Arnold Schwarzenegger
Governor

DAIRY POWER PRODUCTION PROGRAM

DAIRY METHANE DIGESTER SYSTEM 90-DAY EVALUATION REPORT - HILARIDES DAIRY

PIER FINAL PROJECT REPORT

Prepared For:
California Energy Commission
Public Interest Energy Research Program

Prepared By:
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WESTERN UNITED RESOURCE DEVELOPMENT, INC.

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I. Program Background

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 potentially reducing air and ground water pollutants associated with storage and treatment of livestock wastes.

The California Energy Commission (Energy Commission), acting under authority of the Legislative enactment in 2001 of SB5X (Section 5(b)(5)(C)(i)), appropriated and encumbered funding for the Dairy Power Production Program (DPPP). Western United Resource Development, Inc. (WURD) was selected by the Energy Commission as the Contractor for this program. To date, a total of 14 projects have been approved for grants totaling $5,792,370. The projects have an estimated generating capacity of 3.5 megawatts.

Two types of assistance were made available for the grant program: buydown grants, which cover a percentage of the capital costs of the proposed biogas system, and incentive payment grants for generated electricity. Buydown grants cover up to 50% of the capital costs of the system based on estimated energy production, not to exceed $2,000 per installed kilowatt, whichever is less. Electricity generation incentive payments are based on 5.7 cents per kilowatt-hour of electricity generated by the dairy biogas system, which totals the same amount as a buydown grant paid out over five years.

The grant program is overseen by an advisory group comprised of representatives from the California dairy industry; California Department of Food and Agriculture; California Energy Commission; California State Water Resources Control Board; Sustainable Conservation; University of California; and U.S. Environmental Protection Agency AgSTAR Program.

II. Dairy Profile

The dairy owner applied for a buydown grant from to design and install a new covered lagoon digester. The operation consists of the main dairy facility and an adjacent heifer raising facility. The covered lagoon digester is located at the Sierra Cattle Company heifer ranch, which is on dairy property one mile east of the main dairy operation. A farmstead cheese plant is also located on the dairy premises and is owned and operated by the dairy owner and family.

Hilarides dairy

The dairy is located 10 miles east of Tulare on a site once occupied by Lindsay Olive Growers. Construction of the dairy on this site benefited the environment by cleaning up and sealing off the former brine ponds at the long-closed olive packing factory.

During the 90-day study period September-November 2005, there were approximately 9,900 cows on the dairy, of which 5,800 were lactating cows, 1,100 dry milk cows, 1,500 calves and 1,500 bulls. For the same period, the heifer ranch housed an average of 6,000 heifers. The milking cows are currently housed in freestall barns with connecting exercise pens. Dry cows and bulls are housed primarily in drylot pens. The heifers are housed in open corrals with flushed feed alleys.

The dairy facility occupies 2,400 acres, including 1,800 acres of surrounding cropland. Plans to build a second milking carousel and additional freestall barns are underway for the main dairy facility. Construction is expected to be completed by late 2006.

III. Costs/Funding

The dairy owner applied for DPPP funding in October 2001 for the installation of a new covered lagoon digester system. At the time of application for funding, total project costs were estimated at $1,500,000. Because of DPPP advisory group technical concerns (explained below), the owner was presented with two different grant options. The first option was for a buydown grant based on an expected capacity of 250kW and capped at $2,000 per kW to total $500,000, to be paid in progressive increments during construction. The second option was for an incentive payment grant based on an expected capacity of 400KW, to be paid out at 5.7 cents per kWh over a maximum of five years for electricity generated. The total grant available under the second option was $750,000. The dairy owner accept the first option for $500,000 and the grant has been paid in full. The dairy owner did not receive any additional grant funding from other sources.

The dairy owner spent approximately $1,169,684 on project completion, or $330,316 under the projected cost of the project. The dairy owner has incurred an estimated $669,684 in costs above the DPPP grant funding. A significant portion, approximately $120,000, was attributed to the purchase of third and fourth generators at $35,000 apiece and $50,000 for two additional electric panels.

