Nineteen San Francisco Bay Area wastewater agencies, representing over four million people, are working together to develop a biosolids management solution that maximizes the renewable energy potential in biosolids and minimizes greenhouse gas emissions. Currently, managing wet biosolids consumes valuable resources when hauled and applied to the land as fertilizer or as cover at landfills. With appropriate capital investment, we could transform biosolids into energy or into alternative transportation fuels. The Bay Area Biosolids to Energy (BAB2E) Coalition is nurturing new, clean technologies that use the resources in biosolids efficiently on a commercial scale.
The Value of Repurposing Biosolids

Biosolids are an organic by-product of sewage treatment and have historically been used as fertilizer for agricultural use or as cover at local landfills. However, the treatment process has additional value because the water content is very high after using existing technology to de-water the sewage (which is typically 75% water and only 25% solids). Also, a significant amount of energy remains untapped in the biosolids (equivalent to the energy value of firewood).

Current recycling methods of "waste"water treatment plants in the San Francisco Bay Area require nearly one million miles of truck hauling annually, which consumes energy and generates greenhouse gas emissions. In addition, landfills and dedicated land disposal sites have limited capacity and regulations governing their use are increasingly restrictive. All these factors increase costs for "waste"water agencies and their ratepayers. Discovering new ways to recover and repurpose the resources in biosolids will benefit local communities, the environment and our economy.

Disappearing Biosolids Management Options

Local, state, and federal regulations are becoming increasingly restrictive of current biosolids management practices of soil amendment and landfill cover. While the Bay Area Biosolids to Energy Coalition is working regionally, biosolids repurposing is a national issue.

With additional capital investment, the U.S. "waste"water community has the potential to be energy self-sufficient and become a net energy producer, while reducing the volume of waste materials and greenhouse gas emissions.

Biosolids management is a growing problem. Residents of the San Francisco Bay Area produce 29,861,998 cubic feet or 931,444 wet tons of biosolids (annually)—enough to fill AT&T Park to a height of 55 feet.
Biosolids to Energy Program:  
* A Local Solution with Nationwide Value

The Bay Area Biosolids to Energy Coalition is partnering with industry and seeking state and federal funding to test innovative technologies on a commercial scale. Biosolids-to-energy demonstration projects will benefit communities and the environment in the following ways:

- Transform low value sewage into high value commodities such as energy, transportation fuels, and nutrients
- Work with technologies that do not require incineration
- Reliably produce clean, renewable, energy as an alternative to fossil fuel
- Commercialize new, innovative technologies that can be replicated nationwide
- Diversify management of biosolids
- Cost effectively integrate new technologies with existing "waste" water treatment plant processes
- Cut greenhouse gas emissions with innovative technology and by decreasing biosolids hauling
- Keep local resources local

The energy potential contained in "waste" water and biosolids exceeds by ten times the energy used to treat it, and can potentially meet up to 12 percent of the national electricity demand. That's enough to power New York City, Houston, Dallas, and Chicago annually.

—*National Association of Clean Water Agencies* (2009)
Bay Area Biosolids to Energy Coalition

Formed in 2006, the Bay Area Biosolids to Energy Coalition (BAB2E) operates under a Joint Exercise of Powers Agreement. BAB2E seeks to develop options to use biosolids as a renewable energy resource. Producing energy from biosolids on a commercial scale is an emerging field with significant advancements in technology, research and development.

Once fully operational, the BAB2E resource recovery project has the potential to serve as a model for other metropolitan areas across the United States.

A successful regional biosolids-to-energy initiative will reduce the need to import energy supplies and help address San Francisco Bay Area climate change challenges.

