

# DAIRY POWER PRODUCTION PROGRAM PROGRESS REPORT

(Program Funded by SB5X)

*Prepared For:*  
**California Energy Commission**

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## **I. Background and Purpose**

The purpose of the Dairy Power Production Program (DPPP) is to encourage the development of biologically based anaerobic digestion and gasification (“biogas”) electricity generation projects on California dairies. Objectives of the program include developing commercially proven biogas electricity systems that can help California dairies offset the purchase of electricity, and providing environmental benefits by reducing air and ground water pollutants associated with storage and treatment of livestock wastes.

The California Energy Commission, acting under authority of Legislative enactment of SB5X (Section 5(b)(5)(C)(i)), appropriated and encumbered \$9,640,000 for the Dairy Power Production Program (DPPP). Western United Resource Development (WURD) Inc. was selected by the Energy Commission as the Contractor for this program. The term of this program is from July 12, 2001 through March 31, 2004.

## **II. Program Structure**

The California Energy Commission has overall responsibility for the program, and sets policy and program directions based on the enabling legislation. WURD is the Program Administrator and is responsible for day to day operation of the program. An Advisory Board of technical experts helps the CEC and WURD with review of applications and recommendations on program content, direction and effectiveness. The Advisory Board is made up of representatives from State agencies that have regulatory responsibilities over California dairies and biogas systems or could be affected by development of dairy biogas systems. The Advisory Board also has representatives from affected federal organizations and from the environmental community. The members consist of representatives from the California Energy Commission; Western United Resource Development Inc.; U.S. Environmental Protection Agency's AgSTAR Program; California Department of Food and Agriculture; California State Water Resources Control Board; Sustainable Conservation; University of California; and Milk Producers Council. In addition, WURD subcontracts with technical experts to conduct due diligence reviews on the legal, technical, economic and environmental aspects of the proposed projects.

The program is designed to provide two types of assistance for qualifying dairy biogas projects: buydown grants that cover a percentage of the capital costs of the proposed biogas system, or incentive payments for generated electricity. In general, buydown grants cover a maximum of up to fifty percent of the capital costs of the biogas system based on estimated power production, but not to exceed \$2,000 per installed kilowatt electricity, whichever is less. Electricity generation incentive payments are based on 5.7 cents per kilowatt-hour of electricity generated by the dairy biogas system paid out over a maximum of five years. The total cumulative payments under the incentive payment route are intended (after five years) to equal the amount of funding that would be provided for an equivalently sized digester-to-electricity system under the grant buydown approach.

Applications submitted to the DPPP are submitted to the advisory group for preliminary technical and economic review. Applications deemed suitable by the core advisory group are submitted for legal, technical and financial due diligence review. Two different types of reviews are conducted depending on the type of funding request. Buydown

grant applications undergo more rigorous due diligence review than incentive grant applications as buydown grants are paid out as the project is constructed. Incentive grants are paid only after the project is complete and generates electricity. Other specific differences between the two funding pathways are described below.

#### **Buydown Grant Applications**

- Overall suitability of the proposed dairy to employ biogas-to-electricity technology
- Technical assessment of the proposed biogas system to be used at the dairy
- Analysis of the economic feasibility of the proposed project
- Financial feasibility of the proffered project
- Adequacy of applicant's insurance and indemnification of WURD and the California Energy Commission
- Commitment to secure optional performance bond to extend for five years from grant date
- Use of service agreements to cover maintenance and/or problems with all equipment related to the digester, including the biogas reactor system, the prime mover, the gas handling and transmission system, and interconnection/switchgear equipment
- Ability of proposed system to comply with existing laws.
- Other matters as may be deemed appropriate to ensure integrity of program funding

#### **Electricity Generation Incentive Payment Applications**

- Overall suitability of the proposed dairy to employ biogas-to-electricity technology
- Financial feasibility of the proffered project
- Adequacy of applicant's insurance and indemnification of WURD and the California Energy Commission
- Commitment to secure optional performance bond to extend for five years from grant date
- Use of service agreements to cover maintenance and/or problems with all equipment related to the digester, including the biogas reactor system, the prime mover, the gas handling and transmission system, and interconnection/switchgear equipment
- Ability of proposed system to comply with existing laws
- Other matters as may be deemed appropriate to ensure integrity of program funding

As noted earlier, incentive payment applications are subject to less strenuous technical review. Consequently, the applicant takes on greater technical and financial risk with this option.

The advisory group considers the technical, legal and financial due diligence reports when making final funding determinations. To the extent possible, the advisory team tries to ensure the funded projects span the range of California dairy sizes, geographical locations within the state, and types of dairy manure management practices.



funding, and nine have signed grant agreements with WURD. The total project costs and CEC grant awards for the ten approved projects are \$5,287,940 and \$2,532,748, respectively.

