BAY AREA
Biosolids
to Energy

TRANSFORM BIOSOLIDS

into a Valuable Commodity Which Benefits Our Communities

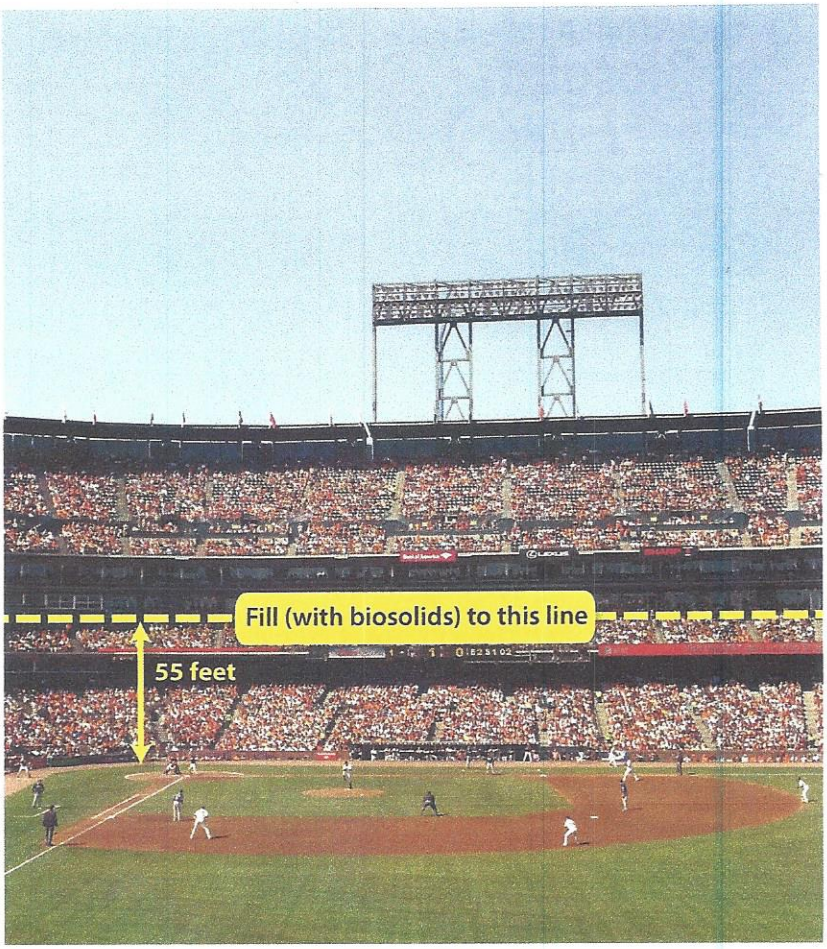
A Regional Approach to Developing a Sustainable Energy or Fuel Alternative

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.

