



Arnold Schwarzenegger
Governor

ANAEROBIC DIGESTER IMPLEMENTATION ISSUES

Prepared For:
California Energy Commission
Public Interest Energy Research Program

Prepared By:
Resource Strategies, Inc.

RESOURCE

STRATEGIES, INC.

Patricia A. Mullins and Susan M. Tikalsky

PIER FINAL PROJECT REPORT

October 2006

Abstract

This is a report of personal interviews with individuals who took concrete steps to install an anaerobic digestion (AD) facility and documentation of the factors that contributed to the current implementation status of their AD project. It was undertaken in two phases:

Phase I. A survey of 64 US farmers who received federal Farm Bill funding in 2003 and 2004 for an AD system.

Phase II. A survey of 10 California farmers who received state funding under the California Dairy Power Production Program for an AD system, and a comparison of their experiences with those reported by farmers in Phase I.

The two phases are covered in separate reports. The first report presents the national sample and the second presents the California sample and the comparison.

Farmers in both samples chose AD technology because of the advantages it offers in manure management and environmental protection. Farmers in the national sample were also motivated by being able to reduce odor and use the digested solids as animal bedding. Neither of these factors was a motivator for the California sample—they were more interested in producing renewable energy.

Both groups rated negotiating an acceptable agreement with the local utility as their greatest challenge. Financing also proved to be difficult for many in the national group and obtaining permits was more difficult for the California group. Despite all of the problems they encountered, farmers in both samples are overwhelmingly in favor of AD technology.

Keywords

Anaerobic digester, biogas, electricity production, manure management

Phase II Report

A Survey of California Dairy Power Production Program Grant Recipients

and a Comparison with the Farm Bill Section 9006
Renewable Energy Grant Recipients from
2003 and 2004

Table of Contents

Executive Summary	3
I. Introduction	6
Background	6
Objective	6
II. Method	7
Sample	7
Data Collection	8
III. Results	8
Data Description	8
Data	8
AD System	9
Biogas Use	9
Status	9
Questionnaire Responses	9
Motivation	9
Challenge	10
Expectation	11
IV. Discussion of California and Comparison to Farm Bill	12
Motivation	12
Odor Control	13
Electricity	13
Solids as Bedding	14
Challenges	14
Local Opposition	14
Financing	15
AD Design	15
Electricity	15
Permits	16
V. Conclusions	17
VI. Recommendations	17

List Figures

Figure 1. Location of anaerobic digester projects receiving DPPP funding	7
Figure 3. Motivation to install an AD system	10
Figure 4. Challenges faced when installing an AD system.	11
Figure 5. Expectations of the challenges faced when installing an AD system.	11

Executive Summary

As farms have increased in size, manure management has become a central focus. Installing an anaerobic digester is one way for farmers to contend with disposal of this waste. It also offers benefits for air and water quality and is a source of electrical generation. A digester processes animal manure (and other organic matter) and produces methane, a biogas that can be captured and used to generate electricity. Anaerobic digestion prevents the methane from being released into the air and avoids manure run-off into soil and water.

Dairy farming is the primary agricultural activity in California and farms tend to be large. Installing an anaerobic digester can be appealing for California farmers because environmental concerns are in the forefront, electricity is expensive, and electrical service is often interrupted. Yet, installing a digester is not without its challenges.

The first goal of this study was to gather information about digester implementation issues from the 10 farmers who received approval for California Dairy Power Production Program (DPPP) grants for anaerobic digester systems in 2002 and 2003. We asked them about the reasons they chose to install a digester and the challenges they encountered. The second goal was to compare the results with findings from the 64 farmers who received federal Farm Bill grants in 2003 and 2004 to install an anaerobic digester, in order to assess whether the implementation issues are similar, or whether there are motivations and challenges that are unique to California.

Motivation

Some of the motivations for installing an anaerobic digester were the same for California farmers and the national sample. For example, manure management and improvement in air and water quality were ranked as high-priority motivators by both groups. There were three major differences between the two samples; in general, these differences were related to geographic location.

