Nineteen Agencies Team to Convert Biosolids to Energy for a Regional Solution

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The country that harnesses the power of clean, renewable energy will lead the 21st century.

America can be the 21st century clean energy leader by harnessing the power of alternative and renewable energy, ending our addiction to foreign oil, addressing the global climate crisis, and creating millions of new jobs that can’t be shipped overseas.

President Barack Obama
Challenges to Biosolids Industry

• Current biosolids management in the Bay Area may not be sustainable
  – 20% projected population increase by 2030
  – Limited landfill capacity
  – Long hauling distance
  – Increasing costs
    • (current range is $45-$90 per WT)

• State and Federal Regulations
  – Increasing restrictions on current practices
    – land application and ADC

• Local Restrictions
  – San Joaquin AQMD Rule 4565 (biosolids eliminated as ADC; incorporation within 3 hours – currently 24 hours)
  – Kern County initiatives
Biosolids Use in California

- Land Application: 55%
- Landfill & ADC: 30%
- Incineration: 3%
- Cement Kilns: 2%
- Lagoons/Ponds: 2%
- Deep Well Injection: 1%
- Surface Disposal: 3%
- Temporary Storage: 4%

*Based on 2011 EPA Data*
Biosolids Land Application in California

Status of County Ordinances

- **Red**: Ban/Practical Ban on All Land Application
- **Orange**: Ban on Class B
- **Green**: Class B Land Application Allowed
- **Black and White**: Developing Ordinances
- **Blue**: No Regulations/Ordinances Enacted
Need to Expand Renewable Energy Sources

- 20% Renewable Portfolio Standard
- 2010 Biopower Targets
- Global Warming Solutions Act
- Obama Administration’s push for renewable energy generation
BA B2E Coalition

- 19 San Francisco Bay Area Agencies
- Nearly 4 million residents
- Seeking a local, sustainable biosolids management solution
- Maximize State and Federal support
- Unprecedented collaborative approach
The Regional Approach

- Joint exercise of powers agreement
- Cost sharing for consultant services
  - Lobbyists
  - Engineering and environmental services
  - Other supporting services
- Decision-making steering committee
- Lead agency
  - Delta Diablo Sanitation District
Fostering Collaboration

- Small districts to large cities
- Agency capacity range: 1.5 – 110 mgd
- Shared planning vision
- Steering Committee
- Subcommittees
- Consensus decision-making
- 1 vote per agency
State and Federal Advocacy

- Alignment with State and Federal initiatives
  - Energy
    - Reduced reliance on fossil fuels
    - Renewable energy development
  - Climate Change/GHG
    - Carbon footprint – AB32
    - Potential GHG credits
- Coalition is spreading the word
  - Energy-wastewater nexus
  - Biosolids as a renewable energy resource
Coalition Size Helps!

State Senate
- Noreen Evans-2nd District
- Jerry Hill-13th District
- Leland Yee-8th District
- Mark DeSaulnier-7th District
- Loni Hancock-9th District
- Ellen Corbett-10th District
- Jim Beall-15th District
- Bill Monning-17th District
- Lois Wolk-3rd District
- Mark Leno-3rd District

State Assembly
- Marc Levine-10th District
- Kevin Mullen-22nd District
- Joan Buchanan-16th District
- Nancy Skinner-15th District
- Richard Gordon-24 District
- Bob Wieckowski-25th District
- Nora Campos-27th District
- Paul Fong-28th District
- Mark Stone-29th District
- Wesley Chesbro-1st District
- Jim Frazier-11th District
- Susan Bonilla-14th District
- Richard Gordon-24th District
- Tom Ammiano-11th District
- Phil Ting-19th District
- Bill Quirk-20th District
The energy potential contained in wastewater and biosolids exceeds by at least five times the energy used to treat it.

*Water Environment Research Foundation (April, 2009)*
Promoting Renewable Energy Development

- U.S. Department of Energy
  - Advanced Research Project Agency – Energy (ARPA-E)
  - Energy Efficiency and Renewable Energy (EERE)

- California Energy Commission
  - Public Interest Energy Research (PIER)
  - Electric Program Investment Charge (EPIC)
  - Alternative and Renewable Fuels
  - Vehicle Technology Program
  - Cap-and-Trade
Project Goals

Maximize the sustainable use of Bay Area biosolids as a valued resource for society and the environment

• Maximize renewable energy resource
• Minimize GHG footprint
• Maximize federal and state financial assistance
Project Focus

• Utilize state-of-the-art technology
  – Air quality controls that meet/exceed stringent BAAQMD standards

• Net energy production
  – Potential co-location with industry to utilize waste heat
Fostering Technology Development