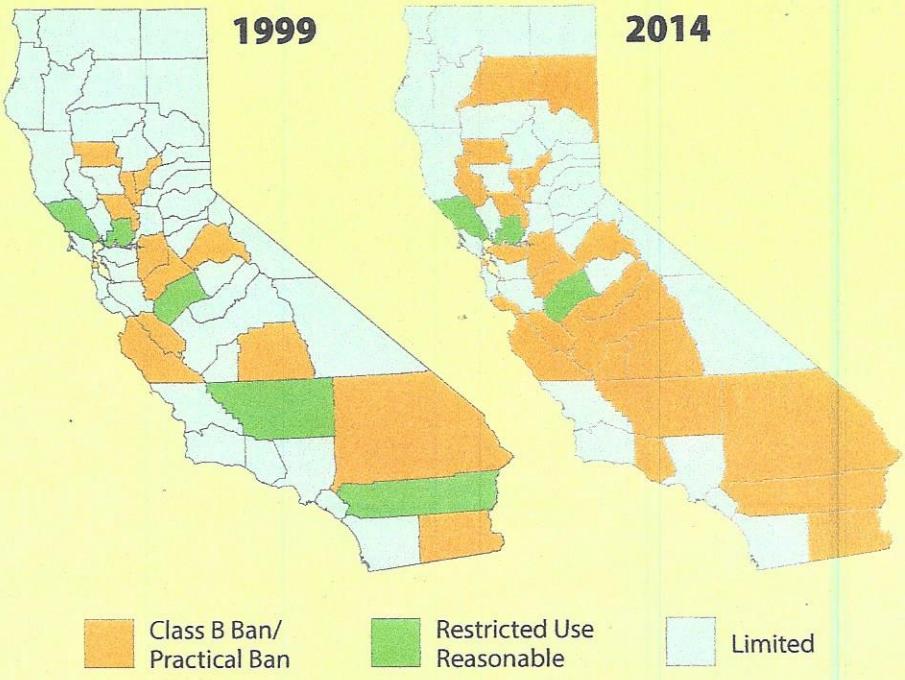


Biosolids management is a growing problem. Residents of the San Francisco Bay Area produce 29,861,998 cubic feet or 931,444 wet tons of biosolids (annually)–enough to fill AT&T Park to a height of 55 feet.

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.

