- Activated Sludge with Biological P Removal and backup Ferric Chloride Addition
- Anaerobic Co-Digestion, Biogas Recovery, and Combined Heat & Power
- Liquid Storage of AD Biosolids and Biosolids Drying & Storage
- \$4.7 Million O&M Budget
- 2013 ACEC Engineering Excellence Grand Award - Net Zero Energy





Initial CHP Generation Project



- 10–30 kW Capstone Turbines
- 2 Cain Heat Exchangers
- Unison Gas Conditioning
- 300 kW Electrical Power
- 1 MMBtu per hour heat recovery
- Electricity and heat produced is used onsite to power equipment and heat the digesters and plant buildings in the winter

Alliant Energy-Wisconsin Power & Light funded the turbine project and recovered costs through the sale of generated electricity to the WWTF

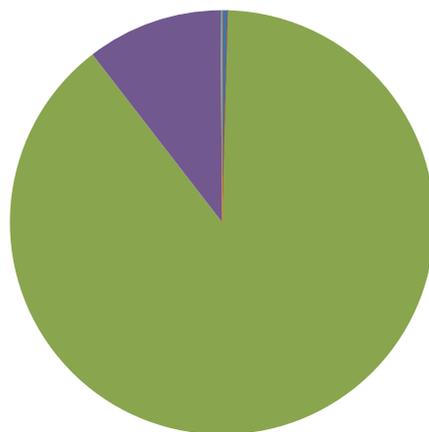


Co-Digestion Program Implemented



- Repurposed Existing Unused Digesters
- Predominately Dairy Waste
- Tanker Trucks 24/7 Access
- 6000 gal/load

Types of HSW



- Grease Trap (Industrial)
- Food Additives
- Whey Processing
- Cheese Processing
- Ethanol Processing Waste
- Urea

HSW Receiving & Feeding

HSW Unloading

A photograph showing green hoses connected to a metal structure on a concrete pad next to a red building.

In-line Strainer

A close-up photograph of a cylindrical metal in-line strainer with a red band around it.

HSW Feed Pump

A photograph of a blue and silver industrial feed pump with various pipes and valves.

 Water Environment Federation
the water quality people

Second CHP Generation Project

A photograph of several green and grey industrial turbines with exhaust pipes.
A photograph of industrial heat exchangers and piping inside a facility.

- 2–200 kW Capstone Turbines
- 2 Cain Heat Exchangers
- Unison Gas Conditioning
- 400 kW Electrical Power
- 1.4 MMBtu per hour heat recovery
- Allowed Beneficial Use of Excess Biogas

 Water Environment Federation
the water quality people

Biosolids Storage Requirements

- NR 204 Requires 180 day biosolids (winter) storage
- Increase in biosolids production attributable to HSW program
- 10.08 MG required; 5.96 MG available
- Alternatives considered to expand biosolids storage capacity
 - Minimal additional liquid storage & eliminate HSW receiving program
 - Large scale liquid storage
 - Liquid storage & drying

Biosolids Process Improvements

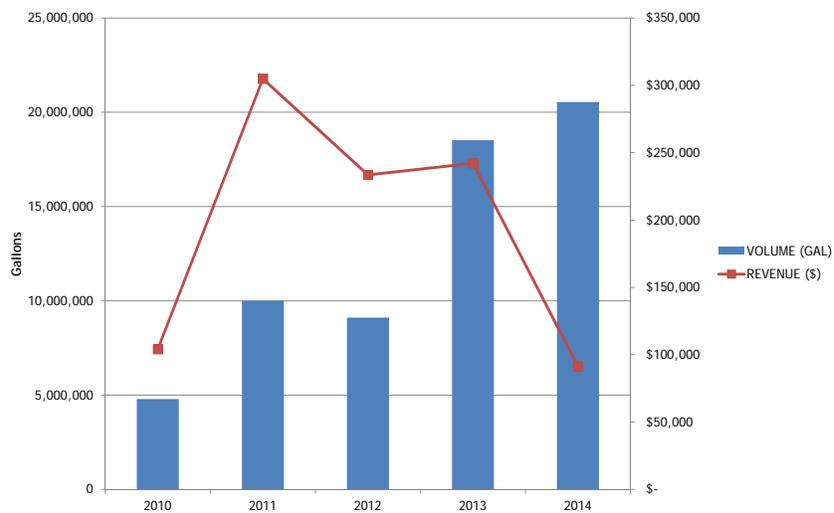


10 Years of HSW Program

- Process 60,000 gpd High Strength Waste
- Biogas Produced: 500,000 ft³/day
- Biogas Quality: 65% Methane
- Equipment Installed: 700kW Electrical Generation
- Electrical Energy Produced: 5,010,000 kWh annually (2013)
- Thermal Energy Produced: 42,000 therms annually (2013)
- Energy Savings: \$270,000 annually (2013)
\$0.05/kwh=\$250,000; \$0.51/therm=\$21,000
- CHP Program Produces: 90% Electrical Needs & 85% Heating Requirements