Paul Kelley, Executive Director, Bay Area Biosolids to Energy Coalition
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www.bayareabiosolids.com

December 1, 2015
Renewable Energy Project
A PUBLIC PRIVATE PARTNERSHIP

Project: 1 truck/day green waste from Mt. Diablo Recycling + 25% of Delta Diablo biosolids = 467 KW electricity
Results: Delta Diablo can go “off the grid”; GHG total footprint reduced 85%

PHG Energy Downdraft Gasification System

- Technology is not incineration
- Reduces greenhouse gas emissions by 85%
- Low emissions profile that will meet or exceed the standards set by EPA’s Clean Air Act and the air standards set by the Bay Area Air Quality Management District
- Gasifier will process 7750 tons/year of wood waste (1 truck/day) & 2480 wet tons/year of biosolids (25% of Delta Diablo biosolids)
- Continuous feed; small footprint; fully automated; few moving parts; energy positive
- System generates syngas, which can replace natural gas in thermal applications to produce steam, hot water and/or electrical power
- Technology is easily integrated into existing wastewater treatment plants or as free-standing operation
- Comparison to anaerobic digestion: volatile suspended solids = 9477 BTU/lb; Anaerobic digestion converts 50% or 4738 BTU/lb; PHG gasifier converts 90% or 8529 BTU/lb
- Made in USA

Contact: Phil Govea, Engineering Services Director | Phone: (925) 756-1928 | Email: PhilG@DeltaDiablo.org

www.bayareabiosolids.com

PROJECT COSTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning, Design &amp; Environmental Studies</td>
<td>$500K</td>
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<tr>
<td>Financing &amp; Legal</td>
<td>$300K</td>
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<td><strong>Total</strong></td>
<td><strong>$10 Million</strong></td>
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</table>

Definition of Biosolids: Biosolids are the nutrient rich organic by-product of wastewater treatment. They are highly processed and analyzed to ensure their safety and must be used in accordance with regulatory requirements.
**GOAL:** Maximize Energy Potential from Biosolids  
Minimize Green House Gases

**Definition of Biosolids:** Biosolids are the nutrient rich organic by-product of wastewater treatment. They are highly processed and analyzed to ensure their safety and must be used in accordance with regulatory requirements.

- 19 Agency Coalition serving over 4 million people
- Term sheet executed with Synagro (largest handler of biosolids in US) and SCFI technology provider from Ireland

Uniqueness of SCFI Technology: Net Energy Positive (harvest energy at 50% moisture compared to incineration at 90%)

**Cost:**

<table>
<thead>
<tr>
<th>PROJECT COSTS</th>
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<tbody>
<tr>
<td>Planning, Design &amp; Environmental Studies</td>
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<td>Financing &amp; Legal</td>
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**Energy**

- Starter project (3 trucks/day) generates 250 KW, equivalent energy for 250 homes or 6 acres of solar

**Ash**

- Reduces biosolids volume by 93%

**Aquacritox Super Critical Water Oxidation Technology**

- Comparison to anaerobic digestion: volatile suspended solids = 9477 BTU/lb; Anaerobic digestion converts 50% or 4738 BTU/lb; Aquacritox HTO converts 100% or 9477 BTU/lb
- First unit will process 22,500 wet tons/year or 62 wet tons/day or approximately 3 trucks
- Continuous feed; small footprint; fully automated; few moving parts; energy positive
- Tested at pilot scale; 5+ years of operating and performance data
- Destroys organic wastes containing high levels of water (82 – 94 percent water)—no dewatering required
- Made in the USA
- Technology is not incineration

**19 Participating California Agencies**

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Executive Director, Bay Area Biosolids to Energy Coalition  
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Dan McIntyre  
Engineering Services Manager  
Dublin San Ramon Services District  
1-(925) 875-2244  
mcintyre@dsrdc.com

www.bayareabiosolids.com
**GOALS:** Maximize Energy Potential from Biosolids
Minimize Green House Gases