Odor. California farmers were not motivated by the odor reduction advantage of using a digester, as was the national group. The warm dry California climate allows farmers to spread manure all year and is less like to carry odor than cooler humid air. The farms in the California sample also tend to be located far from their neighbors, which helps to prevent complaints about odors.

Bedding. Farmers in the California sample also were not motivated to install a digester to use the recovered digested solids for animal bedding. Although the national group saw this as a significant source of savings, some of the digesters that are suitable for the California climate do not produce solids that can be used for bedding. A few of the California farmers do use the solids for bedding but this was not a primary motivator.

Electricity. California farmers were highly motivated, however, by the ability to use the energy generated by the methane from the digester to offset their cost of electricity. In addition to the electrical consumption that is common on a farm—milking machines, barn wells, alley flushing, etc.—the farmers in the California sample use electricity to pump water for irrigation and because of the dry climate they often must use the deeper ground water, which costs more to pump than surface water. And in general, the cost of electricity is higher in California than in other states. So it is not surprising that the California group, contrary to the national sample, ranked offsetting the cost of electricity as a high-priority motivator.

Challenges

As with motivation, the California sample and the national sample were similar in some ways and different in others.

Financing. The California farmers did not find financing their digester project to be a challenge, as did the national sample. They typically used personal or private funding to supplement their DPPP grant, and did not depend on loans.

Permits. Unlike the national group as a whole, this California sample rated obtaining the necessary state and local permits as a challenge. But the process did not affect the timing of their digester installations, like it did for the California farmers in the national sample, whose projects have been delayed by the permitting process.

Utility. For both the California sample and the national sample, arriving at an acceptable agreement with the local utility was their biggest challenge; however, this was a critical issue in California because these farmers were relying on generating electricity as a prime motivator for installing a digester.

There is a great deal of variability among the states regarding the interaction of farmers and utilities, particularly in the management of excess electricity that a farmer generates. The California group expressed three main areas of difficulty with this process, which were similar to those stated by the national group: negotiations with the utility, net metering, and upgrades.

Negotiations

Although California has a net metering policy, farmers still must negotiate an interconnection agreement with their utility. Finding utility personnel who were willing to sit down and work out an agreement was often a frustration for farmers, causing project delays and cost overruns.

Net Metering

California has a net metering policy that utilities must offer, which does make the process of interconnection with the electrical grid somewhat smoother. The offset they receive on their electrical bills for the energy they generate, however, usually does not cover more than half of their yearly electrical costs because there are many other charges added. Several of the farmers in the California sample felt that the

additional charges are excessive and that they reduce the economic incentive to install a digester. This is compounded by their dissatisfaction with the utilities that will not enter into a power purchase agreement for the excess electricity that they generate. As a result of their frustration, some flare off the excess, or generate only enough electricity to use on the farm, rather than supply their utility with free power.

Upgrades

Required upgrades to existing electrical distribution lines and the cost of additional meters also presented a problem for many of the farmers. The time and expense of rewiring and the necessity of having a separate meter for each farm facility have proven to be obstacles to achieving maximum return from the generation capacity of a digester.

Conclusion

Similar to the national sample, the California farmers are interested in installing an anaerobic digester to help with manure management and to benefit air and water quality. In contrast to the national sample, California farmers are also highly motivated by using the energy they produce to offset their electrical bills.

The California sample faces the same major challenge as the national sample, namely, negotiating an acceptable agreement with their utility. This poses a unique problem for the California farmers because offsetting their electrical bill was both a top motivator and a top challenge. The California farmers are highly motivated to produce electricity, but not without fair compensation.

Recommendations

The recommendations that surfaced from the interviews concern financial issues. The California sample depended upon the DPPP grants to help them cover the cost of installing a digester. Like the national sample, they stressed the importance of grant funding as a driving force for digester implementation.

The farmers in the California sample are looking for an economic incentive to generate more electricity. The ability to negotiate a favorable power purchase agreement for the excess electricity can be expected to provide a substantial financial motivation to install more anaerobic digesters in California.

I. Introduction

California has been the leading dairy state in the US in total milk production since 1993, and dairy farming is now the principal agricultural commodity in California.¹ With 20% of all dairy cows in the US living in California,² manure management is a priority.