Volume HSW & Revenue



HSW Challenges



| CAPITAL INVESTMENTS | | | |
|---------------------|--------------------|-----------------------------|--------------------|
| Project | Project Cost | Funding Assistance | City's Cost |
| Co-digestion | \$75,000 | \$0 | \$75,000 |
| CHP Phase I | \$1,200,000 | \$899,000 Alliant Energy | \$301,000 |
| CHP Phase II | \$1,500,000 | \$205,000 Grant | \$1,295,000 |
| Total | \$2,775,000 | \$1,104,000 | \$1,671,000 |



Competition for HSW

2005

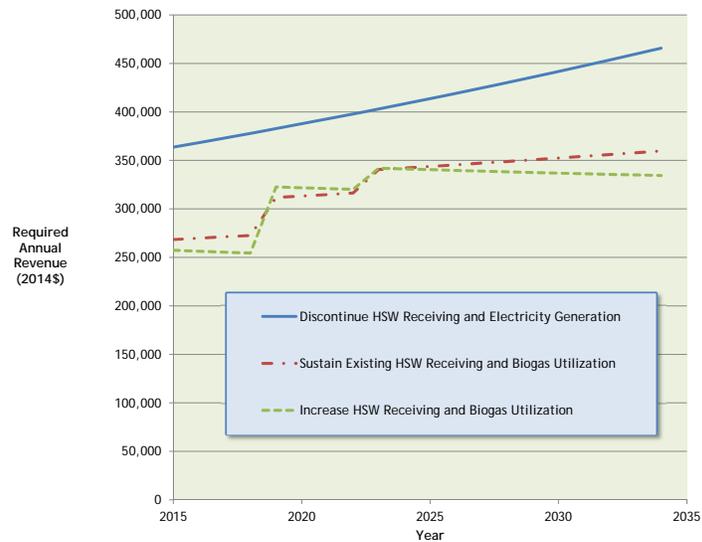
- Sheboygan only regional HSW program
- Increasing revenue from tipping fees
- Significant grant money available
- Utilized existing tank capacity

2014 - BOD Wars

- Multiple POTW co-digestion programs
- Multiple agriculture co-digestion programs
- Private co-digestion programs
- 90% HSW from one supplier
- <\$100,000 Tipping Fees
- Minimal grant money available
- Significant capital improvements to continue HSW and co-digestion
- Offset in energy costs sufficient to fund capital improvements



Future of Co-Digestion Program



Moving Forward Reducing Energy Consumption



Sharon Thieszen
Superintendent, Sheboygan Regional WWTF
sharon.thieszen@sheboyganwwtp.com
(920) 459-3964

- Team Effort
- Evaluate Energy Consumption
- Keep User Rates Low
- Continue Path to Sustainability & Being a RESOURCE RECOVERY FACILITY



East Bay Municipal Utility District Oakland, CA

Sophia Skoda
Former Resource
Recovery Program
Manager



EBMUD's Food Waste Initiative

April 15th, 2015



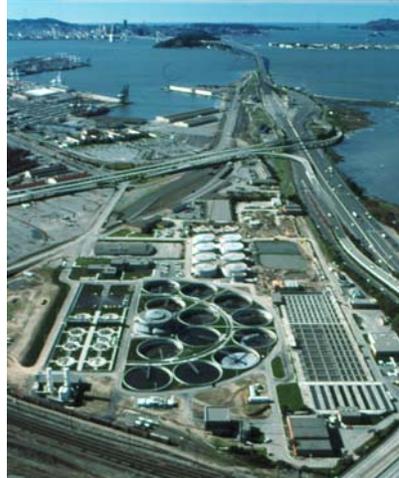
Presentation Overview

- Background
- Why Food Waste?
- Food Waste Pre-processing
- Regulatory Oversight
- Next Steps

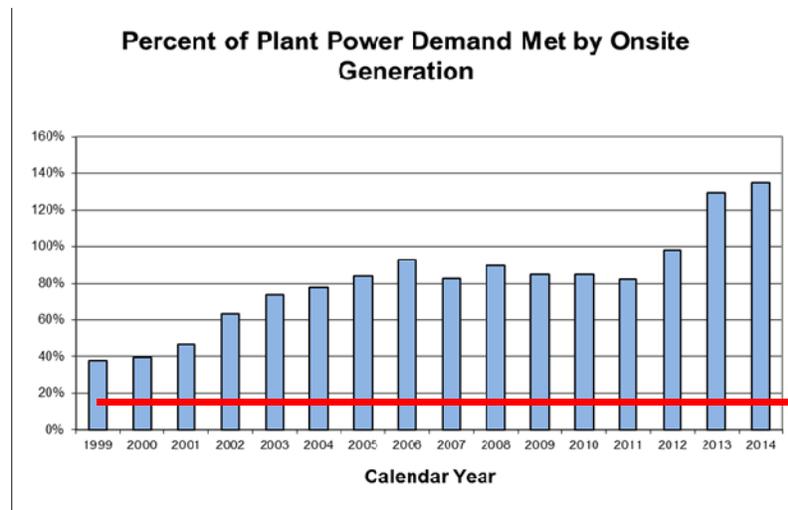


Background

- EBMUD has excess digester capacity
 - Plant originally designed to accept waste from 20 canneries in the service area
 - Now there are zero canneries
 - Capacity to treat 168 million gallons/day
 - Average influent flow is 60 million gallons/day



Background: Power Production



Background: Changing Market Conditions

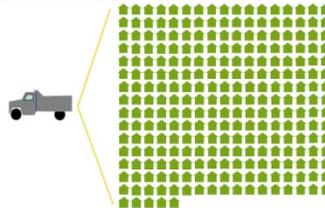
- Increasing energy prices
- Government subsidies/incentives for renewable energy initiatives
- Political focus on GHGs and Climate Change

Increased recognition from potential competitors of the energy value of organic wastes



Why Food Waste?