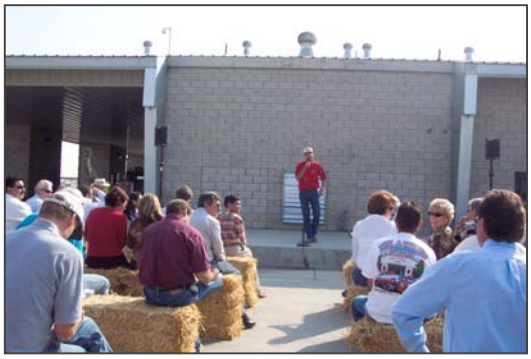
The dairy owner operates the system. Operating costs include oil changes, inspections and routine maintenance. A great deal of time is spent by the dairy owner and staff maintaining the system and monitoring performance. Approximately one to two hours per day are dedicated to the digester project. When an oil change or other maintenance is required, the time requirement is increased. It takes approximately one hour to change the oil in the engine. Oil changes are scheduled every 600 hours or approximately every 25 days (assuming the engine runs 24 hours/day). Operating costs for oil, oil sampling, spark plugs, air cleaner, valves, filters, and time spent monitoring the system amount to approximately $1,000 per month.

IV. Timeline

The grant application was submitted to Western United Resource Development, Inc. in October 2001. In March 2002, during the screening process, the DPPP advisory group raised concerns with some technical elements of the original application. The dairy owner was notified of these concerns and asked to respond to a number of questions. Following response by the dairy owner, the application was sent for due diligence review in April 2002. After reviewing the technical due diligence report, the advisory group asked for clarifications on a number of items before moving the application further. After some delay, beyond the control of the dairy owner (explained further below), a revised application was submitted in March 2003. The revised application did not have any significant changes in design from the original application. After thorough review, the advisory group concluded the proposed system design would be able to produce 250 kW more realistically than the 660 kW estimated in the application. The advisory group decided to offer two grant options to the dairy owner (explained above). Additionally, the dairy owner was offered the chance to qualify for a higher buydown grant by making suggested modifications to the system design, which the dairy owner opted against.

It was originally expected that the project would be operational by summer of 2003. However, due to a number of outside obstacles (explained below), the system was not officially operational until September 2005. Some biogas and electricity was produced as early as December 2004, but not on a sustained basis. Additionally, it wasn't until September 2005 that the first two generators were up and running on a continuous basis.

A grand opening event was held at the dairy on October 20, 2005 to celebrate the startup of the system's ability to generate electricity on a sustained basis. Representatives from the California Energy Commission, Sharp Energy, California Department of Food and Agriculture, city and county officials, local, state and federal government representatives, general public, media, Southern California Edison and the grant administrator Western United Resource Development were on hand for the ceremony and tour of the dairy, cheese plant, and digester.



Digester grand opening

V. Outside Obstacles

Low milk prices have had a significant impact on participants in the grant program. Beginning in late 2001, low milk prices began to put a strain on a dairy farmer's ability to obtain funds to invest in methane digester projects. Prices received by dairy farmers were at the lowest levels in over 25 years. Though dairy markets are typically cyclical in nature, producers experienced more than 20 months of extremely low prices. These low prices were, in most months, below a dairy producer's cost of producing milk.

Perhaps the largest factor in the delay of this project was the lengthy permitting process for developing the dairy site. The permitting process extended three and one-half years and required a $1 million environmental impact report (EIR). The dairy owner's plans were first stalled when California's attorney general sued Tulare County under the California Environmental Quality Act (CEQA). The suit demanded that Tulare County require EIRs for all new dairy construction. Construction at the dairy was put on hold as the county developed its dairy EIR. In attempts to restart the permitting process, the dairy owner joined with others to conduct their own privately funded EIR. Under the new EIR, and after one of the most thorough environmental reviews in the county's history, the dairy owner finally received his permit in October 2002 after a unanimous decision by the Tulare County board of supervisors. The dairy was the first in more than three years to receive a permit in Tulare County. The dairy owner started construction immediately and began milking cows in May 2003.