Eleven applications are currently under due diligence review in the program or pending due diligence review. The total amount of program funding requested by these eleven projects is over \$4 million.

All 46 applications made to the program have been geared to on-farm biogas systems. At the beginning of 2003, the CEC and WURD started considering allowing applications for centralized biogas systems located off-farm. Centralized biogas systems offer some benefits unavailable from on-farm approaches under certain conditions. In general, the unfavorable economics of transporting dairy wastes requires a very high density of dairy farms. Two areas of the state typically have the types of densities that could support a centralized biogas system approach: the Chino Basin in southern California and the Kings County region of the San Joaquin Valley. Consequently, the CEC and WURD have earmarked up to \$2 million of the program funds for a centralized biogas system project, and are in active discussions on a centralized biogas application.

Overall, progress has been slower in the program than originally anticipated. The program was originally targeted to have all the approved projects installed by summer of 2002. The program has experienced delays for several reasons. For example, dairy biogas projects proposed in the program use more water and consequently must have larger digesters than planned. The larger digesters increased capital costs beyond the estimates used in planning out the program. The CEC originally budgeted DPPP project share at no more than \$1250 per installed kilowatt. As projects applications were submitted, it became apparent that the larger digester sizes would require the DPPP share to be increased to \$2000 per installed kilowatt if the program were to meet a fifty percent project cost share. Project applicants were unwilling to sign grant agreements until the CEC rendered a decision on the cost share. Project applicants have also experienced delays in obtaining needed permits and electricity interconnection agreements. Delays in obtaining interconnection agreements pose serious problems to implementing dairy biogas systems in California. Several attempts have been made to develop a streamlined process for obtaining interconnection agreements, including specific legislation (SB 2228, McLeod). However, almost all of the dairy biogas projects are still experiencing delays for these items.

It should be noted that the importance of the interconnection issue extends will delay dairy biogas systems. Under California's Renewable Portfolio Standard, twenty percent of electricity is to be developed from renewable resources by 2017. The inability to interconnect small renewable resources, such as biogas systems, could significantly impact the state's ability to harness these renewable resources and meet RPS goals.

Lastly, low milk prices have had an impact on progress in the program. Beginning in mid-2002, low milk prices began straining available funding from dairy owners with pending applications. Consequently, dairy farmers with pending applications have slowed the process while they secure the fifty-percent of match funds required by the program. In light of these delays, the CEC extended the deadline to have all awarded projects installed by December 31, 2003.

## 1. Administrative Funds

The total administrative funds allocated to WURD are \$1,030,250. WURD is responsible for program marketing, processing of applications, performing technical and due diligence reviews, monitoring and evaluating projects, and performing annual program performance reviews. WURD has spent approximately \$475,000 on administrative costs, leaving the remaining administrative funding at a little over \$553,000.

## 2. Project Funds

Project funding is budgeted at \$8,609,750 for the program. To date, ten projects have been approved and nine have signed grant agreements with WURD. The ten approved projects represent over \$2.5 million in project funding. In addition, there are eleven projects in various stages of review and approval. These eleven pending projects represent a little over \$4 million in project funding. Lastly, as described in the previous section, the CEC and WURD have earmarked \$2 million in project funding for a centralized biogas system project. More detailed information on the allocated project funding is provided below.

### a. Funding for approved projects

Ten projects have been approved and nine have signed grant agreements with WURD. Grant funding available to these awarded projects is \$2,532,748. Total projects costs range from \$75,000 to \$1,289,520. Grant awarding amount and payment methods for the ten projects are outlined in the Table 1.

Table 1: Funding for approved projects

Dairy ID Number	CEC Grant Funding Amount (\$)	Estimated kW Potential	Payment Method
201	\$181,000	120	Buydown
204	\$600,000	300	Buydown
207	\$67,900	75	Buydown
221	\$320,000	160	Buydown
222	\$513,553	280	Buydown
225	\$190,925	260	Incentive
226	\$244,642	130	Buydown
230	\$262,449	160	Buydown
232	\$37,500	30	Incentive
238	\$114,779	150	Buydown
<b>Total</b>	<b>\$2,532,748</b>	<b>1,665</b>	

### b. Funding for pending projects

Eleven projects are pending review and approval of grant awards from the program. Projects 102 and 128 have been through both advisory group and due diligence review, and are currently preparing clarification questions. The remaining nine projects are in the midst of finalizing project estimates. Table 2 outlines the funding, estimated kW potential and payment method for the eleven pending projects.