Processing animal manure using anaerobic digestion (AD) is an efficient means of managing solid waste; it can also solve potential air and water quality problems brought about by waste disposal, and it produces biogas, which is a source of renewable energy. Thus, AD can address both environmental and energy concerns.

Background

The DPPP was funded by the California state legislature in 2001 under SB5X, giving the California Energy Commission authority to appropriate \$9,640,000 for the program. The purpose of the DPPP was to support the development of AD systems on California dairy farms in order to offset electricity consumption and reduce air and ground water contaminants.³ Fourteen projects were awarded funding (out of 55 applications) either in buy-down grants, which cover 50% of capital costs up to \$2,000 per installed kW, or incentive grants, paying 5.7 cents per kWh generated by the AD system over a maximum of five years.

Objective

AD is a relatively new technology for farmers in the US and implementation of on-farm AD systems can be a challenge. The goal of this project was to provide a clear picture of implementation issues for California farmers who have installed an AD system. It is not meant to be an evaluation of the DPPP award program, or an assessment of AD technology. It is a presentation of the reasons why a group of California farmers chose to install an AD system, a report of their experiences, and a comparison of these findings to the experiences of a group of farmers from across the US.

This project was undertaken in two phases:

- Phase I was a survey of the motivations, successes, and challenges encountered by the 64 farmers who received federal Farm Bill funding in 2003 and 2004 to implement an AD system.
- Phase II was a survey of the successes and challenges encountered by the 10 farmers who received state-level funding from the California DPPP for an AD system, and a comparison with the results from the Phase I survey.⁴

¹ California Milk Advisory Board

² Ibid.

³ Western United Resource Development, Inc., the contractor managing the DPPP

⁴ One California farmer received funding from both sources.

This is the report of Phase II; the results from Phase I are summarized in a separate report.

II. Method

Sample. The sample for this phase of the study consisted of 10 farmers⁵ who were recipients of funding awards approved in 2002 and 2003 under the California DPPP program.⁶ Figure 1 shows the location of the 10 AD projects that constitute the sample in California. With the majority of California dairies located in the Central Valley, and Tulare county leading the state in milk production,⁷ it is not surprising that 60% of the sample came from this area.



Figure 1. Location of anaerobic digester projects receiving DPPP funding.

⁵ Although in one case the AD system is owned and operated by a waste water treatment agency, most often they are owned and operated by farmers, so for ease of explication, the latter term will be used in this report to represent the individual or entity who applied for funding.

⁶ According to Kathi Schiffler of Western United Resource Development: “Of the fourteen approved for grant funding, ten projects are complete. The remaining four projects opted not to construct their digester systems due to various fiscal concerns.” Personal communication, September 20, 2006.

⁷ Tillison, J. The growth of California’s dairy industry: Will it continue? *Proceedings of the California Alfalfa Symposium 1997*. Visalia, CA.

Nine of the AD projects were proposed for single dairy farms and one was for a wastewater treatment plant that receives manure from six neighboring dairies. The number of animals per farm ranges from 300-6,000 cows.

Data Collection. A postcard was mailed to all 10 farmers informing them of the survey and requesting their cooperation. This was followed by a structured telephone interview, which provided the primary source of data regarding experiences planning, installing, and implementing AD systems in the US. The interviews were supplemented with e-mail and fax communications when necessary, as well as Internet searches for printed information.

In addition to gathering narrative information about their AD project, farmers were asked to complete a 4-item questionnaire that required ratings of factors related to their motivation to install an AD system, their challenges at each stage of the process, and their expectations.

The interview questions and the questionnaire were identical to those used with the Farm Bill award recipients in Phase I.

III. Results

This section presents the results from the Phase II California group divided into two categories: 1. description of the data, and 2. descriptive statistics based on the questionnaire responses. The next section offers a discussion of these data and a comparison with the findings from the Farm Bill group interviewed in Phase I.

The narrative responses to the interviews yielded qualitative data that supported the questionnaire responses. Quantitative analysis was limited to descriptive statistics based on the ordinal data generated by the questionnaire. Low statistical power, due to the small sample size and variability of responses, precluded any further non-parametric analysis. This means that all conclusions should be interpreted with care.