**Energy**
- Starter project (3 trucks/day) generates 250 KW, equivalent energy for 250 homes or 6 acres of solar

**Ash**
- Reduces biosolids volume by 93%!

**AquaCritox Hydro Thermal Oxidation Technology**
- Comparison to anaerobic digestion: volatile suspended solids (VSS) = 9477 BTU/lb; Anaerobic digestion converts 50% or 4738 BTU/lb; AquaCritox HTO converts 100% or 9477 BTU/lb
- First unit will process 22,500 wet tons/year or 62 wet tons/day or approximately 3 trucks
- Continuous feed; small footprint; fully automated; few moving parts; energy positive
- Tested at pilot scale; 5+ years of operating and performance data
- Destroys organic wastes containing high levels of water (82 – 94 percent water)—no dewatering required
- Made in the USA
- Technology is not incineration
- No NOx, no SOx formed; no emissions
- Technology is easily integrated into existing wastewater treatment plants or as free-standing operation
- System generates steam and CO2; CO2 is recovered for market; steam is converted to electricity; about 20 percent of the lower heating value of the wet feed can be recovered as electrical power
- Second generation technology under development; second generation technology will produce hydrogen fuel and recover chemicals from low heating value wet waste streams

**Definition of Biosolids:** Biosolids are the nutrient rich organic by-product of wastewater treatment. They are highly processed and analyzed to ensure their safety and must be used in accordance with regulatory requirements.

BAB2E Coalition - 19 public agencies serving over four million people

Term sheet executed with Synagro (largest handler of biosolids in US) and SCFI technology provider from Ireland

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**PROJECT COSTS**

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| Initial Operations | $6.8 Million |
| **Total** | **$24.5 Million** |

**Contact:**
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Dublin San Ramon Services District
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Email: mcintyre@dssrd.com

February 12, 2016
A PUBLIC-PRIVATE PARTNERSHIP
Renewable Energy Project

GOALS:
Minimize Green House Gases
Maximize Energy Potential in Biosolids

SEWAGE INFLOW
BIOGAS
25% increase in biogas boosts equivalent energy production – see table below*

BIOFERTILIZER

Biosolids are the nutrient rich organic by-product of wastewater treatment. They are highly processed and analyzed to ensure their safety and must be used in accordance with regulatory requirements.

FSSD/Lystek Partnership
A 20-year, Public-Private Partnership between the Fairfield-Suisun Sewer District (FSSD) and Lystek, a proven leader in biosolids and organics management.

An innovative project to develop a regional, 150,000 tons per year Organic Material Recovery Center (OMRC).

The multi-use Lystek system optimizes the operation of anaerobic digesters, reduces volumes at source, increases biogas production and contributes to the circular economy and long-term, agricultural sustainability.

RECYCLING VALUES OF LYSTEGRO

(150,000 tons per year @ 17% solids)
Water (83%) 29,000,000 gals/yr
Soil/organics (17%) 28,000 tons/yr

ENERGY VALUE OF LYSTEMIZE*

Production1 kWh/y 5,527,000
15,142
Household equivalent 853

% Increase2 25 25 25

Increased Electricity 1,381,750 3,768 213

1CY2015 Electrical Energy produced from cogeneration
2LysteMize returned to digester, increasing gas production 25%

Lystek Thermal Hydrolysis Technology
There is a distinct movement towards the conversion of Wastewater Treatment Plants (WWTP’s) into Wastewater Resource Recovery Facilities (WRRF’s).

The presence of the Lystek system at the FSSD allows for optimization or “LysteMizing” overall plant performance.

- LysteMize™ reduces volumes & GHG’s at source & boosts biogas production for green energy by 25% (+)
- LysteCarb™ for Biological Nutrient Removal (BNR) systems offers a safer, more cost effective, alternative carbon source (vs. methanol or glycerol)
- LysteGro™ Class A (EQ) biofertilizer eliminates pathogens & aligns with the Healthy Soils Initiative for California – builds soil health, retains (saves) water & maximizes the inherent value of macro & micro-nutrients

Bay Area Biosolids to Energy (BAB2E) is a coalition of 19 public agencies serving more than four million people in the Bay Area.

CONTACT
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2016.04.04
**Bay Area Biosolids to Energy Project**

**Goals:**
- Maximize Energy Potential from Biosolids
- Minimize Green House Gases

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- Technology is easily integrated into existing wastewater treatment plants or as free-standing operation
- System generates syngas, which can replace natural gas in thermal applications to produce steam, hot water and/or electrical power
- Reduces greenhouse gas emissions at least 50% over current biosolids practices
- Made in USA

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Dec. 2, 2015