Table 2: Funding, Estimated kW Potential, and Payment Method for Pending Projects

Dairy ID Number	CEC Grant Funding Amount (\$)	Estimated kW Potential	Payment Method
102	\$665,000	330	Buydown
128	\$648,853	420	Buydown
137	\$245,000	340	Buydown
120	\$375,000	220	Buydown
140	\$650,000	450	Buydown
141	\$800,000	400	Buydown
146	\$360,000	300	Buydown
139	\$81,806	300	Buydown
143	\$81,806	300	Buydown
144	\$81,806	300	Buydown
145	\$81,806	300	Buydown
<b>Totals</b>	<b>\$4,071,077</b>	<b>3660 kW</b>	

#### IV. Status of Awarded Projects

##### A. Project Locations

One objective of the program is to select projects that span geographical locations throughout California. Applications received in the program are very representative of the distribution of dairies in California. Applications were received from several large dairy counties including Fresno, Tulare, Kings, Merced, San Joaquin, San Bernardino and Stanislaus.

Locations of the ten projects awarded for funding and that have grant agreements are shown in Figure 2, and are shown in Table 3. The ten projects are also representative of the dairy distribution in California and span from San



Figure 2: Locations of Awarded Projects

Diego County to Marin County.

Table 3: Distribution of Approved Projects

Dairy ID (Name)	Location	County
201	Strathmore, CA	Tulare
204	Atwater, CA	Merced
207	Marshall, CA	Marin
221	Lodi, CA	San Joaquin
222	Buttonwillow, CA	Kern
225	Visalia, CA	Tulare
226	Lakeside, CA	San Diego
230	El Mirage, CA	San Bernardino
232	San Luis Obispo, CA	San Luis Obispo
238	Tulare, CA	Tulare

### B. Digester Type and Project Cost

Approved projects use two types of digesters: plug flow reactors and covered lagoons. The plug-flow digester design is basically a long linear reactor wherein wastes move slowly through the reactor as a "plug." Plug flow digesters are often built below ground level, with an airtight expandable cover. Organic wastes are collected daily and added to one end of the trough. Each day a new "plug" of organic wastes is added, slowly pushing the other manure down the trough. Plug flow digesters are usually operated with a total solids concentration of 11 to 13 percent, at the mesophilic temperature range, and with a hydraulic residence time (HRT) from 20-30 days.

A covered lagoon is an earthen lagoon fitted with a floating, impermeable cover that collects biogas as it is produced from the organic wastes. The cover is constructed of an industrial fabric that rests on solid floats laid on the surface of the lagoon. The cover can be placed over the entire lagoon or over only that part producing the most methane. An anaerobic lagoon is best suited for organic wastes with a total solids concentration of 0.5 to 3 percent. Covered lagoons are not heated.

The total costs of ten awarded projects range from \$1469/kW installed to \$4831/ kW installed and are shown in Figure 3. Applications #207 and #225 are designed to refurbish the existing digesters and therefore reflected lower costs as compared with other projects. It is difficult to analyze the difference of the other project costs until the awarded projects are completed and the



Figure 3: Total Cost of Awarded Projects

real costs of the digestion systems are collected.

The total estimated cost, type of digesters, and total estimated electricity are listed in Table 4.

Table 4: Costs and Characteristics of Approved Projects

Dairy ID Number	Total Estimated Cost \$/kW installed	Type of Digester	Total Estimated kW Installed
201	\$3,017	Cov'd lagoon	120
204	\$4,298	Cov'd lagoon	300
207	\$1,811	Cov'd lagoon	75
221	\$4,831	Cov'd lagoon	160
222	\$3668	Cov'd lagoon	280
225	\$1,469	Plug flow	260
226	\$3,764	Plug flow	130
230	\$3,281	Plug flow	160
232	\$2,500	Cov'd lagoon	30
238	\$1,530	Cov'd lagoon	150

### C. Individual Project Status

#### #201

Dairy #201 has 1050 milking cows. The project will install a covered lagoon to convert manure into biogas, which will then be used to generate electricity for on-site use. The designed electricity capacity from biogas is 120 kW.

The project has not been completed. The new lagoon has been completely dug and engineering plans have been completed. However, the project has run into delays in obtaining necessary permits. In particular, the Tulare County Resource Management Agency (RMA) requires the farm to obtain a new special use permit to increase the allowable animal units by 283 animals. Low milk prices have also strained available funding from the dairy owner who is providing 50 percent of the total project cost. Pending permit decisions by Tulare County, Harmony Farms expects to complete the project by fall of 2003.



