

Quarterly

# NEWSLETTER

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## From the Director

**T**he increasing application of anaerobic digestion systems for improved waste management and renewable energy generation is evident in the recent startups of projects supported under a combination of state, federal, and private financing.

Over the past year, five California dairies have begun operating anaerobic digestion systems, and nine other biogas systems are expected to become functional in 2005. Further details are provided in this newsletter, including information on the Dairy Power Production Program managed for the Energy Commission by Western United Resource Development Inc. Studies assessing the potential of conversion technologies for municipal solid waste have also recently been completed, and a report on the subject will be submitted by the Integrated Waste Management Board to the legislature in early 2005. The draft report is currently available for review. Results will be described in future California Biomass Collaborative newsletters.

A key topic of interest emerging from the survey conducted during the first Collaborative forum was state biomass policy. The Collaborative is currently preparing an issues paper on opportunities for sustainable biomass management and development, and this will be an item for discussion at the upcoming forum in March. I look forward to seeing you all there, and as always, I welcome hearing from you with any updates or other information you feel would be of interest to the Collaborative.

—Bryan Jenkins

## CBC Second Annual Forum March 1

**C**alifornia Biomass Collaborative will hold its second annual forum at the CalEPA building 1001 I Street, on March 1 in Sacramento. The forum, titled *Sustainable Management & Development of Biomass in California*, includes discussions on:

- Accelerating renewable energy development
- Emerging technologies
- Biopower, Biofuels, and Bioproducts
- Lifecycle and environmental impacts
- Financing and incentives
- Needs for comprehensive biomass policy in the state

This forum provides an opportunity to share your thoughts about the development of biomass and hear about current issues and perspectives from a diversity of speakers. Join us in bringing together the many sectors involved in promoting the sustainable management and development of biomass in the state. The forum agenda is posted on the Collaborative Web site, <http://biomass.ucdavis.edu/>. To register for the forum, visit the conference Web site at <http://conferences.ucdavis.edu/cabiomass> and submit the electronic registration form.

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## California Expands its Role in Renewable Energy Development

**T**he oil crises of 1973 and 1979 sparked development of biomass-to-biogas systems utilizing anaerobic digestion in California, but many were discontinued for economic and technical reasons. The Langerwerf Dairy system in Butte County is one of the few remaining. In the last several years, driven largely by environmental action, a second wave of biogas system development has occurred that promises to be the start of a substantial growth in these facilities throughout the state.

New state incentives provided after the California electricity crisis of 2000-2001 coupled with other incentives and regulations have resulted in renewed interest in biogas systems development. For example, the Dairy Power Production Program (DPPP) was initiated by the California Energy Commission (CEC) Public Interest Energy Research (PIER) program in response to Senate Bill 5X (2001). Among other things, SB5X provided \$15 million in grants to be used for pilot projects encouraging the development of biogas systems utilizing anaerobic digestion. A total of \$10 million was earmarked for the development of manure methane power projects on California dairies. Five million dollars in grants was for peak power production during peak demand periods through revision of system operations in anaerobic digestion of biosolids and animal wastes in Southern Califor-

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**Table 1. CEC supported dairy and food waste biogas projects.**

Owner	County	Support Program	Milking Cows (except as noted)	Biogas System Type	Generating Capacity (kW)	Status
Blakes Landing Dairy	Marin	DPPP	237	Covered lagoon	75	Operational
Castelanelli Bros. Dairy	San Joaquin	DPPP	1600	Covered lagoon	160	Operational
Gallo Cattle Company	Merced	DPPP	5081	Covered lagoon	300	Operational
Koetsier Dairy	Tulare	DPPP	1500	Plug flow	260	Operational
Meadowbrook Dairy	San Bernardino	DPPP	1900	Plug flow	160	Operational
Harmony Farms	Tulare	DPPP	1050	Covered lagoon	120	In Development
Hilarides Dairy	Tulare	DPPP	6000	Covered lagoon	250	In Development
Van Ommering Dairy	San Diego	DPPP	600	Plug flow	130	In Development
CalPoly Dairy	San Luis Obispo	DPPP	175	Covered lagoon	30	In Development
Plane View Dairy	San Bernardino	DPPP	1100	Mixed	100	In Development
Lourenco Dairy	Tulare	DPPP	1258	Covered lagoon	150	In Development
Inland Empire Utilities Agency	San Bernardino	DPPP	4700	Plug flow	563	In Development
Eden-Vale Dairy	Kings	DPPP	770	Plug flow	150	In Development
Bidart Dairy II	Kern	DPPP	7200	2-stage plug flow	1000	In Development
Inland Empire Utilities Agency Phase II	San Bernardino	CEC grant	dairy manure + food waste	Centralized European Type	1500	In Development
Valley Fig Growers	Fresno	CEC grant	food processing waste water (40,000 gals/day)	Covered lagoon	70	In Development

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nia. A number of other state and federal programs support biogas development.