Another obstacle facing this project was the cumbersome and time-consuming process of getting net metering legislation passed in order to allow net electricity generated by a utility customer to be credited against electricity consumed. Although advantageous, this legislation, AB 2228 (Negrete McLeod), was not passed until 2003. After the law's passage, issues with the utility's interpretation of tariffs had to be worked out with the Public Utilities Commission. It should be noted that AB 2228 sunsets on January 1, 2006; however, new legislation, AB 728 (Negrete McLeod), was recently signed by the Governor. This new bill extends and expands the biogas net metering program through December 2009.

VI. Animal Distribution

As previously mentioned, during the 90-day study period September-November 2005, there were approximately 9,900 cows on the dairy, of which 5,800 were lactating cows, 1,100 dry milk cows, 1,500 calves and 1,500 bulls. For the same period, the heifer ranch housed an average of 6,000 heifers. The milking cows are currently housed in freestall barns with connecting exercise pens where they spend approximately 21 hours each day. The other three hours are spent in the milking parlor. Dry cows, bulls and heifers are housed in drylot pens where they typically spend half their time on the feed aprons.

Covered lagoon

VII. Manure Collection & Processing

Feed alley

Manure for the covered lagoon digester is currently collected only from the heifer facility. At this time, manure from the dairy facility is not used in the system. As long as the heifer facility produces enough biogas to generate sufficient energy to supply power needs to the dairy, the owner does not plan on adding the dairy manure to the system. Manure from feed alleys at the heifer ranch is flushed daily using recycled lagoon water, generating 180,000 gallons of flushed manure water daily. This manure water gravity flows into four settling ponds that are cleaned twice yearly to remove manure solids directly to cropland. The manure water is pumped by floating pumps to the north end of covered digester lagoon #1, where most of the gas production occurs. The overflow continues to lagoon #2, where a smaller amount of gas is collected from five floating covers. The manure water that remains after digestion is then pumped from the second lagoon to cropland, where it is mixed with surface or groundwater and applied at agronomic rates as fertilizer for crops of corn, wheat, or alfalfa.

VIII. Biogas Utilization System

Lagoon #1 is fed once daily (taking approximately four hours) with flushed-manure slurry, and maintained at ambient temperatures. The dimensions of lagoon #1 are 1,100' x 220' x 18' deep. The lagoon is covered by a film of high density polyethylene (HDPE) material that is 60 millimeters thick. The cover is solidly anchored to the sides, having been folded into the surrounding trench and covered with concrete and earth. The anaerobic digester has an estimated hydraulic retention time of 67 days. A system of sand-filled HDPE pipes floats on the cover to partition the cover into cells. This allows for rainwater removal and helps direct biogas to the perimeter where the main gas collection pipe is located. Corrugated pipe extends around the perimeter, under the cover, to provide a pathway for the biogas to flow to the point of collection at the north pump house.

Overflow from lagoon #1 travels to lagoon #2. The dimensions of lagoon #2 are 1,100' x 220' x 15' deep. This lagoon is partially covered with five floating covers that measure 300' x 155' in total. The five floating covers atop this lagoon are made of 45 mil polyethylene and are installed to allow for fluctuating water levels resulting from rain or irrigation. Gas collection is accomplished by floating corrugated pipe under each cover. Gas flows to the collection point at the south pump house, where it mixes with the gas from lagoon #1 and is pumped one and one-half miles to the dairy.

At the time of the grant application, gas production estimates for both the heifer and newly constructed dairy facility were calculated. However, only manure collected from the heifer facility has been utilized by the system to produce biogas. Estimates by the developer included in the grant application indicated that approximately 280,800 cubic feet per day of biogas could be generated from the heifer facility alone. The produced biogas was estimated to have the ability to power generators with a total system capacity of 585 kW. If the generators were run 100 percent of the time, 14,040 kWh per day of electricity could be generated.

IX. Biogas and Energy Production

Produced biogas is metered at the pump houses located on each lagoon. For the 90-day period, biogas production averaged 185,198 cubic feet per day at the north lagoon (lagoon #1), and 26,111 cubic feet at the south lagoon (lagoon #2) for a total average of 211,309 cubic feet per day. The collected biogas travels 1.5 miles to the dairy through an underground pipeline with water traps that expel much of the moisture and impurities from the gas. Excess gas flows through a relief valve and then to a flare located at the generation area.