## #204

Dairy #204 has a total of 4686 milking cows. The project will install a covered lagoon to produce electricity at a designed capacity of 300 kW. The overall project plans have been completed. Construction has begun. The pads for the manure separators have been leveled, and the lagoons have been partially excavated.

The project has been delayed. The primary reason for the delay is the length of time that was required to obtain construction permits.

The project is expected to be completed by December 31, 2003.



## #207

Dairy #207 has 237 milking cows. The project will refurbish a covered lagoon. The designed electricity capacity is 75 kW. The overall project plans have been completed. Equipment has been ordered and all items are expected to arrive by May 1, 2003. The project will take several months to complete the construction, as well as obtain the Rule 21 interconnection permit from PG&E so that the project can generate power in parallel with the grid.

The project is expected to be completed by September 1, 2003.



## #221

Dairy #221 has 1600 milking cows. The project will install a new covered lagoon to convert manure into biogas, which will then be used to produce electricity. The designed electricity capacity from biogas is 160 kW. The overall project plans have been completed and construction has begun. The lagoon is completed and the grading has been completed for the utility structure.

The project is expected to be completed by June 30, 2003. The only uncertainty is with the utility interconnection.



## #222

Dairy #222 has 3600 milking cows. The project will install a new covered lagoon to convert manure into biogas, which will then be used to produce electricity. The designed electricity capacity from biogas is 280 kW.

Application 222 has been approved and is currently pending on signing grant agreement with WURD.

The project is expected to be completed by Dec 31, 2003.



## #225

Dairy #225 has 1500 milking cows. The project will refurbish a plug flow digester. The total design electricity capacity from biogas is 260 kW.

The overall project plan and construction have been completed. The only delay is with the utility interconnection.



## #226

Dairy #226 has 600 milking cows. The project will install a new plug flow digester. The designed electricity capacity is 130 kW. The overall project plan has been completed. The construction is expected to begin on July 10, 2003. The project has been delayed due to California Environmental Quality Act (CEQA) reporting requirements and habitat issues associated with the grading permit.

The project is expected to be completed by December 31, 2003.



## #230

Dairy #230 has 1900 milking cows. The project will install a new plug flow digester. The designed electricity capacity from biogas is 160 kW. The overall project plan has been completed. The project has begun construction. The pivots, storage pond, and mixing pit have been finished.

The project is currently waiting on for a permit for the digester. It is difficult to give a revised date of completion of the project



## #232

Dairy #232 has 175 milking cows. The project will refurbish a covered lagoon. The designed electricity capacity from biogas is 30 kW.

The project plans have been completed. The original construction was completed last July 2002 and the lagoon has been running since that time. The project is now working on replacing certain gas line components including the gas blower, moisture and sediment trap, meter and microturbine compressor. These devices are expected to be in placed by July 1, 2003.



The project is expected to be completed by July 1, 2003.

## #238

Dairy #238 has 1258 milking cows. The project will install a new covered lagoon. The designed electricity capacity from biogas is 150 kW.

The project has been awarded recently. The project plans are expected to be done within a month. The project is expected to begin construction as soon as the plans are complete.