- High energy potential
- Represents a large percentage of solid waste stream to landfill
- Diversion from landfill through food waste digestion
- Digestion may be the highest and best use of food waste

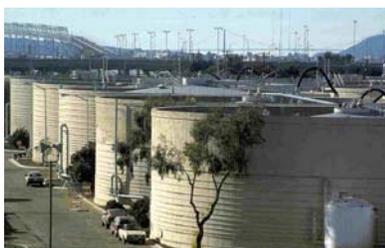


1 truck/day will power 260 homes



Why Food Waste?

- One digester can process ~ 200 ton/day of food waste
- Digester gas to be converted into renewable energy
- 200 ton/day of food waste \approx 2 MW of energy



Energy
Generation



EBMUD Food Waste Pilot History

- 2005: Begin to accept small amounts of food waste
- 2006: Reliable acceptance of 20 tons of food waste per week



- 2011: Contract signed with Recology
- 2014: Oakland votes to send commercial food waste to EBMUD

Benefits of Food Waste Digestion

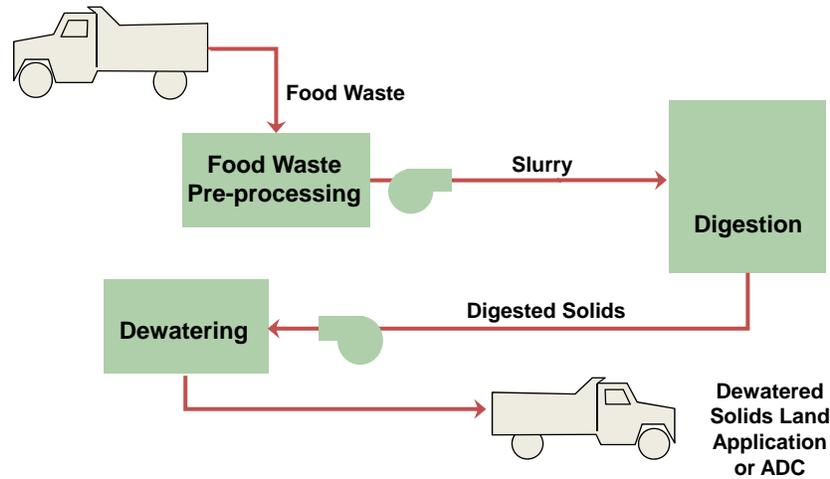
- Local and sustainable digester feed stock
- A renewable energy source
 - High energy value: 1 truck/day (i.e. 20 tons/day) will power 260 homes
 - Potential renewable energy and greenhouse gas credit opportunities
- Supports state goals:
 - CARB / AB 32 - GHG emission reductions
 - CPUC and CEC - Renewable Portfolio Standard
 - CalRecycle - Zero Waste California

Food Waste Challenges

- Contaminants
 - Nature of contamination
 - Variability in control of the waste stream
- Processing technology still evolving
- Permitting
 - No existing regulations fit
 - Current best fit: Biosolids Composting at POTW



Food Waste Processing Schematic



Pre-Processing System

- Near Term - 10 tons/day clean ground CCCSWA material ; RFP process underway for large scale facility
- Long Term - larger scale pre-processing facility ~ 200 tons/day
- Pre-processing system will produce an organic food waste slurry material for digestion and dewatering

Segregation of Food Waste

- Value in segregation of food waste from municipal biosolids
 - Polymer use
 - Isolation of impacts
 - Re-use alternatives for remaining solids
- Near Term Co-Digested Biosolids Uses
 - 50% to land application
 - 50% to ADC

Regulatory Oversight

- Acceptance of new waste types has exposed EBMUD to regulatory oversight by new agencies—CA Dept. of Food and Agriculture (CDFA) for FOG wastes and CalRecycle/Local Enforcement Agency for food waste.
- EBMUD is working, along with others in the state, to address appropriate regulatory pathway.
- EBMUD operations are currently regulated under an existing NPDES program framework administered by the State Regional Water Boards.

The Future - Food Waste



- Commercial Food Waste
 - Bay Area generates approximately 1,700 tons/day
 - Sustainable, local, high methane value feed stock
 - Working to expand pilot with long-term (10+ year) contracts
 - Significant interest from local communities in regards to landfill diversion and renewable energy
 - Potential for green house gas emission credits via destruction of methane gas (as compared to alternative)

Contact:

John Hake at 510-287-1542

jhake@ebmud.com

WEF Wasted Food-to-Energy Webinar

April 15, 2015



Jason Dow, P.E.
General Manager
Central Marin Sanitation Agency



Marin Sanitary Service & **Central Marin Sanitation Agency**



Central Marin Commercial Food-to-Energy Program

WEF Wasted Food-to-Energy Webinar

April 15, 2015



Presentation Outline



- Central Marin's Commercial Food-to-Energy (F2E) Initiative
 - What is F2E?
 - Public-Private Partnership - CMSA and Marin Sanitary Service
- Marin Sanitary Service F2E Program
 - About MSS
 - Transfer Station Improvements
 - MSS outreach, training, services, and collection statistics
- CMSA F2E Program
 - About CMSA
 - Treatment plant F2E/FOG facility
 - Anaerobic digestion and energy production
- Program Metrics, Benefits, and Reasons for Success
- Questions