At the dairy, the gas flows to four Cat G342 engines, each with a capacity of 125 kW for a total capacity of 500 kW. For most of the 90-day study period September-November 2005, only two generators (at 125 kW each) were running on a consistent basis. Beginning in November, the third and fourth generators were brought on line. Electricity flows from the generators to the switchgear and utility interconnection facility adjacent to the engine room. Electricity generated by the system is used at the dairy. Any net generation is sent to the local utility for partial credit under net metering provisions. On average, the electrical needs of the dairy could be 100% supplied by biogas. During seasons with lower electrical usage, such as winter, excess production may be experienced.


Engine generator

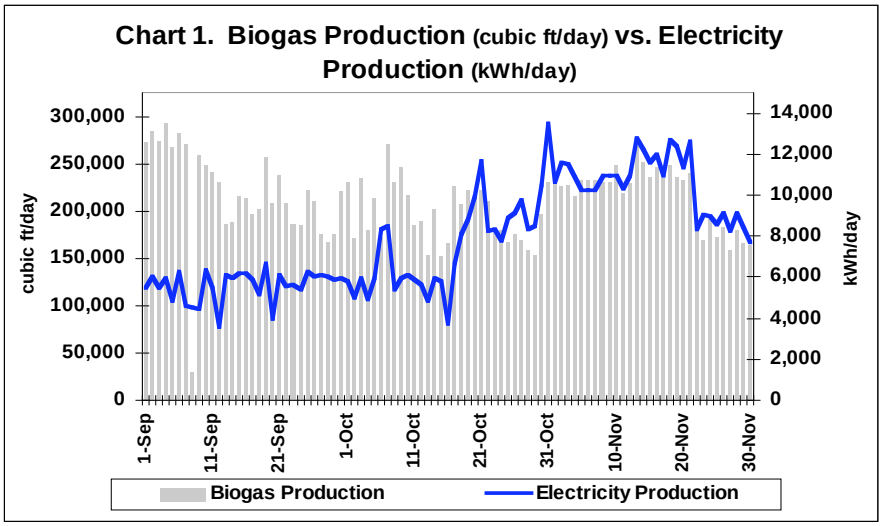
Engine cooling is provided by a propeller pump located on a cistern, which receives its water from the milk refrigeration units. This water is then circulated through a shell and tube-type heat exchanger and back to the cistern for use in cow washing and barn cleaning.

In initial design specifications, it was estimated that the digester would produce 280,800 cubic feet/day of biogas from 6,000 animals at the heifer facility. In the grant application, this amount of biogas was

estimated to provide enough fuel to support generators with a total capacity of 585 kW. Assuming the generators would run 24 hours per day, total potential electrical generation could reach 5,124,600 kWh per year or an estimated 14,040 kWh per day.[1]

Although biogas was produced as early as December 2004, the system was officially operational as of September 2005 and has been producing electricity from biogas on a sustained, continuous basis since that date. During the months of September and October 2005, approximately 40% of the biogas produced was flared and, consequently, not used for electrical generation. However, during this period only the first two of four generators were running on a consistent basis. With the addition of the third and fourth generators in November, very little biogas was flared, leading to increased electrical generation.

Chart 1 compares biogas production to electricity production for the 90-day startup period. Total biogas output of the digester averaged about 219,770 cubic feet/day in September and 197,058 cubic feet/day in October. Biogas production increased from October to November, climbing to an average of 217,097 cubic feet/day. Both generators experienced reduced downtime from September to October with a combined total of 76 hours of downtime in September and 52 hours in October. However, downtime increased slightly in November to 88 hours due to necessary maintenance. Generator #1 experienced the least downtime, with an average of 26 hours per month for the 90-day period, while generator #2 averaged 45 hours for the same period. November data is not available for Generator #3 and #4.



Downtime occurred for a number of reasons, including for the performance of routine maintenance such as oil and valve changes. Generator #2 showed longer downtime due to the fact that it was brought on-line later than the first generator and therefore required adjustments to reach optimum performance.

Electricity production reached an average of 5,602 kWh/day in September and rose to 7,473 kWh/day in October. Electricity production increased to an average of 10,525 kWh/day in November. Even though biogas production declined slightly from September to October, electricity production rose due to the fact that more biogas was utilized (i.e., less biogas was flared). Generator #1 was operational an average of 23 hours/day in September, October and November. Generator #2 was operational an average of 22 hours/day in September, 23 hours/day in October and 22 hours/day in November.

