EBMUD’s Renewable Energy Initiatives

David R. Williams
Director of Wastewater

Presentation to:
Metropolitan Water Reclamation District of Greater Chicago

September 30, 2011
• Historical overview of the role of WW utilities
• A new role and the driving forces
• Introduction to EBMUD
• Renewable energy efforts
• Renewable energy credits and greenhouse gas offsets
• Looking forward
• POTW as a “green factory”
Historical Roles for Wastewater Utilities

- Protector of public health
- Protector of the environment
<table>
<thead>
<tr>
<th>Period</th>
<th>Major Concern</th>
<th>Wastewater Treatment Objectives</th>
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<tbody>
<tr>
<td>Pre-1970</td>
<td>Waterborne disease and protection of human health</td>
<td>Eliminate pathogens with treatment and disinfection</td>
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<tr>
<td>1970-2005</td>
<td>Degradation of aquatic environment with impacts to wildlife</td>
<td>Reduce pollutant loading to receiving water bodies</td>
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<td>2005 onward</td>
<td>1) Resource scarcity and costs</td>
<td>1) Resource recovery from waste materials</td>
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<td>2) Climate change</td>
<td>2) Reduce carbon emissions</td>
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A New Role Emerges: Waste to Energy

Biodiesel

Biogas
Driving Forces

- Commodities pricing – escalating rapidly with developing nations growing demand
- Climate change – pressure to use fewer fossil fuels
• Regional water and wastewater public agency serving the east San Francisco Bay

• Drinking water system serves 1.3 million people

• Wastewater system serves 650,000 people
Hydroelectric Power

- Two Hydropower Plants
  - Pardee 30 MW
  - Camanche 10 MW

- Production ~ 185,000MWh/yr
- Offsets ~ 70,000MT/yr CO₂
Existing On-site Generation

- Three 2.2-MW IC engines
- Avg. output is about 3.0 MW
- Historically met ~40% of plant load
New Renewable Energy Efforts
- **Sobrante ~** 600,000 kWh/yr
- **Adeline ~** 40,000 kWh/yr
- **PV Power Purchase Agreements**
  - 5 locations
  - **Total of** ~1,290,000kWh/yr
Microturbines

On-site cogeneration for office buildings
Resource Recovery (R2) Program
Unique Conditions at EBMUD

- Excess digester capacity available
- Plant site on network of major interstate highways
- Economies of scale
- Limited alternatives in major urban area
- In-house expertise to perform research
Waste Examples

• Started with:
  – Septage

• Progressed to:
  – Fats, oils, and greases (FOG)

• Expanded program includes:
  – Food processing waste
  – Winery waste
  – Industrial/commercial process waste
    • Well purge water
    • Tank rinsate
  – Animal processing waste
    • Chicken blood
    • Beef blood
    • Turkey lungs
  – Municipal and agricultural lagoon wastes
R2 Program Provides

- Robust treatment
- Renewable energy production
- Tip fee generation which helps keep rates low
- In the future Program may also provide Renewable Energy Credits and Greenhouse Gas (GHG) Credits
Low Strength Waste
(Headworks)
Low Strength Waste Deliveries

~350,000 gpd
FOG / Biodiesel
Trap Grease to Biodiesel Pilot
FOG Experience

- FOG can cause blockages and SSOs
- EBMUD began accepting FOG ~10 years ago, in support of a regional control program
- Process and operations problems encountered during early years:
  - 3-foot scum blanket build up in primary digesters
  - “Blinding-up” on-line instrumentation
  - Impacts on whole effluent toxicity testing
- Partnership with third party to “harvest” brown grease led to a pilot to convert brown grease to biodiesel
- Currently, EBMUD accepts FOG directly to our upgraded thermophilic well-mixed digesters
Trapped Grease to Biodiesel Pilot

Constructed a 100-gallon batch facility

Produced 1,300 gallons of biodiesel
Biodiesel Pilot Results

- **QUALITY**: Biodiesel from brown grease can meet all ASTM quality requirements with the exception of ultra low sulfur
- **VEHICLE COMPATIBILITY**: No short term vehicle maintenance or performance issues
- **SIMILAR TO COMMERCIAL**: Feasible to use brown grease biodiesel or commercial biodiesel
- **TRUST**: Our drivers and mechanics gained some confidence in the fuel
- **VALUABLE BYPRODUCT**: Glycerin may be digested to produce more biogas
• Production costs could be competitive with petroleum diesel, if significant amount of interceptor grease is available

• Cost strongly influenced by economies of scale and method to identify and procure interceptor grease from wide area (and perhaps supplemental virgin oil)

• Technical hurdles remain including:
  – Need for reliable cost effective means to convert interceptor waste (mostly water, some solids, about 2% grease) to brown grease (a feedstock for biodiesel)
  – Need for reliable cost effective means to reduce sulfur content to meet new California standards for Ultra Low Sulfur Diesel (15ppm)
EBMUD Future for Biodiesel