Data Description

Data. We interviewed each of the 10 grant recipients, resulting in a 100% response rate. A total of 38 attempts were made to carry out nearly four hours of interviews from April through July 2006. All of the interviewees completed the questionnaire. We also talked with the regional USDA representative, AD system designers, and electric utility representatives for clarification and to gain additional perspectives.

AD System. Half of the farmers in this sample chose a covered lagoon AD system and half chose a plug flow. Three AD system designers account for 90% of the installations.⁸

- RCM Digesters, Inc. 50%
- Williams Engineering Associates 20%
- Sharp Energy, Inc. 20%

Biogas Use. All of the projects use the biogas from the AD system primarily for on-site electricity; two farms flare the excess and the remainder provide the excess to the electrical grid. Four mentioned that they also use the generated heat for the farm operations.

Status. The current status of each AD project was classified according to the description given by the grant recipient/interviewee. All of the projects are operational, defined as having a digester that is in the startup, shakedown, or steady-state phase.

Questionnaire Responses

Motivation. In order to investigate the factors that led farmers to consider installing an AD system, we asked them to assign a number from 1 (low) to 5 (high) indicating their priorities for seven pre-selected issues potentially influencing their motivation to install an AD system. The seven issues chosen were those most often mentioned in the literature on anaerobic digesters:

- Odor—meaning odor control and reduction
- Application—being able to apply manure to farmland more easily (e.g., when the ground is frozen)
- Electricity—including both electricity sales and offsets of electrical bills
- Bedding—using recovered digested solids for animal bedding or compost
- Fertilizer—using the digester effluent as a replacement or substitute for commercial fertilizer
- Environment—protecting air and water quality
- Manure—managing the volume of manure

The DPPP program has a renewable energy focus; consequently, it is not surprising that the data show that offsetting their electrical bill or selling electricity was a top-ranked motivator (Figure 2), receiving a median ranking of 5 from this sample of farmers. Two other issues—protecting the environment, and manure management—also received a median of 5. Two issues had a median ranking of 3: land application of manure and using recovered digested solids for bedding, and two issues had a median ranking of 1: odor reduction and fertilizer.

⁸ The wastewater treatment plant completed its own design and construction.

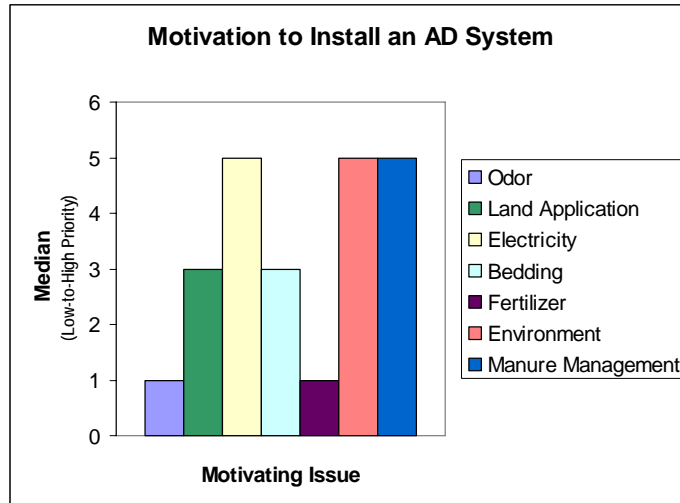


Figure 2. Motivation to install an AD system.

Challenge. We also presented farmers with six possible obstacles to implementing an AD project and asked them to rate each one according to how challenging it has been. The six factors were chosen based on a review of the AD literature relating to potential barriers to implementation:

- Grant—getting grant approval
- Financing—arranging acceptable non-grant financing
- AD system—selecting a specific AD system design
- Utility—negotiating an acceptable agreement with the local utility
- Permits—obtaining the necessary state and local permits
- Opposition—facing local opposition

Analysis of the data revealed negotiating with the utility as the most challenging issue, with a median of 5 (very challenging). Permitting was the second most challenging issue with a median of 4, followed by the grant process and local opposition (median=3).⁹ Selecting an AD system and arranging financing were rated the lowest, with a median of 2 and 1.5, respectively (Figure 3).