[1] Total potential energy production of 5,124,600 kWh/year would assume a 585 kW capacity engine running 24 hours/day and 365 days/year. Assuming 24 hours/day is likely an overestimate as the generators will undoubtedly have some downtime for maintenance, etc. Given any mechanical problems, downtime would be increased further.

As previously mentioned, to date, the dairy has taken advantage of the 2003 net metering law, AB 2228 (Negrete McLeod), which allows electricity generated by a customer to be credited against electricity consumed. Under the local utility Southern California Edison (SCE) net metering program, an electric meter is used to measure and track the "net" difference between the amount of electricity produced and the amount of electricity consumed during each billing period. This is done on a time-of-use basis according to the customer's rate schedule. Twelve monthly billing cycles commencing on the anniversary date of final interconnection is considered the "relevant period."

At the end of each billing period, a credit is given for any energy generated that is in excess of the energy consumed (net generation). Only the generation rate component of the total retail rate is used in the calculation of generation credits. All other charges, including but not limited to, transmission charges, distribution charges, public goods charges, nuclear decommissioning charges, monthly basic service fees, minimum charges, demand charges, and non-energy related charges are calculated prior to the netting of energy supplied or produced, for all energy supplied to the dairy. If energy consumption is greater than the energy produced, the customer is billed the difference. SCE offers the customer an opportunity to "bank" charges for electricity produced in excess of consumption in the form of a credit. This credit can be applied to future generation-related charges on other accounts included in net metering. However, any credits remaining at the end of the 12-month billing period are not paid out by the utility, and are forfeited by the customer-generator. Likewise, any unbilled generation charges that cannot be offset by accrued generation credits must be paid to the utility company. Unfortunately, the dairy owner will be experiencing the second of these two scenarios for the first 12 month period ending December 2005. This is due to the fact that net generation for the months January-September 2005 was quite small, resulting in an accumulation of unbilled generation charges for the child accounts. Based on recent performance in November and December 2005, this will not be the case in the next relevant period. Rather, it is likely that excess credits will be accrued.


Power control room

The main dairy meter (referenced as "parent" account by SCE) and six other dairy accounts (referenced as "child" accounts by SCE) are included in net metering on the dairy. Total savings from electricity generation at the dairy are a combination of things. For any time-of-use in which electricity production exceeds usage, a generation credit would be accrued, valued at the applicable generation rate. In addition, because the dairy's main load is connected to the generators, the second and largest savings come from the offset of electricity purchased from the utility company in any given month. For instance, when compared to the same month's usage in 2004, the kWh purchased from the utility declined by 116,277 kWh in September, 133,968 in October and 117,334 in November. While, at first, it was assumed this decline in power purchased by the dairy owner could be valued at the full retail rate ($0.08-$0.09 per kWh), this is not the case. This is because demand charges have not come down correspondingly. In fact, demand charges were greater than the prior year during September and October, reaching over $5,000 in September 2005, compared to about $3,000 in September 2004.

For September and October 2005, the dairy was on the TOU-PA-5 rate schedule, which specifies that maximum demand is established by the measured maximum kilowatt input recorded during any 15-minute metered interval. So, at any point when the digester system was down (e.g., due to maintenance), that period of highest recorded demand was used to establish the demand charges for the month. The dairy owner was able to successfully address this problem in November by carefully monitoring operation of the generators. Maximum demand for the month was reduced considerably, leading to much more beneficial savings to the dairy owner. The dairy owner is hopeful that it will be easier to address the demand problem with all four generators on-line. With all four generators in operation, total generator capacity reaches 500 kW, while the average recorded demand at the dairy is an estimated 334 kW. This should mean that one generator could be down at any given time and the system should still be able to offset the dairy demand. However, it will require a great deal of effort by the dairy owner to ensure optimal performance and the operational timing of each generator.