Although biogas systems are generally recognized as providing environmental benefits when properly implemented, concerns remain over the use of public funds to support development. A recent Sierra Club guidance document, for example, opposes public subsidies to methane digesters and other energy generation facilities at large confined animal feeding operations (CAFOs) for reasons of environmental protection, animal health, and public safety. Amounts paid by the utilities for energy delivered to the grid and time required for utility interconnection are also of concern.

The DPPP has awarded contracts to 14 dairies in California, and several biogas-power projects have recently begun operating or are in development (Table 1, above). Several other landfill gas and waste digester projects will be discussed in the next newsletter.

Capital costs are expected to range from \$1,500 to \$6,000 per kW installed and depend on whether the system is refurbished or new along with other factors.

The average generating capacity is estimated to be 82% of the full rated design capacity. Energy used on-site displaces utility purchases valued at retail rates, including high-value peaking power. Other benefits include recovery of waste-heat for industrial processing and digester heating (combined heat and power or CHP), odor, and greenhouse gas emission reductions, potential reductions in surface and groundwater contamination, and use of digester effluent for fertilizer or soil amendment. Sale of digested residue offers another revenue stream to improve economic feasibility. With more systems in operation, additional testing is required to obtain better air emission and other environmental and technical performance data in support of regulation and permitting.

In May 2004, Blakes Landing Dairy/Straus Family Creamery in Marin County began operating a 75 kW system. The company obtained a \$67,900 buydown grant from the DPPP to refurbish an older, covered lagoon digester. Other support for the project was obtained from the Marin Resource Conservation District, the Regional Water Quality Control Board, and US

EPA. Manure is collected through a flush system, using about 2,400 gallons per day of fresh water. Solids are separated over an inclined screen before manure enters the lagoon. The lagoon digester is unheated and follows ambient temperatures. Biogas is used to fuel an internal combustion reciprocating engine-generating set.

Last October, Castelanelli Dairy in San Joaquin County opened a nominal 160 kW covered lagoon biogas system. The dairy milks 1,400-1,600 cows, and raises an additional 2,100 cattle. Manure is collected through a flush system, using 400,000 gallons per day of recycled lagoon water. Sand and solids are separated ahead of the lagoon. Residence time in the unheated lagoon is approximately 40 days, resulting in the production of 60,000 to 130,000 cubic feet of biogas per day depending on season of the year and lagoon temperature. The system also utilizes a reciprocating engine-generator set for power generation.



Zhiqin Zhang, CEC Dairy Power Production Program project manager, congratulates Larry Castelanelli on the successful completion of the biogas system.

Also in October, Gallo Farms Cottonwood Dairy began operation of a digester system. A seven-acre covered lagoon receives manure from more than 5,000 milk cows and cheese whey from Gallo's cheese plant. Biogas fuels a 300 kW reciprocating engine-generator set. Currently about half the biogas is flared and the company plans to add a second engine to double generating capacity. Power and heat recovered from the engine are used in the company's cheese plant with energy savings estimated at \$275,000 per year.

Meadowbrook Dairy's 160 kW biogas facility began operation in November in San Bernardino County. The digester is a plug flow type, and the system also employs a reciprocating engine-generator set.



Seven-acre covered lagoon at Gallo Farms. Inclined screen solids-separator is visible in distance.

Koetsier Dairy in Tulare County refurbished a plug flow digester and will be generating 260 kW from manure produced by 1,500 dairy cows.

Inland Empire Utility Agency (IEUA) has operated several centralized digesters on manure collected from dairies located in the Chino basin through funding from SB 5X and other sources. IEUA also has tested food waste additions to improve gas production. IEUA is currently working under a CEC grant on the development of a larger centralized European-style digester system.

European policies aimed at improved waste management and greenhouse gas reductions have stimulated a marked growth in digester capacity in recent years with a number of technological improvements. California and the United States currently lag Europe in application of these types of systems. The IEUA project is intended to assess performance relative to an existing plug flow digester. IEUA hosted the Anaerobic Digester Summit II last June.

