CALIFORNIA BIORESOURCES ALLIANCE
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California Municipal Wastewater Digester Economic Issues

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Some California Municipal Anaerobic Digester Statistics - 1

- Sludge generated from 90 percent of California municipal wastewater is digested
- Over 50 percent of the current plants have digesters
- Only 9 municipal wastewater plants in California with greater than 5 mgd of flow do not have digesters
- 47 plants with flow less than 5 mgd have digesters
- Over 15 percent of the plants with digesters are importing some supplemental digester feed to boost biogas production

Some California Municipal Biogas Statistics - 2

- 71 percent of plants with digesters use the biogas
- ~ 94 percent of the sludge gas from digesters is used for anything from digester heating to pipeline injection
- 60 percent of plants with digesters generate electricity through cogeneration
  - Internal Combustion Engines – 42 %
  - Turbines – 6 %
  - Microturbines – 5 %
  - Fuel Cells – 6 %
- 3 percent of the plants with digesters inject the biogas into gas pipelines

Many Wastewater Treatment Plants are Refocusing on Biogas Use

- Energy independence
- Offers security/ reliability
- Best use of available resources
- Supports regulatory compliance
- Sustainable
- Cost effective

BUT -

- Digesters are expensive
- Air quality regulations add to the complexity, costs, and uncertainty
- Cogeneration is expensive and requires maintenance expertise
- Digested biosolids still have inherent disposal/benifical use costs and reliability concerns
- Digesters reduce the viability of gasification etc. by using much of the energy value

Municipal Digesters Are Expensive

- A typical municipal anaerobic digester can cost $7 to $12 million
- A recent CA study found that:
  - For typical municipal anaerobic digester design with 95 feet diameter digesters and associated facilities
  - Construction cost
    - $11 each
    - $33 million for a 40 mgd facility digester
    - $88 million with cogeneration and dewatering facilities
  - Highest life cycle cost of the alternatives except incineration
  - But, lowest GHG emissions of the alternatives

Cogeneration

General Design Considerations

- WWTP Digester gas can normally generate 40%-70% of WWTP's average power requirement
  - 40-50% is typical of CA plants with engines
  - 60% or more with Fuel Cells or with FOG/foodwaste addition
- Recovered heat is normally adequate to heat digesters
- Robust gas conditioning system is key to the success of all options. Must remove moisture, H2S, and siloxanes

Digester Gas Treatment System, EMWD-Moreno Valley, CA

Reciprocating Engines

- Proven technology for biogas gas – 4 major manufacturers
- 60 to 400 KW generation capacities
- Strict (and getting stricter) air permit regulations
- BACT requires oxidation catalysts and SCR
- Installation now requires extensive fuel conditioning to remove contaminants – no longer optional
- Efficiency 30-40%

335-kW Digester Gas Fueled Cogeneration System, Chico, CA WWTP

Micro Turbines

- Easy to permit - CARB-07 compliant
- Only two manufacturer's with DG experience (Capstone, FlexEnergy-Ingersoll Rand)
- Lower efficiency than engines; approximately 25%
- Requires >50 psi fuel pressure
- 30 to 250 KW Units

250-kW Landfill Gas Fueled microturbine Cogeneration System, Lancaster, CA

Gas Turbines

- Strict air permit regulations
- Limited manufacturer's with experience on DG (Solar Turbines, Rolls Royce-Allison)
- Effective fuel conditioning is required
- 3,000 to 10,000 KW - Competitive only for larger installations; greater than 3MW
- Efficiency typically 25-38%
- Requires >200 psi pressure

3.5 MW gas turbine Cogeneration System

Fuel Cells

- Ultra low emissions
- Expensive
  - Operational issues have significantly increased capital and O&M costs
- SGIP grant no longer favors fuel cells
- Only one manufacturer with digester gas experience
  - Fuel Cell Energy
- Very high efficiency 47%
- 250 to 2,800 KW units

250-kW Digester Gas Fueled Fuel Cells, EMWD-Moreno Valley, CA

Cogeneration Can Require A Long Payback Time ~ 25 MGD Facility with Digesters

Alternative (Costs in Million $)	No Cogeneration	Power Purchase Agreement	633 kW Engine Generator Cogen System	500 kW Microturbine Cogen System	600 kW Fuel Cell Cogen System
Estimated Cogeneration System Project Cost	$0	$0	$4.1	$4.8	$9.3
Estimated SGIP Grant Funding	$0	$0	($1.4)	($1.1)	($3.1)
Estimated Net Project Cost	**$0**	**$0**	**$2.7**	**$3.7**	**$6.2**
Present Worth of Energy Costs	$12.7	$11.6	$6.9	$8.4	$8.1
Total 20-Year Present Worth Costs	**$12.7**	**$11.6**	**$9.6**	**$12.1**	**$14.3**
Present Worth of Net Benefit Compared to No Cogeneration System		**$1.1**	**$3.2**	**$0.7**	**($1.6)**
Payback Period of Cogeneration System, years		**N/A**	**8**	**16**	**20+**

Current Biogas Sale Options in California

- Southern California Gas is only NG utility allowing digester gas into pipeline
  - Point Loma WWTP, San Diego
- SRCSD sells gas to SMUD
  - SMUD transmits digester gas in a dedicated SMUD pipeline to Carson Ice Power Plant
- DG to vehicles
  - City of Modesto & Phoenix systems in 1980's
  - Storage and compression costly

Biosolids Issues Remain after Digestion

- County land application restrictions
- Landfill limitations
  - Now
  - Future
- Public concerns
  - Odor
  - Pathogens
  - Fear of the unknown

What Funding Is Available?

Grants:

- DOE Energy Efficiency Block Grants
- USDA Rural Energy Program
- Self Generation Incentive Program
- SRF Green Project Reserve Funds

Loans:

- CEC SMART Loans
- SRF Programs
- Clean Renewable Energy Bonds (CREB's)

Externally Financed:

- Power Purchase Agreements (PPA's)
- Leasing Options

Bureau of the Public Debt
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QUESTIONS?

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