So, because demand charges were not reduced in September and October even though total kWh purchased from the utility declined significantly, only the energy charge portion of the full retail rate can be used to estimate the savings from the offset. Analyses of the utility bills show this to be an estimated $0.05 per kWh. However, due to the large reduction in measured demand for November, an estimated rate of $0.08 per kWh can be used to determine savings attributed to the reduction of power purchased from the utility for that month.

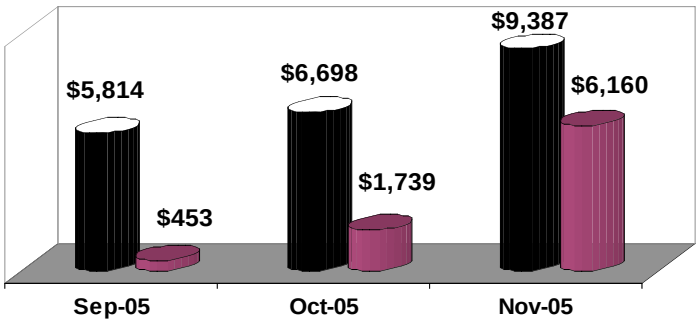
Other savings, though much smaller during most of the study period, came from any net generation (times at which generation exceeded consumption at the dairy). During the 90-day study period, there was very little net generation in September or October. However, net generation increased substantially in November. Savings due to net generation amounted to approximately $453 in September, $1,739 in October, and $6,160 in November. Net generation is credited only at the Generation rate, which averaged about $0.04 per kWh during the period. Due to the results witnessed in November, when all generators were on-line, it is expected that net generation will increase substantially in the months ahead, and the credits earned can be used towards offsetting generation charges of the other dairy accounts. This will be especially beneficial during the summer months.

Unfortunately, the savings detailed above were offset somewhat by “minimum charges” applied on the September and October utility bills. At that time, the main dairy account was on the TOU-PA-5 rate schedule, which allows for “minimum charges” to be applied. These charges averaged about $3,000 in both September and October. These minimum charges are linked to demand charges each month. They are based on the highest demand in the current billing period or the preceding eleven months. This meant that even if demand at the dairy went down due to optimal performance of all generators, these minimum charges would have reverted back to previous demand charges. Given this, the dairy owner opted to change his rate schedule. The change was effective beginning with his November utility bill. As a result, minimum charges were not incurred in November, saving the dairy owner approximately $3,000 per month.

Net metering with SCE began in January 2005. Estimated savings due to electrical production January-November 2005 are approximately $58,813. Estimated monthly savings during the 90-day period September-November 2005 are much higher than prior months due to the fact that the system was up and running on a more consistent basis. Estimated average monthly savings September-November 2005 are nearly double that of earlier months, averaging approximately $10,083 per month. Savings for November 2005 are even greater at an estimated $15,547 for the month. As previously mentioned, the greater savings in November are a combination of additional generation (leading to greater offset of power purchased by the

dairy as well as additional net generation credits) and a large reduction in demand charges. In addition to the estimated savings outlined above, the dairy owner also experienced lower charges (approximately $3,000) in November due to the rate schedule change and subsequent elimination of minimum charges.

Chart 2. Estimated Savings Due to Offset of Power Purchased from Utility ($/month) and Estimated Savings Due to Net Generation of Electricity ($/month),



Given November's performance, it is likely that generation credits will be accrued beyond what can be used to offset the generation charges of the six current child accounts for the next relevant period. Consequently, the dairy owner is exploring the possibility of adding additional child accounts to the net metering set-up at the dairy. As previously mentioned, any excess generation credits remaining at the end of the relevant 12-month period will be forfeited by the owner, resulting in lost savings. The dairy owner is hopeful that someday the utility will be required to purchase the excess energy produced on the dairy. However, there are currently no power purchase agreements available to biogas customer generators, and no requirement for the utility to pay the full retail rate for this energy. Net metering is currently the only benefit available to the dairy owner.

Chart 2 compares monthly cost savings from generated electricity for the 90-day period. Savings are broken out into estimated savings from the offset of power purchased from the utility and estimated savings due to net generation.

As previously mentioned, the estimated savings increased substantially in November 2005 when compared to prior months. While the estimated average monthly savings for the 90-day period September-November 2005 are $10,083, November's savings are estimated at $15,547 due to electrical generation alone (i.e., the savings from elimination of minimum charges are not included since this was directly related to the rate schedule).