⁹ The results for local opposition are based only on two respondents, one giving a rating of 5 (very challenging) and another a rating of 1 (not very challenging).

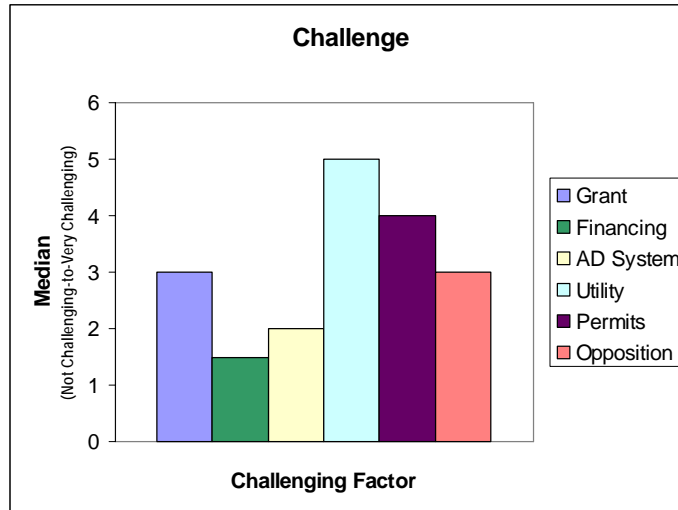


Figure 3. Challenges faced when installing an AD system.

Expectation. We were also interested in the farmers’ expectations of each of the potential challenges—whether it was harder or easier than they thought it would be, or whether it was about what they had anticipated. All of the issues were rated to be about what respondents expected (median=3) (Figure 4).

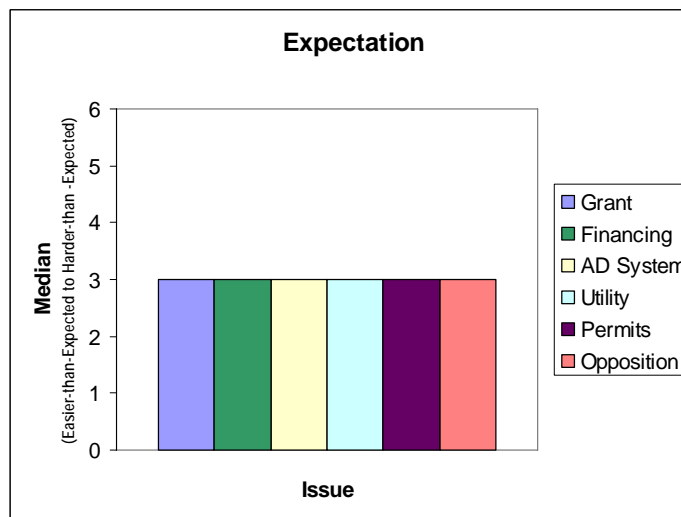


Figure 4. Expectations of the challenges faced when installing an AD system.

Is the process of implementing an AD system worth the trouble? The final question on the survey stated: “If you were just starting to research new methods of manure management would you still consider an AD system as a solution?” Only one farmer in this sample said no. The remaining nine expressed enthusiasm for AD technology.

IV. Discussion of California and Comparison to Farm Bill

The goal of this phase of the research project was to identify, analyze, and summarize the implementation issues encountered by California farmers who have installed AD systems and to compare their experiences with those encountered by farmers in other states across the country. The 10 farmers who received funding through the waste-to-energy initiative of the California DPPP provided insight on their motivations for considering an AD system, and on their successes as well as the barriers to implementation they faced.

Motivation

California farmers said they were interested in AD technology to help them with air- and water-quality control, manure management, and electricity sales and offsets. They voiced less concern about land application of manure and using the recovered digested solids for animal bedding, and little concern for odor reduction or fertilizer replacement as motivators.