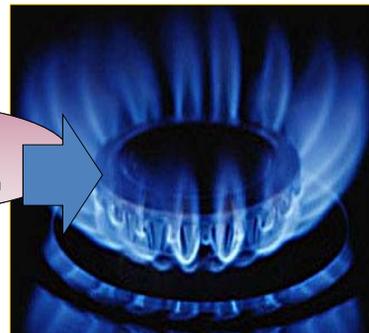


Commercial Food Waste to Energy



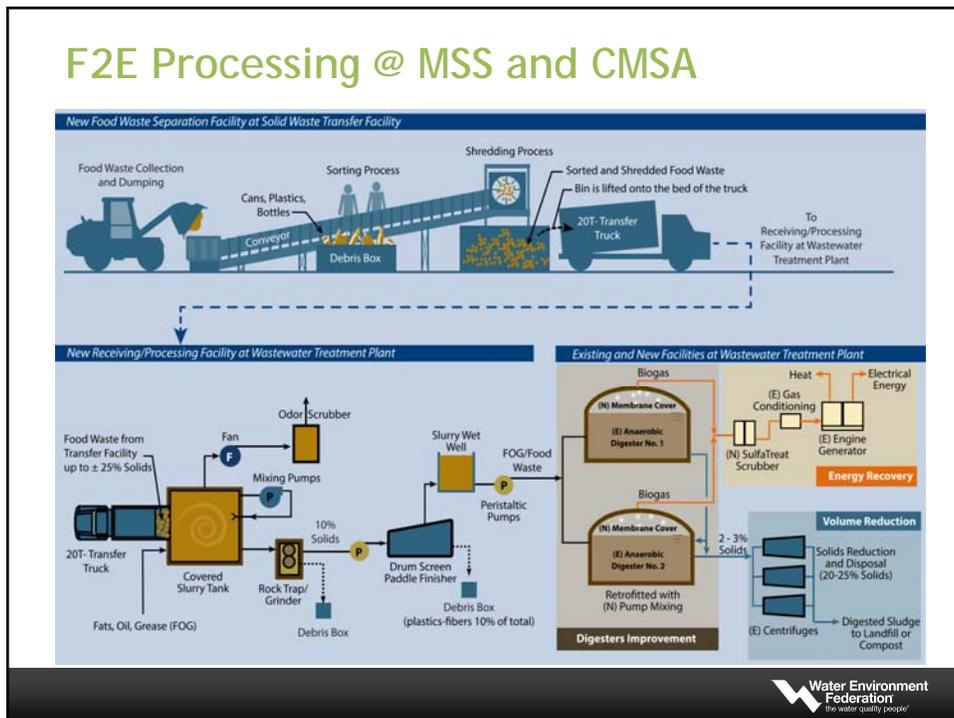
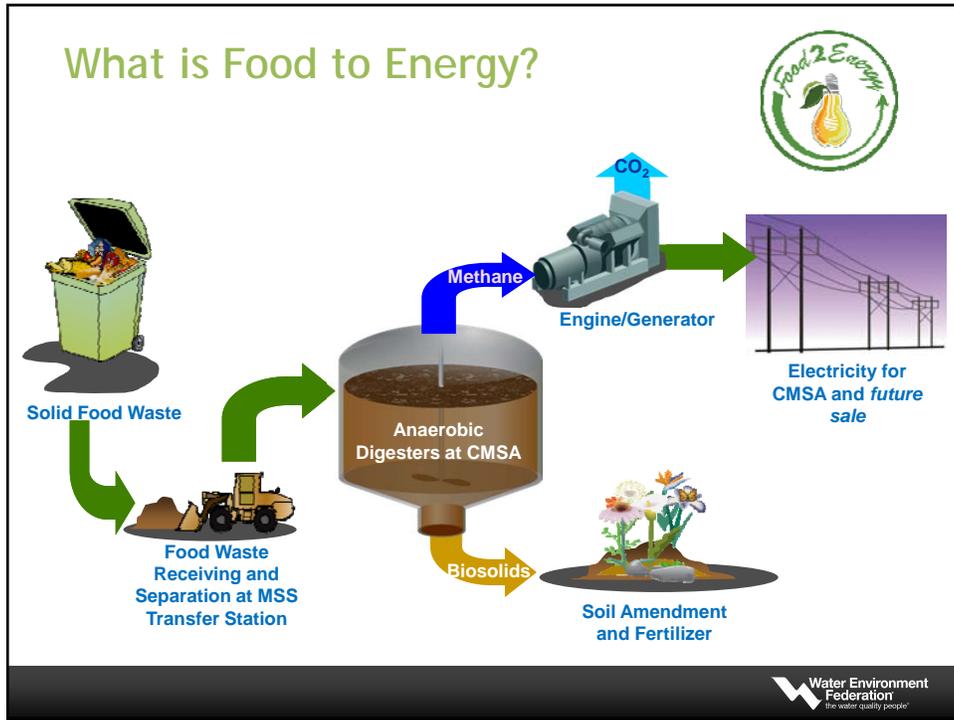
Central Marin Food Waste

Process:
Anaerobic digestion



Biogas (methane)





Why Go After Food Waste?