Assuming an average monthly cost savings of $15,547, the estimated payback period for this project is approximately 3.6 years.[2] It is expected that the monthly savings moving forward will match and possibly exceed November's performance, further reducing the payback period.

X. Energy Usage

In 2004 (before on-farm electrical generation), on average, approximately 222,673 kWh/month or 7,669 kWh/day of electricity was needed to supply the on-farm electric needs. This includes

[2] Assumes $669,684 in total out-of-pocket expenses for the dairy owner above total grant funding of $500,000. Using a total project cost of $1,169,684 (i.e., without grant funding), the estimated payback period is increased to 6.3 years. This does not include cost savings to due the possible sale of byproducts or offset of natural gas or propane needs.

usage for all seven dairy accounts. Average electrical on-farm metered production during the 90-day period was 238,499 kWh/month, or 107% of on-farm usage.

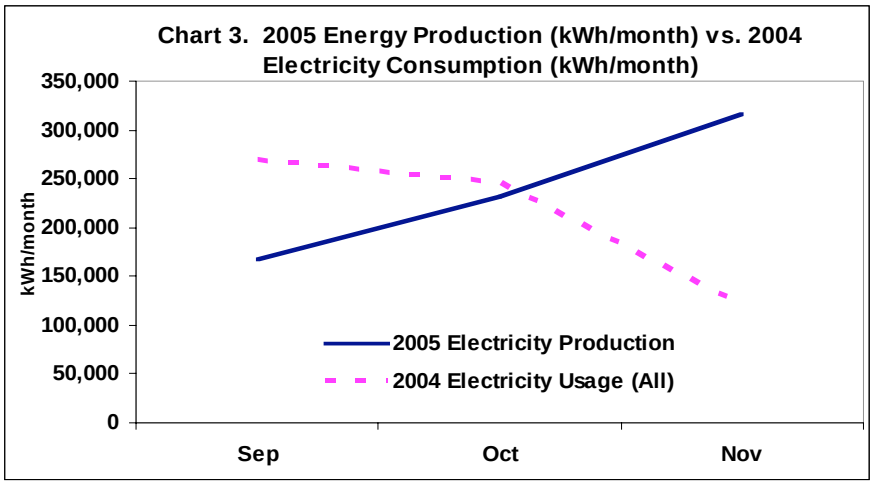


Chart 3 compares September-November 2004 electricity usage for all seven accounts to September-November 2005 electricity production each month. The 2004 electrical consumption is used as a baseline to show electrical needs prior to on farm electrical generation. November illustrates the potential for excess electrical generation during months of peak system performance and low energy use on the dairy.

Table 1 compares the peak, mid-peak and off-peak energy usage for the main dairy or "parent" account September-November 2004 and September-November 2005. Due to on-farm electrical production, electrical usage (or power purchased from the utility) was reduced across all categories in 2005 when compared to 2004. For 2005, electricity usage from the utility is primarily in the off-peak hours, with 56% of the usage falling in this category; 33% of the electricity usage on the dairy is mid-peak, with the remaining 12% falling into the peak category.

Table 1	"Parent" Peak Usage		"Parent" Mid-Peak Usage		"Parent" Off Peak Usage	
	2004	2005	2004	2005	2004	2005
September	24,265	6,158	40,490	11,249	88,460	19,531
October	8,537	326	51,287	6,876	92,315	10,969
November	0	0	38,003	53	79,708	324

XI. System Performance

The performance of the system thus far has been in line with expectations. Table 2 compares the system design performance calculations with the actual performance for the 90-day period September through November 2005. Given that these are considered startup months and the data covers a very short period of time, these should be considered preliminary results.

In the initial design specifications, it was estimated that the digester would produce 280,800 cubic feet/day of biogas from 6,000 cows at the heifer facility, or 46.8 cubic feet/day of biogas per cow. The daily biogas production was estimated to result in electricity generation of 2.34 kWh per cow per day. For the 90-day period studied, the design calculations for biogas were not quite matched, with an average biogas production of 35 cubic feet/day per cow for an average electricity generation of 1.31 kWh per cow per day. The average electricity generation metered by the dairy owner was 7,867 kWh per day compared to an originally estimated 14,040 kWh per day. Again, it must be noted that nearly 40% of the available biogas was flared September-October 2005 and consequently not used for electricity production.