• Technologies ready for commercial demonstration
  – Capital intensive
  – “The Valley of Death”
• Bridging the funding gap
  – State and federal funding
Parallel Demonstrations

• Many vendors interested in demonstrating their technology
• Technologies look promising
• Vendor resources + available funding separate from RFQ process
• Projects
  – CEC funded gasification/dry digestion with biosolids and green waste
  – Entrepreneur funded biological drying process
  – Entrepreneur pyrolysis process to generate diesel
  – CEC funded drying/chemical process to produce hydrogen
Status

• Advocacy efforts continuing through state and federal lobbyists

• Communications Committee
  – Sub-committee reports to steering committee

• Request for Qualifications
  – Evaluated potential technologies
  – Short-listed teams
    • Synagro
    • Intellergy
    • Maxwest
    • SCFI
  – Demonstration projects
Chemergy HyBrTec demonstration

• HyBrTec process converts wet biosolids to hydrogen
  – 1 ton of 50 wet wt% biosolids yields 165 pounds of hydrogen and 1.8 MWh of heat

\[ \text{Biosolid Reaction:} \quad \text{C}_6\text{H}_{10}\text{O}_5 + 7\text{H}_2\text{O} + 12\text{Br}_2 \rightarrow 24\text{HBr} + 6\text{CO}_2 \]

\[ \text{Electrolysis:} \quad 2\text{HBr} \rightarrow \text{H}_2 + \text{Br}_2 \]
Next Steps

• 2013 RFP to short-listed teams
• Demonstration Project(s)
  – 35-75 wet tons per day
  – Phasing – development, construction, and operation
  – Modular units
  – Determine predictable revenue stream
  – Net energy production and GHG reduction
  – Long-term services if successful
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<table>
<thead>
<tr>
<th>Coalition Member</th>
<th>Stabilization Method</th>
<th>Dewatering Method</th>
<th>Cake Concentration</th>
<th>Annual Biosolids [wet tons]</th>
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<tbody>
<tr>
<td>San Francisco Public Utilities Commission</td>
<td>Anaerobic digestion</td>
<td>OSP – Belt filter press</td>
<td>17%</td>
<td>77,111</td>
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<td></td>
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<td>SEP – Centrifuge</td>
<td>28.5%</td>
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<td>City of Burlingame</td>
<td>Anaerobic digestion</td>
<td>Belt filter press</td>
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<td>City of Richmond</td>
<td>Anaerobic digestion</td>
<td>In transition</td>
<td>Unknown</td>
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<td>West County Wastewater District</td>
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<td>Sludge drying beds</td>
<td>80 to 90%</td>
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<td>Anaerobic digestion</td>
<td>Centrifuge</td>
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<td>11,801</td>
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<td>675</td>
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<td>19,098</td>
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<td>Vallejo Sanitation District</td>
<td>Lime treatment</td>
<td>Belt filter press</td>
<td>31% (at pH 12)</td>
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<td>Belt filter press</td>
<td>17.5%</td>
<td>8,247</td>
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<td>Anaerobic digestion</td>
<td>Centrifuge</td>
<td>25%</td>
<td>5,450</td>
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<td>Anaerobic digestion</td>
<td>Centrifuge</td>
<td>26.5%</td>
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<td>Anaerobic digestion</td>
<td>Dedicated land disposal</td>
<td>Unknown for facility</td>
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<td>Ironhouse Sanitary District</td>
<td>None</td>
<td>Belt filter press</td>
<td>15%</td>
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<td>Incineration/None</td>
<td>Belt filter press</td>
<td>28%</td>
<td>26,100</td>
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Chemergy Demonstration

Diagram showing the process:
- Cellulosic Feedstock
- Waste Water
- CO₂, & vapors of Br₂, HBr, H₂O
- Heat Out
- Reactor 200°C
- Gas/Liquid Separator HEX
- DC Power
- Electrolysis Cell
- Concentrated HBraq
- Br₂, Dilute HBraq
- Filter Press
- Ash, Sulfates, Br₂, HBraq
- Ash & Sulfate Cake
- CO₂
- H₂
Components of HyBrTec demonstration

- Required equipment is commercially available
Electrolytic hydrogen production (25°C):

- HBr electrolysis requires less energy (9 kWh/lb H₂) than released upon its reaction with oxygen (15 kWh/lb H₂)
- Additional 11 kWh/lb H₂ of heat is also released from biosolid reaction

Source: Summary of Electrolytic Hydrogen Production (Water Electrolysis), September 2004, NREL/MP-560-36734
Gryphon Dryer

- Compressed Air Injection
- Lid Structure (diffuser & heating)
- Continuous Conveyor
- Vacuum Chamber
- Return Air and pre-heat tubes
- Vacuum line to condenser