- Received $1M Grant from California Energy Commission to further research
  - Cost-effective brown grease production
  - Sulfur removal
- Securing land lease for glycerin waste
- Glycerin
  - COD > 10x municipal sludge
    (700,000 ~ 1,000,000 mg/L)
  - Negligible solids for disposal
FOG Receiving and Digester Blending

Blend Tank 2

Blend Tank 1

FOG Tanks
(Future – in construction)
Food Waste
Food Waste

- Second largest category of municipal solid waste to landfills
  - Less than 3% currently diverted, mainly for composting
- Diversion from landfill conserves space and reduces GHG emissions
  - Organic material, like food waste, breaks down in a landfill and releases methane gas, which is a potent GHG
Food Waste Background

- Food waste is the largest single category of municipal solid waste in CA (16%) or 5.6 million tons (CIWMB, 1999)
- Key component for meeting mandated solid waste diversion goals (state law, AB 939)
- Composting is the most common diversion method
- Composting limitations:
  - Net energy consumer, long process (90 days)
  - Air quality concerns (VOCs)
- Anaerobic digestion has been successfully used to treat municipal sludge, but has not been widely used in the US for food waste.
Focus on Food Waste

- Food Waste creates 3.5 times the amount of energy as the same volume of municipal sludge
- Local sustainable feedstock for excess digester capacity
- Local solution to a local disposal problem benefiting the ratepayer and community

1 truck/day will power 260 homes (~0.2MW)
Food waste comes from Bay Area communities and commercial facilities
Contaminants in Commercial Food Waste
Local waste management company hauls and preprocesses food waste before it is anaerobically digested at EBMUD
Solid Liquid Waste Receiving Station
Food Waste Delivery at MWWTP
Contaminants in Delivered “Clean” Food Waste
• Food waste contaminants led to processing problems - plugging, equipment damage.

• Contaminants included:
  – Silverware, chopsticks, shells, bottle caps, plastics.

• EBMUD staff investigated processes to remove contaminants.
Patented Food Waste Process
Food Waste Processing

EBMUD’s Food Waste Processing System

Processing Residuals for Compost
Food Waste Challenges

• Non-traditional; no existing model (in US) for food waste processing and digestion at a wastewater treatment plant

• Significant effort in innovation and development of technology and process

• Creation of new relationships with food waste providers (solid waste haulers, solid waste authorities)

• Food Waste processing challenges
  – Understanding contaminant impacts to other treatment processes and equipment
  – Developing cost-effective contaminant control options; at source (restaurants), with preprocessing, and/or post-digestion?
R2 Program Results
PGS Renewable Energy Expansion Project

- Installing a new 4.5 megawatt (MW) turbine to expand the existing Power Generation Station (online by July 2011)

\[
\text{Current} \quad \text{Future} \\
\text{Three 2.1 MW Engines} \quad \text{Add 4.5 MW Turbine} \\
\]

\[
\text{+} \quad = \quad 11 \text{ MW}
\]

- Become a net energy producer and reduce greenhouse gas emissions
Biogas Turbine
Slight drop in 2007 due to digester upgrade and engine overhaul projects

Out year projection assumes availability of acceptable waste streams
## Current R2 Rates

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Rate ($/gal)</th>
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<tbody>
<tr>
<td>Septage</td>
<td>$0.07</td>
</tr>
<tr>
<td>FOG</td>
<td>$0.11 (non-conc) / $0.15 (conc)</td>
</tr>
<tr>
<td>Groundwater</td>
<td>$0.02</td>
</tr>
<tr>
<td>Process Water</td>
<td>$0.04</td>
</tr>
<tr>
<td>Gray Water</td>
<td>$0.03 (&lt;75k mg/L TDS)</td>
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<td>$0.06 (75k to 200k mg/L TDS)</td>
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<tr>
<td>Sludge</td>
<td>$0.05 (up to 3% TS)</td>
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<tr>
<td></td>
<td>+ $0.01 per % TS up to 20%</td>
</tr>
<tr>
<td>Liquid Organic Material</td>
<td>$0.03</td>
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<tr>
<td>Solid Organic Material</td>
<td>$30 to $65/ton</td>
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Tip Fee and Energy Revenue

- Estimated Energy Value
- Tip Fee Revenue
- Cumulative Tip Fee Revenue

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Revenue ($M)</th>
<th>Cumulative Tip Fee Revenue ($M)</th>
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<tbody>
<tr>
<td>FY02</td>
<td>$0.3</td>
<td>$0.3</td>
</tr>
<tr>
<td>FY03</td>
<td>$1.9</td>
<td>$2.2</td>
</tr>
<tr>
<td>FY04</td>
<td>$2.7</td>
<td>$4.9</td>
</tr>
<tr>
<td>FY05</td>
<td>$3.6</td>
<td>$8.5</td>
</tr>
<tr>
<td>FY06</td>
<td>$4.4</td>
<td>$12.9</td>
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<tr>
<td>FY07</td>
<td>$5.8</td>
<td>$18.7</td>
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<tr>
<td>FY08</td>
<td>$7.0</td>
<td>$25.7</td>
</tr>
<tr>
<td>FY09</td>
<td>$7.7</td>
<td>$33.4</td>
</tr>
<tr>
<td>FY10</td>
<td>$7.6</td>
<td>$41.0</td>
</tr>
<tr>
<td>FY11</td>
<td>$9.4</td>
<td>$50.4</td>
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Trucked Waste Acceptance Challenges