- Food is the second largest source of waste in California
 - ~16% percent of the Commercial waste stream
 - ~25% of the Residential waste stream
- A 2014 Waste Characterization study found ~29 % of residential solid waste sent to Landfill by MSS, is food waste. For commercial customers it was ~39%.



Public-Private Partnership



Central Marin Sanitation Agency



Public Private Partnership



- Concept development (2008)
- Methane Capture Feasibility Study - project by CMSA, San Rafael, and MSS (2008/2009)
- Presentations to cities, towns, and Board of Supervisors (2009 and 2012)
- Food Waste Processing and Disposal Agreement executed in 2013
- Public tours at MSS and CMSA
- Presentations to environmental groups and press
- Delivery of FOG and food waste began in late 2013/early 2014



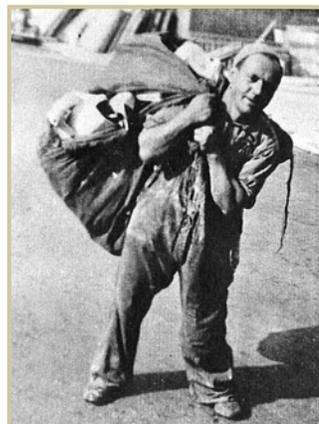
Public-Private Partnership



Marin Sanitary Service
CONSERVATION – OUR EARTH, OUR MISSION, OUR JOB



- Marin Sanitary Service (MSS) a private company
 - Provides curbside solid waste collection, recycling, and organics services to Marin County since 1948.
 - Serves nine jurisdictions within the County of Marin
 - Serves ~30,000 residential and 3,000 commercial/multifamily dwellings.
 - Process approximately 250,000 tons of solid waste, organics, and recyclables annually

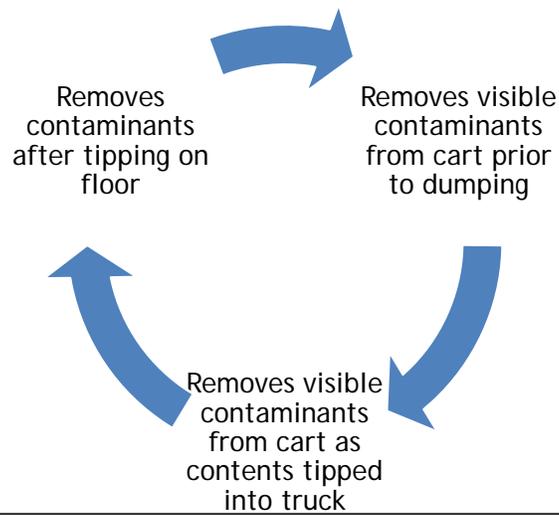


First Line in Quality Control

- Customer Enrollment: pre-consumer food waste
- Staff Training & Monitoring
- Tools for Success
 - Labeling and Signage
 - Kitchen Layout
 - Internal and External collection containers



Second Line in Quality Control: Contamination Removal Protocol





CLEAN FEEDSTOCK



Transfer Station - Tipping Floor



MSS Processing Equipment



Loading food waste onto the conveyor



Hopper, Belts, and Magnet



Program Details



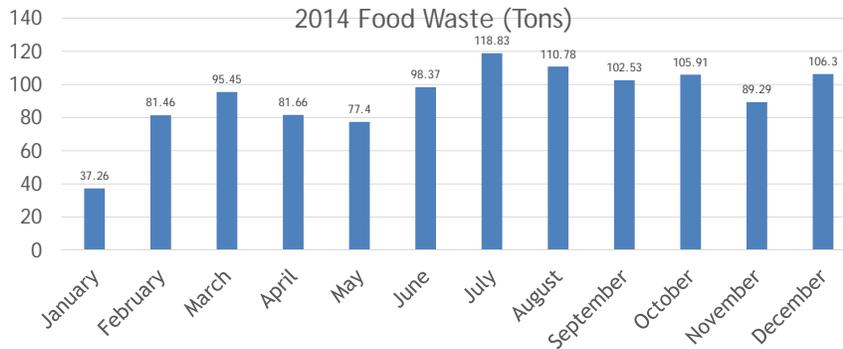
- **Customer Enrollment**
 - Pre-consumer commercial food waste would be collected and then transferred to the MSS transfer Station for processing to remove contamination and then transported to CMSA.
 - Eventually include post-consumer food waste
 - Recruit up to 250 commercial food waste producers
 - Program outreach
 - Kitchen staff training
 - Frequent monitoring



F2E Collection Statistics



| | |
|-------------------|----------|
| Customers | 102 |
| Collection Days | 6 |
| Avg. Route HRS | 4.1 |
| Avg. Cart Weight | 132 lbs. |
| Avg. Daily Weight | 4.3 tons |