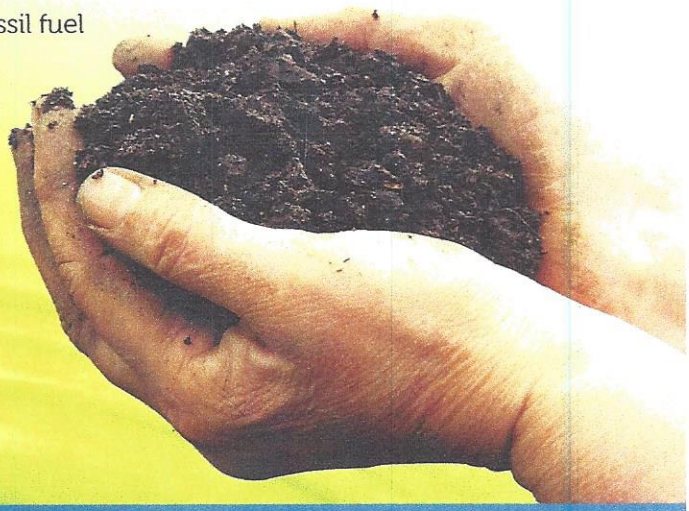


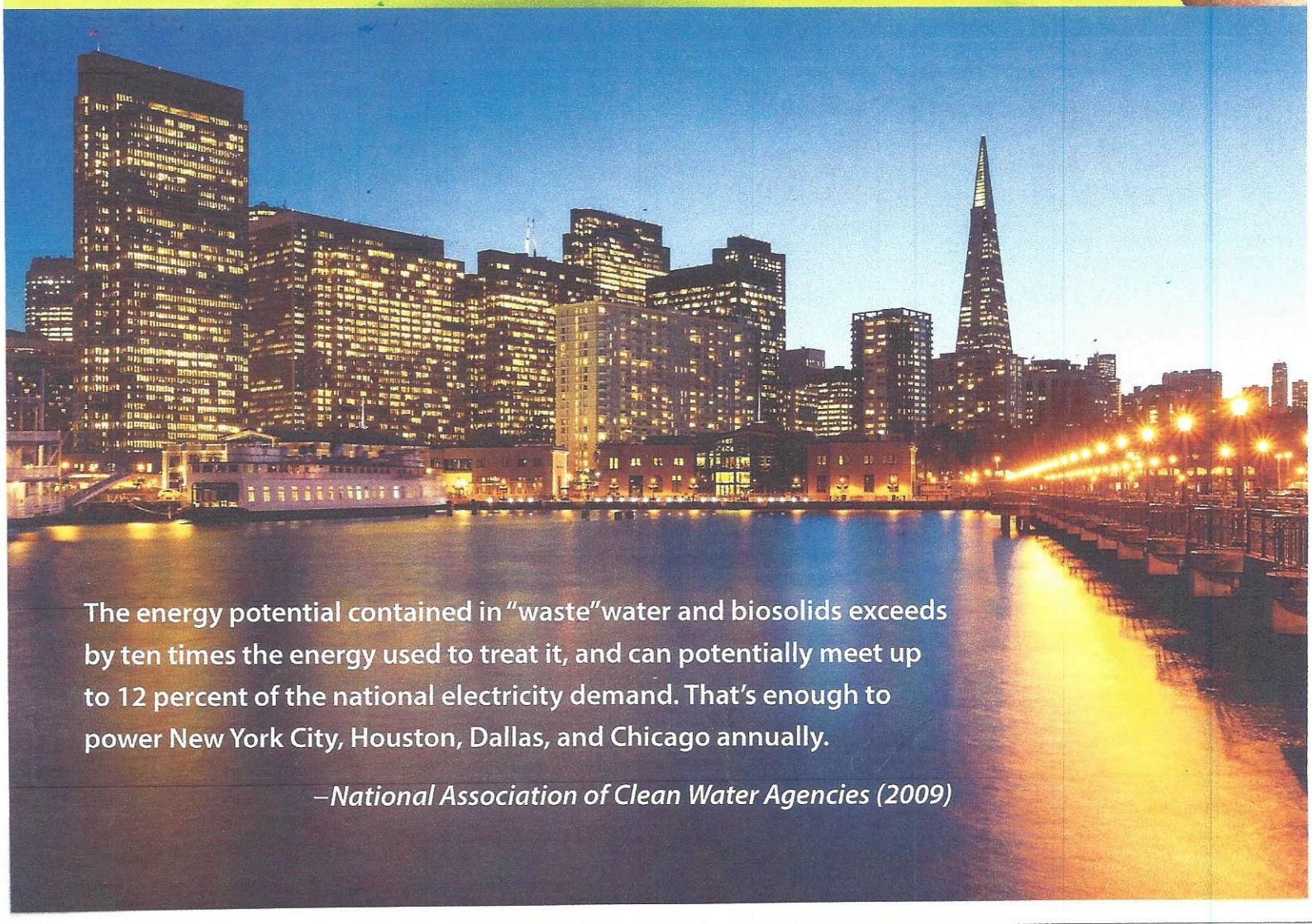
Biosolids to Energy Program:

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

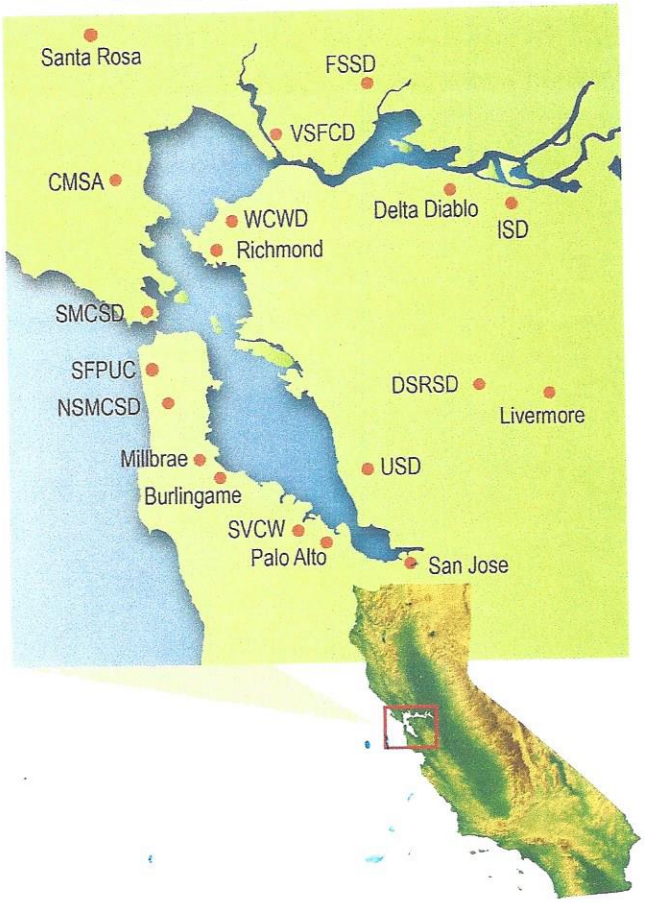




The energy potential contained in "waste"water and biosolids exceeds by ten times the energy used to treat it, and can potentially meet up to 12 percent of the national electricity demand. That's enough to power New York City, Houston, Dallas, and Chicago annually.