• Rigorous acceptance criteria to ensure process integrity
• On-going research and pilot digester studies for evaluation
• Impacts to other treatment processes and equipment from sidestreams
• New system developed for tracking deliveries and invoicing
R2 Program Lessons Learned

- **Anaerobic Digestion**
  - Robust way to convert a range of organics to methane gas/energy
  - “Good mix” of waste streams needed to maintain digester health
  - Demonstrated operation outside published parameters with careful monitoring

- **Regulatory Framework**
  - May be entering solid waste permitting arena
  - Exploring merits of a rendering license

- **Think Like a Business**
  - Balancing traditional O&M perspectives with market-based considerations
    - 24-7 deliveries
    - Can you afford plant shutdowns and turning away trucks that depend on you?
    - Staff buy-in for cost-benefit of plant impacts with revenue and energy production?
  - Revenue stream is not “locked down” to one site; e.g., FOG volumes and tipping fees can plummet as more POTWs begin to accept this material

- **Public Perception**
  - High level of interest
  - Understand need to look for opportunities for renewable fuels/energy
  - Managing related odors is a key to long-term success
New Revenue Opportunities

Renewable Energy Credits and Offsets
A REC is the environmental attribute associated with the renewable energy

Aka “green tag”

Typically sold in units of MWh

Unbundled from the electricity it could be sold separately
• California’s RPS is 20% by 2010 for investor-owned utilities (IOUs)

• IOUs might meet the RPS by purchasing RECs

“20% by 2010!”
Expected Evolution of REC Sales in California

PAST
No REC

PRESENT
Bundled REC

FUTURE?
Unbundled REC

Electricity only to buyer

Electricity and REC to buyer

Electricity to Buyer 1

REC to Buyer 2
• AB 32 requires GHG emission reductions to 1990 baseline levels by 2020 (~25%)

• California Air Resources Board (CARB) recommends cap and trade approach to reducing emissions

• Greenhouse gas (GHG) offsets are a potential component of cap and trade system
Emissions Trading: Allowances vs. Offsets
Revenue Opportunities?

- For WWTPs with renewable generation:
  - Green premium for power or REC sale
  - Possible GHG offset revenue for waste diversions, e.g., food wastes diverted from landfills
Looking to the Future
Food Waste Sourcing

- Interest in securing long term commitments with local food waste providers
- Signed a contract with Central Contra Costa Solid Waste Authority
  - 5.5-year contract for up to 15 tons per day (tpd)
  - Tip fee starting at $45/ton and escalating annually
  - Sharing of any REC or GHG credits TBD
- Signed contract with Recology
  - 10 to 20 year contract for 120 tpd
  - Tip fee starting at ~$46 and escalating annually
  - Sharing of energy value and REC
- Land-lease to Recology for construction of a Food Waste Receiving and Preprocessing Facility
Competition for organic waste from other POTWs continues to grow so focus for growth is on wastes that are more complicated from a technical or regulatory perspective, e.g.:

- Residential Food Waste
- Green Waste
- Biofuel By-products
- Field Dead and other Animal Processing By-products
A New Role for WWTPs?

- Historically: A protector
- New Role: A provider
- Forces driving new role:
  - Natural resource scarcity
  - Climate change
- Producing green products can help to reduce WWTP’s carbon footprint
Possible Green Products

- wastewater
- food waste
- water for industry & irrigation
- fertilizer
- biofuel
- electricity
- other high strength organic waste
- wastewater
- FOG

Other possible green products include:

- electricity
- biofuel
- fertilizer
- water for industry & irrigation
## Challenges and Opportunities

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Opportunities</th>
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<tbody>
<tr>
<td>Waste to Energy R&amp;D investments</td>
<td>Greater energy self-sufficiency and associated cost savings</td>
</tr>
<tr>
<td>Impacts to existing treatment processes</td>
<td>New revenue streams from environmental commodities</td>
</tr>
<tr>
<td>Capital req’ts for new facilities</td>
<td>Reduced carbon footprint</td>
</tr>
<tr>
<td>Mgmt of energy purchases and sales</td>
<td>Potential to pass on savings to ratepayers</td>
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<tr>
<td>GHG emissions compliance</td>
<td>Value of offsets and REC’s from renewable energy</td>
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</tbody>
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Closing the Materials Cycle Loop

Natural Resources → Manufacturing → Distribution → Consumption → Disposal → Waste Recycling
Questions