Central Marin Sanitation Agency



- Regional Wastewater Agency in San Rafael, Marin County
- Serves about 120,000 people and San Quentin State Prison
- Joint Powers Agency (JPA) with four satellite collection agencies
- Wide range of influent flows: 7MGD (ADWF) to 116 MGD (PWWF)
- Contract services:
 - Collection system O&M for San Quentin Village
 - Pump station O&M for SQ prison and Corte Madera
 - P2 for six local agencies



F2E/FOG Facility



Paddle Finisher



Digestion - Anaerobic Digesters



Biogas Purification - Step 1

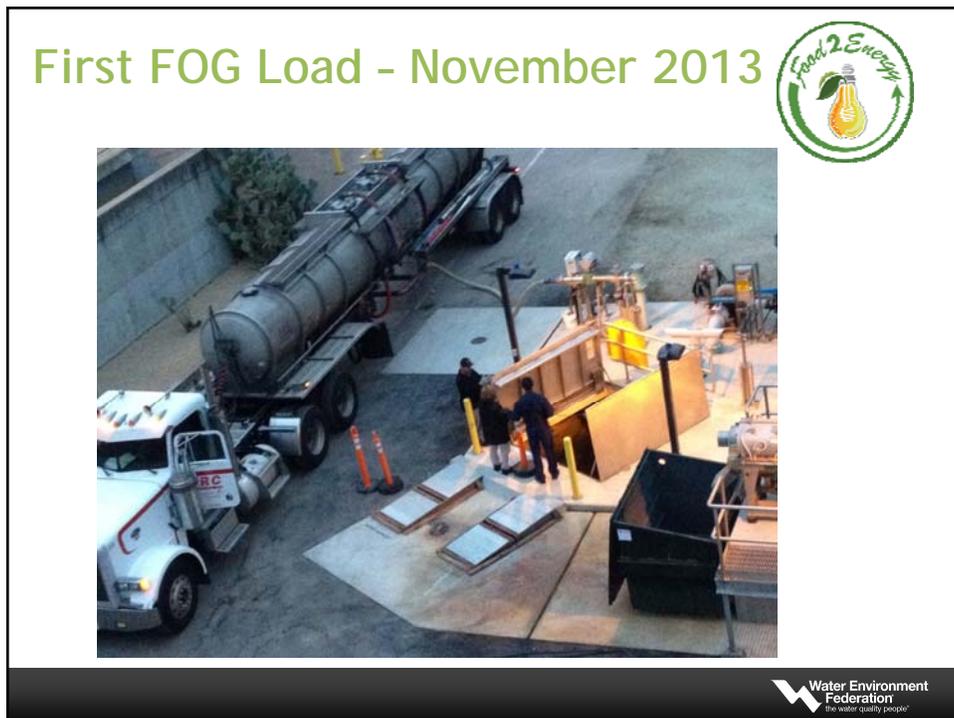
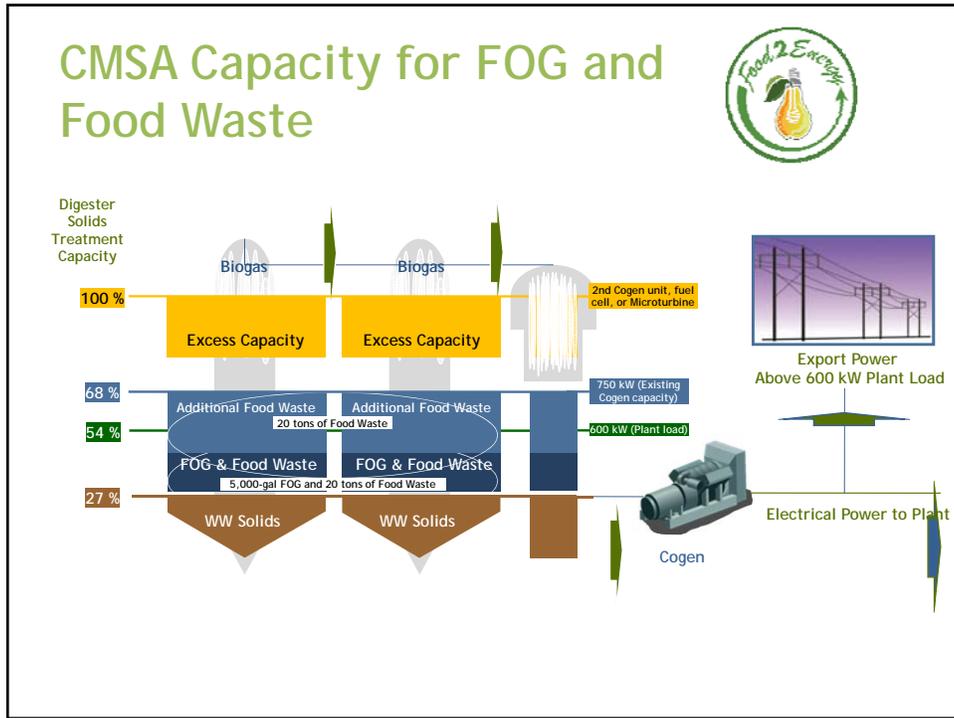