Valley Fig Growers in Fresno is installing a food processing waste-water covered lagoon digester system to generate biogas for a 70 kW microturbine-generator set. Biogas also can be used to fuel the boilers that provide process steam and hot water. The digester will reduce the organics in the waste-water sent to the municipal sewer, thereby reducing waste treatment

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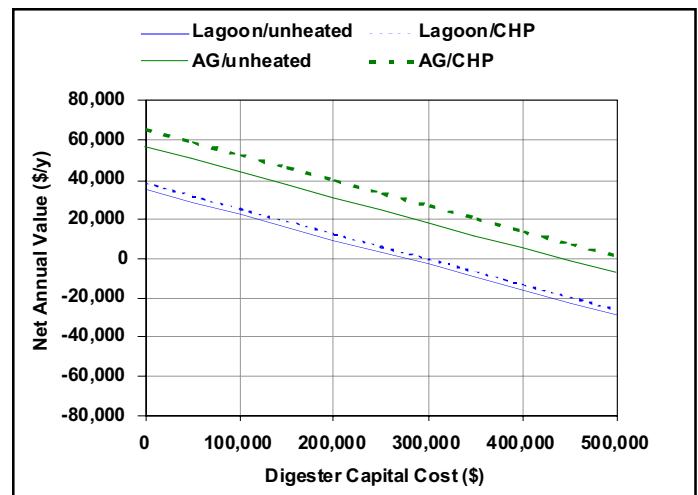


Figure 1. Annual net present value (\$/year) of biogas-power generation from a model 1,000-cow dairy for flush water (typically recycled) use of 48 gallons per head per day, operating and maintenance costs of \$0.015/kWh, electrical energy valued at \$0.10/kWh, and no by-product credit for digester effluent. The figure compares unheated covered lagoons, covered lagoons heated with recovered engine heat (CHP), unheated attached-growth (AG) in-vessel digesters, and CHP heated AG digesters. To isolate the effect of the digester, the digester capital cost axis in the figure excludes the gen-set capital cost, although the latter is included in the calculation of the net annual value. The lagoon produces positive net value (breakeven) for digester system capital costs below \$300,000 (total installed cost including genset not exceeding \$3,500/kW) while the attached growth systems breakeven below \$400,000 (total installed cost not exceeding \$4,100 to 4,600/kW). Higher flush water use decreases the breakeven capital cost.



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## **CBC Membership and Operation**

The CBC is an organization of more than 300 members, representing the diverse interests of the biomass community. To become a member, visit the Collaborative's Web site at <http://biomass.ucdavis.edu>.

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costs. The total capital cost of the project is estimated at \$1.2 million, with the company providing 60 percent. The remainder is covered under a separate grant with the CEC. Savings from waste-water disposal will be about \$100,000 per year, with savings of \$50,000 to \$100,000 per year in energy costs. The system is scheduled to become operational in early 2005.

The economic feasibility of biogas systems depends on the opportunity to displace retail electricity, to utilize heat, and the cost avoided in using alternative forms of waste management. Results of a recent modeling study comparing unheated and heated covered lagoons with unheated and heated attached-growth digesters show that where electrical energy is valued at appropriate retail rates, advanced systems may realize higher net annual economic benefits than lagoon systems (Figure 1). More data from the new systems coming on line are needed to evaluate these results.

The potential electricity-generating capacity using biogas systems in California is currently estimated at more than 900 MW, with 136 MW from dairy, 465 MW from landfill gas, 75 MW from municipal waste-water treatment, and additional capacity from food processing, other animal, and vegetable residues. Existing capacity is 293 MW, mostly in landfill gas and waste water

treatment, with an undeveloped potential exceeding 600 MW. By 2017, the total capacity might exceed 1,200 MW.

Biogas or biomethane can also be used for transportation, hydrogen production, and chemical synthesis. Clearly, biogas systems can contribute significantly to the state's energy needs, as well as providing environmental benefits. There remain, however, a number of technical and economic uncertainties, including management requirements, operator safety, and capacity effects, centralization, system integration, the potential for optimizing across local or regional scales, and other incentives supporting technology adoption. Effective designs, marketing, policies, and regulations combined with appropriate monitoring and enforcement will be needed for the sustainable growth of these systems.

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