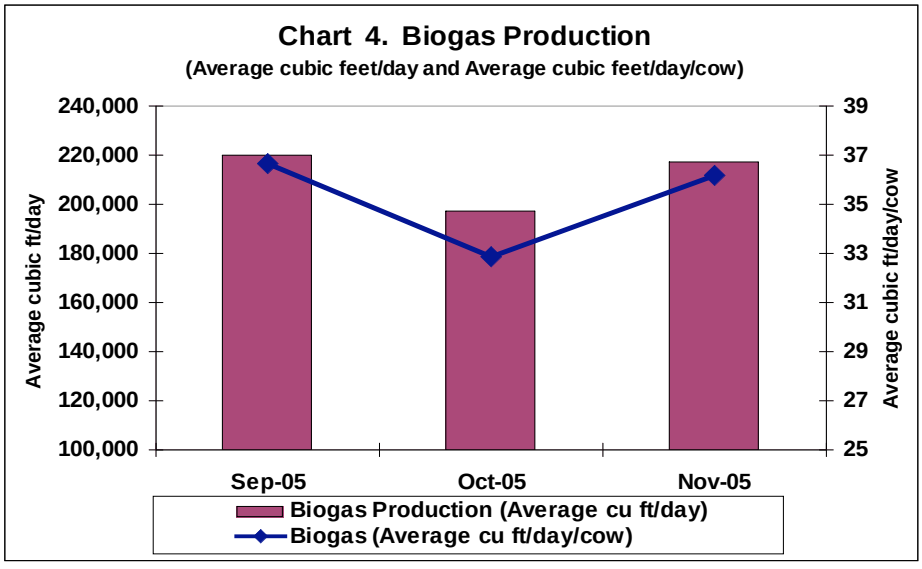
Table 2: Digester Design and Actual Performance

	Design	Actual September-November 2005 Average
Cows (at heifer facility only)	6,000	6,000
Manure Slurry		
Total gallons per day	240,000	180,000
Digester Specifications		
Type	Covered Lagoon	Covered Lagoon
Digester Feeding Mode	Intermittent	Continuous
Retention Time (days)	67	67
Gas Production		
Total (cubic feet per day)	280,800	211,308
Per Cow (per day)	46.8	35
Electrical Output		
Generator Capacity (kW)	585	250 September-October 500 beginning November
Generator Availability (operational hours/day)	24	23 for both generators
Total (kWh/year)	5,124,600	2,871,433 *
Total per day (kWh)	14,040	7,867
Total per cow (kWh/day)	2.34	1.31

*As noted, 40% of available biogas was flared September-October 2005

Chart 4 compares the average cubic feet of biogas production per day and per cow for September-November 2005. Cooler weather in October is attributed for the slight dip in biogas production.

Because the project is still in the startup phase, some system adjustments and improvements have been required. The dairy owner continues to monitor system performance and to make modifications as necessary.



XII. Heat Utilization

The dairy currently uses propane for heating purposes. At this time, no recovered heat is used for heating.

XIII. Dairy Owner Qualitative Feedback

On a scale from one to four, the dairy owner was asked to rate his experience in a number of areas concerning the digester project. The specific questions, along with their monthly and average rankings, are included in Table 3.

Table 3: Qualitative Questions

Questions Ranked 1-4, with 1=poor and 4=excellent	**September 2005**	**October 2005**	**November 2005**	**Average**
1. **Ease in operating the biogas production and biogas to electricity systems**	4	4	4	4
2. **Extent to which system gives advantage to your dairy manure management**	4	4	4	4
3. **Extent to which the system helps with odor control**	na	na	na	na
4. **Extent to which the system helps with reducing water use for manure management**	na	na	na	na
5. **Extent to which system helps address electricity issues important to your dairy operation**	4	4	4	4
6. **Overall satisfaction with the system so far**	4	4	4	4
7. **Any other comments or recommendations?** Demand charges hurt profitability.				

na = no answer