Biogas Purification - Step 2



750 kW (1000 hp) Engine Generator





First Food Waste Load - January 2014



Permitting and Operation



- MSS regulated by CalRecycle, and CMSA is regulated by the San Francisco Bay Regional Water Board and Cal Recycle.
- CalRecycle's Local Enforcement Agency (LEA) approved a Limited Volume Transfer Operation permit for CMSA, and a Solids Waste Transfer Station Permit amendment for MSS.
- CMSA Notified SFRWB that the facility is operational
 - NPDES permit Standard Operation Procedure (SOP) developed
- LEA is performing quarterly inspections at CMSA until CalRecycle regulations change to exempt POTWs that receive organics for co-digestion.
- Digester health has remained stable and has not been affected by the new organic loading
- Minimal operational issues with new facilities and equipment



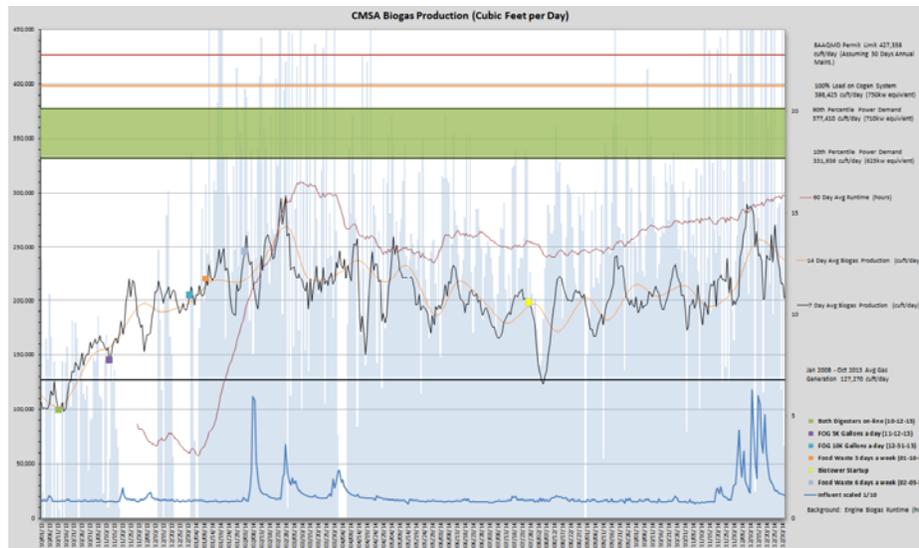
FOG and Food Waste Program Metrics



- Amounts Received
 - FOG: up to 15,000 gallons per day, 6 days a week
 - Food waste: average 4.2 tons/day, up to 6 days a week
- Biogas generation increase from 127,000 ft³ (5-yr average) to over 225,000 ft³/per day average.
- Volatile Solids Ave: 91% for FOG; 91% for food waste
- Digester Hydraulic Residence Time Ave: 35 days +/-
- Cogenerator runtime on biogas increased from approximately from 7-9 hours/day up to 16 hours/day.
- Program Expenses:
 - CMSA facility cost: \$2 million (\$1.9 for construction)
 - MSS equipment cost: \$530,000
 - MSS operating costs: \$315,000 (collection, processing, disposal, outreach)



Biogas Gas Production - Oct 2013 to Dec 2014



Benefits of F2E Program



- A local renewable energy project
- Increases CMSA's energy self sufficiency
- Utilization of existing CMSA asset capacity
- Potential for CMSA to export energy (future)
- Reduces greenhouse gas emissions - about *2,000 metric tons per year (Cap and Trade value?)*
- Reduces landfilling of food waste; reject material is composted
- Helps achieve local agency and County of Marin zero-waste goals

Why a Success?



- CMSA and MSS Board support
- Marin Sanitary Service partnership
- Support from Board of Supervisors, central Marin town and city councils, and regulators
- Digester and cogenerator unused capacity
- Unanticipated Revenue Bond proceeds
- EBMUD facility and process used as a model
- CMSA & MSS staff contributions during facility design, testing, and start-up, daily facility operation and maintenance, and on-going program administration.

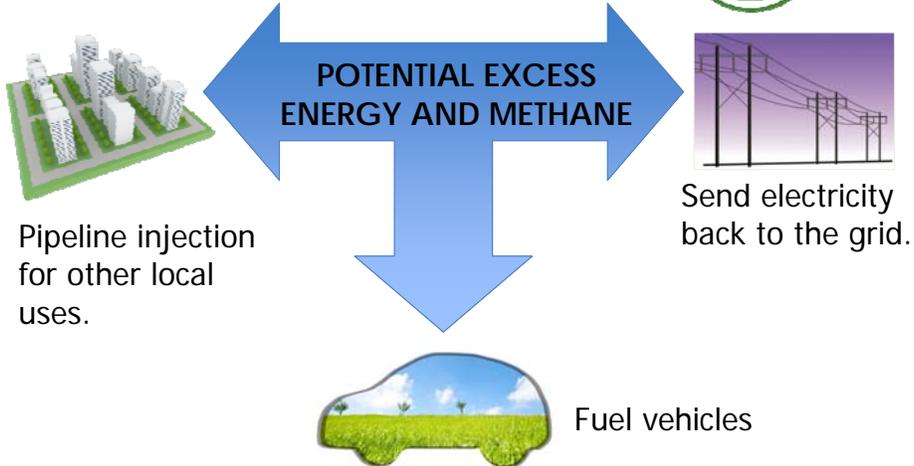
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- CMSA & MSS staff contributions during facility design, testing, and start-up, daily facility operation and maintenance, and on-going program administration.