–National Association of Clean Water Agencies (2009)

Participating Agency District Locations



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.

The Coalition–19 Public Agencies Working Together

Agency (Population served)	Congressional District
Central Marin Sanitation Agency (CMSA) 115,000	Jared Huffman-2nd
City of Burlingame 36,000	Jackie Speier-14th
City of Livermore 80,273	Eric Swalwell-15th
City of Millbrae 22,000	Jackie Speier-14th
City of Richmond 68,000	Mark DeSaulnier-11th
City of San Jose and San Jose/ Santa Clara Water Pollution Control Plant 1,400,000	Mike Honda-17th Anna Eshoo-18th Zoe Lofgren-19th
City of Santa Rosa 230,000	Mike Thompson-5th
Delta Diablo 190,000	Mark DeSaulnier-11th Jerry McNerney-9th
Dublin San Ramon Services District (DSRSD) 159,000	Eric Swalwell-15th
Fairfield-Suisun Sewer District 131,000	John Garamendi-3rd
Ironhouse Sanitary District (ISD) 38,000	Jerry McNerney-9th
North San Mateo County Sanitation District (NSMCSD) 107,000	Jackie Speier-14th
Palo Alto Regional Water Quality Control Plant 217,331	Anna Eshoo-18th
San Francisco Public Utilities Commission (SFPUC) 756,000	Nancy Pelosi-12th Jackie Speier-14th
Sausalito Marin City Sanitary District (SMCSD) 16,500	Jared Huffman-2nd
Silicon Valley Clean Water (SVCWD) 220,000	Jackie Speier-14th Anna Eshoo-18th
Union Sanitary District (USD) 334,600	Eric Swalwell-15th
Vallejo Sanitation & Flood Control District (VSFCD) 120,000	Mike Thompson-5th
West County Wastewater District (WCWD) 95,000	Mark DeSaulnier-11th
Total Population Served 4,336,154	

BAY AREA Biosolids to Energy

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

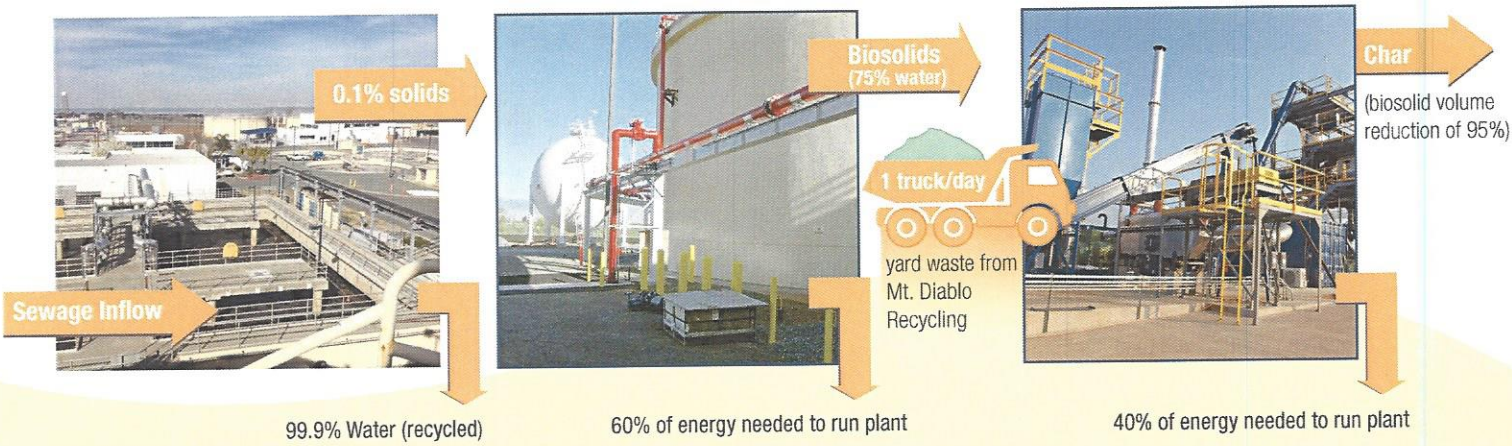
Delta Diablo

Mt. Diablo Recycling
reduce • reuse • recycle • respect • recover
A Garaventa Company