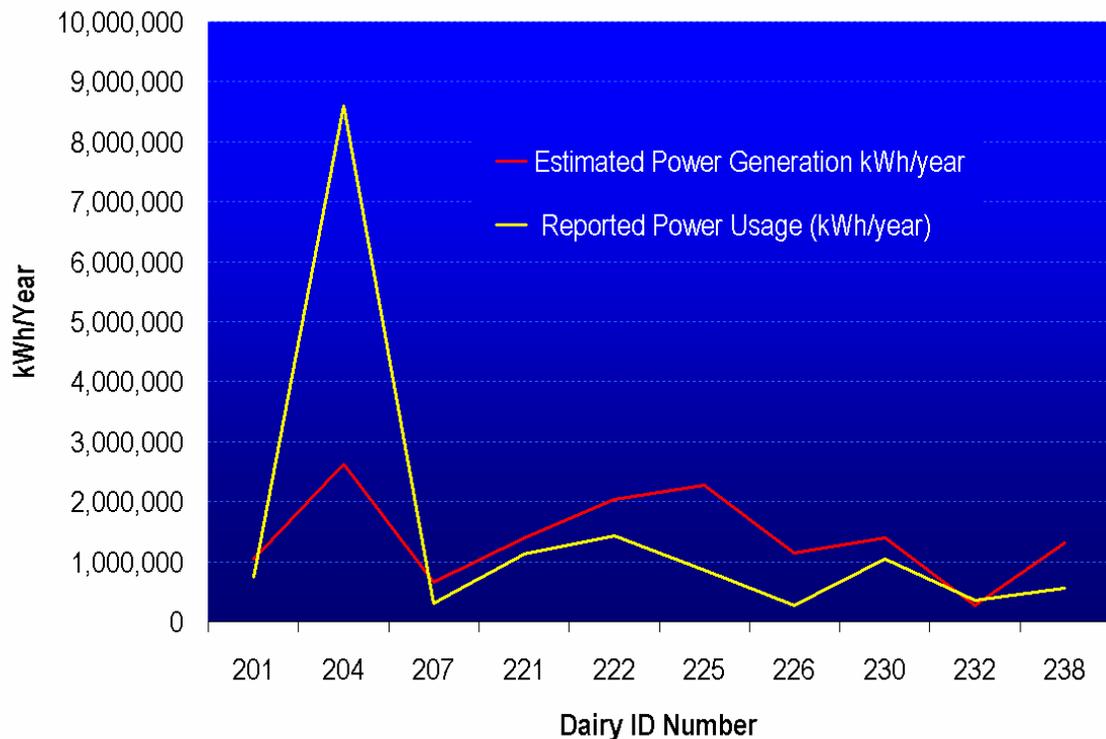
## V. Benefits of the Program

### A. Power Generation

Producing electricity from livestock wastes currently considered a waste disposal problem is a primary benefit of the program. California has an estimated 2153 dairies housing an estimated 1.6 million dairy cows. Statewide, dairy cows generate nearly 16 million wet tons of manure each year requiring disposal. If biogas to electricity systems were installed at every California dairy, the systems would provide approximately 75 MW of generating capacity and over 657 million kilowatt-hours per year of delivered electricity.

If all 46 projects requesting funding from DPPP were constructed they would represent an electricity generation capacity of over 8.4 megawatts (MW) and provide nearly 74 million kilowatt-hours (kWh) per year of electricity. The ten approved projects represent a generating capacity of nearly 1.7 MW and are capable of producing over 15 million kWh hours per year of renewable electricity.

Power production from biogas at dairies is especially beneficial because it can help offset expensive and (as seen in 2001) valuable peak electricity. Figure 4 shows the relationship between electricity use and potential biogas electricity production on the applying dairies. In most cases, the estimated amount of power available from biogas at the dairy closely matches power used at the dairy. Therefore, biogas generated electricity can greatly offset electricity purchased at retail rates by the dairies. This not only helps the dairies economically, but preserves electricity generated from fossil-fired peaking units for consumers that have little or no capability to generate electricity. Table 5 outlines the approved projects' estimated electricity generation capability and energy usage.



**Figure 4: Electricity use and potential biogas electricity generation at dairies**

Table 5: Electricity Characteristics of Approved Projects

Dairy ID Number	Estimated kW Capacity	Estimated Power Generation kWh/year	Reported Power Usage KWh/year
201	120	1,051,200	743,367
204	300	2,628,000	8,610,000
207	75	657,000	300,012
221	160	1,401,600	1,129,135
222	280	2,044,000	1432080
225	260	2,277,600	850,875
226	130	1,138,800	276,940
230	160	1,401,600	1,049,040
232	30	262,800	345,888
238	150	1,314,000	548,375
Totals:	1665	14,176,600	15,285,712

### B. Manure Management/ Environmental Benefits

Digesters installed at dairies provide environmental benefits by reducing odor problems and methane emissions. Methane is considered among the most reactive climate change gases. An estimated 214,328 tons per year of methane gases will be generated if the manure is left uncollected on dairies. Digesters also provide benefits by reducing potential surface and groundwater contamination.

### C. Cost Savings to Dairies

The estimated cost savings to the dairy from offset electricity costs are substantial. As previously mentioned, in most cases the estimated electricity generation offsets most or all of the electricity usage on the dairy. However, because the initial capital costs are also substantial and there are yearly operating costs, the payback periods estimated by the applicants vary.

Estimated energy offsets for the awarded projects are listed in Table 6.

Table 6: Estimated energy offsets for the awarded projects

Dairy ID Number	Estimated Electricity Offsets per Year
201	\$63,000
204	\$295,000
207	\$30,000
221	\$110,752
222	\$113,242
225	\$51,898
226	\$56,381
230	\$75,396
232	\$18,000
238	\$50,000
Total	\$863,669

In addition to these offset costs, there are several revenue streams that can be explored. A rather large revenue stream for currently operating methane digester projects have come from the ability to sell excess generated power back to the utility company. Other possible offset costs or revenue streams may come from the utilization of biogas for heating or cooling purposes or from the sale of any bi-products. This information will be gathered through project monitoring.