FUTURE OF F2E



Questions?



Jason Dow – CMSA
jdow@cmsa.us
415-459-1455, ext 145

Kim Scheibly – MSS
kim.scheibly@marinsanitary.com



Hill Canyon Wastewater Treatment Plant Thousand Oaks, CA

Chuck Rogers
Superintendent



City of Thousand Oaks Hill Canyon WWTP



HCTP By the Numbers

14 8.5 100%
2%
2%
25



Core Values



Cogen



900 kW

Solar



500 kW



Conservation Optimization Renewable Energy Generation



FOG



100% CHALLENGE



To Do List

- Focus on conservatory optimization
- More waste needed
- New facilities needed to accept waste
- 400K ARRA grant
- RFP for FOG
- New engine needed



Caveat Emptor



Challenges

- Failure is possible
- Don't over invest
- Have good reasons for doing this
- Regulatory issues may pop up
- FOG is nasty
- Variable BTU

Lessons Learned



Recommendations



Final Thoughts

100% 35,000,000 kWh



One Size Does Not Fit All



City Council Party



Opportunity Awaits



How Can I Help?

Chuck Rogers

City of Thousand Oaks

Hill Canyon Wastewater Treatment Plant

9600 Santa Rosa Road

Camarillo, CA 93012

(805) 491-8177

cerogers@toaks.org



City of West Lafayette, Indiana

Dave Henderson,
Utility Director



Waste to Energy

Food Waste as a Resource in West
Lafayette, Indiana



West Lafayette Facility Overview



- 10.5 MGD Plant
- 2 Mesophilic Anaerobic Digester
- 1 million gallons volume
- Co-Generation process online since 2009.
- Located near Purdue University



Combined Heat and Power

- Two 65kW Capstone Microturbines
- Gas Conditioning
 - Remove Moisture
 - Remove Siloxanes



Co-Digestion Feedstock

- Fat
- Foo
- Veg
- Spo

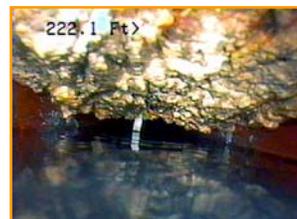


K.

Fats, Oil, and Grease

Sources are plentiful, however. . .

- Deliveries have decreased.
- Competition for material.
- Price Wars? 10 ¢ per gallon revisited.



Residential Service

- Keep cooking oil and grease out of sewers.
- Keep it out of landfills.
- Free service to residents.

Save your home's pipes, save the earth
 Recycle your cooking oil in free containers



It's easy and free to recycle your used cooking oil, fats and grease. Stop by West Lafayette City Hall, 609 W. Newja, and pick up a free collection bottle. When it's full, exchange it for an empty bottle at: West Lafayette Recycling Center, 709 S. River Road, West Lafayette

The city will feed your used cooking oil and grease to the digester at the Wastewater Treatment Plant and convert it to electricity.

You'll save your home drains from clogging, reduce landfill waste and help cut city electric costs—all while protecting our environment.

WEST LAFAYETTE
 609 W. Newja
 West Lafayette, IN 47906
 764/774-1100
www.westlafayettein.gov



Food Waste : More Digester Fuel

- Use excess digester capacity.
- High quality food waste from Purdue
- Source separated at the Dining Halls.



Pilot Project with Purdue



Food Waste Receiving Station



Food Waste Potential

- West Lafayette Sanitation Department picks up 25-30 tons of Municipal Solid Waste each day.
- Based on EPA data, 18% of the MSW may be food waste (4.5 - 5.4 tons each day from WL residences).
- Our digesters currently receive 1- 2 tons each day from Purdue University Dining Courts.



Water Environment
Federation
the water quality people

Digester Renovation and CHP Project Overview

- \$10.4 million in SRF Loan.
- Provided upgrades to existing digesters, new building to house microturbines, mixing pumps, and control equipment.
- Included FOG receiving station.

Water Environment
Federation
the water quality people

COSTS FOR FOOD WASTE STATION

| | |
|--------------------------|-----------------|
| Engineering | \$18,155 |
| Construction | \$17,000 |
| Grinder | \$50,000 |
| Platform and Cart Tipper | \$13,011 |
| Total | \$98,166 |

Electricity & Natural Gas : Savings

- Up to 20% of wastewater plant's electricity needs.
- Generates 679 MWh/year
- 40 % reduction in natural gas usage. 24,900 therms/year in heat recovered from microturbines.



Food Waste is Everywhere. . .

- Schools
- Hotels
- Prisons
- Stadiums
- Military Bases
- Restaurants
- Grocery Stores
- Universities
- Food Processing Plants



Room for Improvement

- Better mixing of the receiving tank
- Heavy object trap added to FOG inlet. Better screening ahead of pumps.
- Separate receiving tank for Food Waste in the future.
- Cleaning the food carts.



What is Next?

- Electric Vehicles using Green Energy
- Excess biogas produced. Need for a 3rd microturbine is being evaluated
- Sources of grease, food waste, and other high strength waste are plentiful. May use extra biogas in CNG vehicles.
- Separate waste receiving stations for liquids and solids



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WEST LAFAYETTE



WATER RESOURCE RECOVERY

Questions?