PHG Energy

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

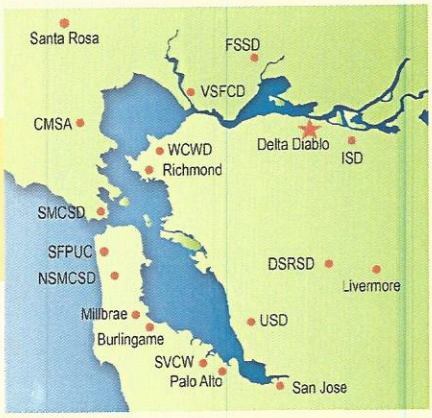
- Technology is not incineration
- Reduces greenhouse gas emissions by 85%
- Low emissions profile that will meet or exceed the standards set by EPA's Clean Air Act and the air standards set by the Bay Area Air Quality Management District
- Gasifier will process 7750 tons/year of wood waste (1 truck/day) & 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

PROJECT COSTS

Planning, Design & Environmental Studies	$500K
Project Management, Administration & Outreach	$200K
Site Acquisition, Permitting & Interconnections	$500K
Engineering, Construction & Construction Management	$8.5 Million
Financing & Legal	$300K
Total	**$10 Million**

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.

BAY AREA Biosolids to Energy



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

February 15, 2016

BAY AREA Biosolids to Energy

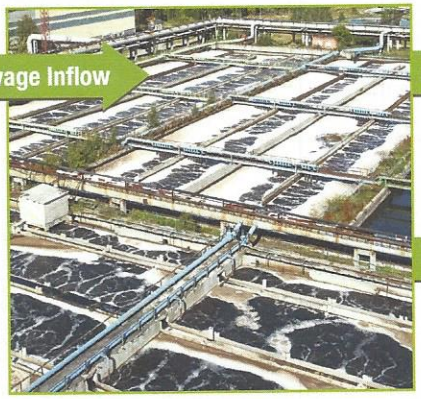
A PUBLIC PRIVATE PARTNERSHIP

Renewable Energy Project

Dublin San Ramon Services District
Water, wastewater, recycled water

SYNAGRO SCFI

BAY AREA BIOSOLIDS TO ENERGY PROJECT



Sewage Inflow

99.9% Water
(Recycled water)

0.1% Biosolids
(High energy available)

GOAL: 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%!

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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:

PROJECT COSTS

Planning, Design & Environmental Studies	$1.2 Million
Project Management, Administration & Outreach	$1.6 Million
Site Acquisition, Permitting & Interconnections	$2.5 Million
Engineering, Construction & Construction Management	$11.1 Million
Financing & Legal	$1.3 Million
Initial Operations	$6.8 Million
Total	**$24.5 Million**

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
- Destructs 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 CO_2; CO_2 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

19 Participating California Agencies

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Renewable Energy Project

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Water, wastewater, recycled water

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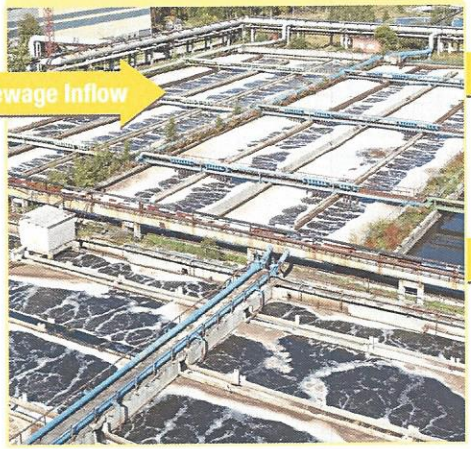

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AquaCritox Hydro Thermal Oxidation Technology

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February 12, 2016

BAY AREA Biosolids to Energy

A PUBLIC-PRIVATE PARTNERSHIP

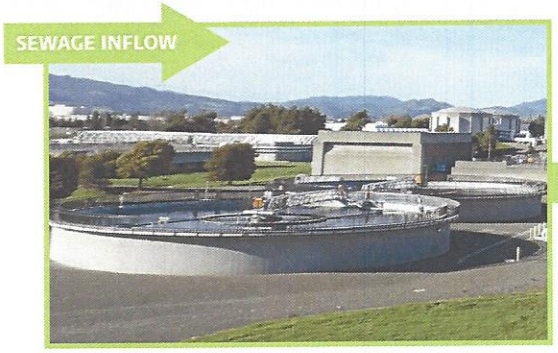
Renewable Energy Project

Lystek — Nothing wasted. Everything to gain.

FAIRFIELD-SUISUN SEWER DISTRICT

GOALS:

Minimize Green House Gases
Maximize Energy Potential in Biosolids



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

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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.

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.

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*

	Production[1]	% Increase[2]	Increased Electricity
kwH/y	5,527,000	25	1,381,750
kwH/d	15,142	25	3,768
Household equivalent	853	25	213

[1]CY2015 Electrical Energy produced from cogeneration

[2]LysteMize returned to digester, increasing gas production 25%

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2016.04.04

BAY AREA Biosolids to Energy

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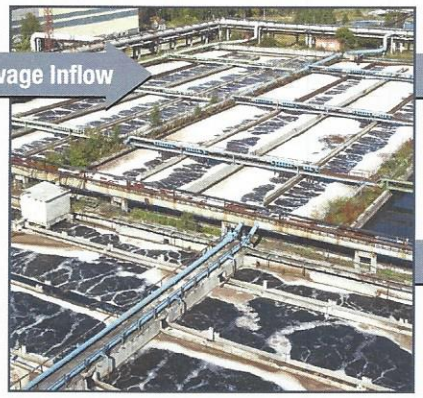
Renewable Energy Project

Delta Diablo

PHG Energy

BAY AREA BIOSOLIDS TO ENERGY PROJECT



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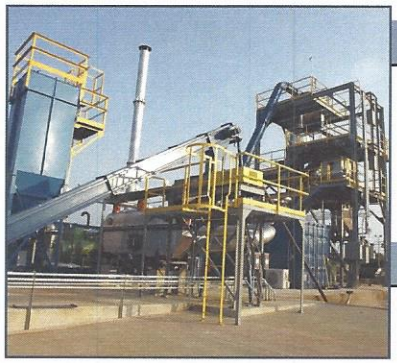

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The project (1 truck/day of wood waste + 8 tons/day of biosolids) generates 400 KW, enough power for Delta Diablo to be energy neutral

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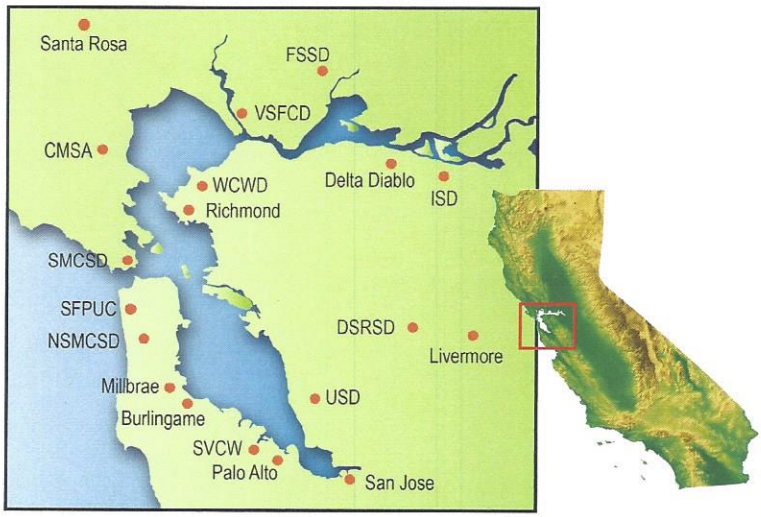

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- Reduces greenhouse gas emissions at least 50% over current biosolids practices
- Made in USA

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Dec. 2, 2015