Some of these factors are the same as those that motivated farmers in other areas of the US to install an AD system. For example, using AD technology for manure management was a priority for the Farm Bill farmers who had large dairy herds or who wanted to expand their herd. California farms tend to be large¹⁰ already, so manure management is a priority, and AD technology provides one way to address this issue.

Air and water quality are enhanced with the use of AD systems because much of the biogas resulting from animal waste is captured instead of being released into the air, and manure runoff into surface and ground water is avoided. These advantages of AD are as important to California farmers as they are to farmers across the country. And the California farmers mentioned that they are looking ahead to avoid possible problems should they be included in regulation of greenhouse gas emissions.

The California group, similar to farmers in other states, is not highly motivated by the advantages of land application of manure that are afforded with an AD system, and they rate as a low priority being able to use the processed manure to replace commercial fertilizer. Many of the farmers spread the manure to fertilize their land if they grow crops, but this is not a motivation for installing a digester in either group.

In addition to the similarities between both groups, there were differences in three motivating factors for the California farmers. The most dramatic differences were seen in the much lower ranking they gave to odor reduction as a reason to install a digester, and the much higher ranking they gave to electricity sales and offsets. They ranked the use of recovered solids as bedding somewhat lower than the Farm Bill group, but there was not as great a difference in this factor between the two groups.

¹⁰ The average number of cows for the Farm Bill sample was 1,312 and for the California DPPP sample the average was 2,390.

Odor Control. All but two of the 64 farmers in the Farm Bill group cited odor control as their top reason for wanting to install a digester. Even though they could not attribute a specific financial benefit to reducing odor, they were concerned about forestalling problems with neighbors. This was particularly true for the farmers who were interested in expanding their herd or securing the future of the farm in the face of encroaching development. But the California farmers ranked odor control as one of their two lowest priorities, along with being able to replace commercial fertilizer. We asked them about this difference.

Although it is not the case that, as one farmer chided, “California farms don’t smell,” 60% of the farms in the sample are located in the dry Central Valley region where the arid climate does not carry odors in the same way that a cooler, humid climate does. “Odor just is not an issue,” was a comment frequently heard from the California farmers, borne out by their low ranking of odor reduction as a motivator for installing an AD system. In fact, the four farmers who did rate odor reduction as their highest priority are all located in the Central Coast and South Region of California, a region that has more moisture in the air.

A second reason California farmers gave for ranking odor reduction as a low priority was related to the difference in basic manure management practices in California compared to the rest of the country. As one said, “We can spread manure on our fields and till it under all year round, unlike colder parts of the country.” And, “We don’t have to let it accumulate for any period of time in the winter,” was heard from another. Further, one of the AD designers mentioned that the farms in this sample tend to be located a considerable distance away from their closest neighbors.

Electricity. In contrast to farmers across the US, who as a group did not rank electricity sales or offsets as a top motivator, California farmers were highly motivated by being able to use the biogas from their AD system to generate electricity and offset their electrical bills.

Electricity is a big item in every farmer’s budget, but it accounts for an inordinate proportion in California, where, in addition to providing electricity to the milking barn and barn well, farmers typically use electricity to pump water for irrigation. According to a report¹¹ on agricultural electricity rates, “more than 90% of the electricity used by agricultural customers in California is used to pump water. The same report stated that “the dairy sector uses about 9% of the electricity used by agriculture in California,” and “slightly more than half of the dairy sector’s electricity use occurs in the San Joaquin Valley.” And farmers in this area, such as those in our sample, typically use ground water, as opposed to surface water, which requires more energy to bring to the surface, particularly as ground water depths decrease. Coupled with “relatively high prices for electricity...twice or three times as large”¹² in California compared to other western states, it is not surprising that the farmers in our sample rated electricity as a primary motivator.

¹¹ California Energy Commission. 2001. Agricultural Electricity Rates.

¹² Ibid.

The 2001 energy crisis in California also highlighted the importance of uninterrupted power. Rolling outages forced dairy farmers to dump their milk, so being able to meet on-site energy needs as well as reduce their monthly payout for electricity is significant to the California group. The role the farmers can play in providing electricity to the grid was recognized by some. As one said, “It helps reduce the strain on the California grid.” And California farmers were motivated by the state’s policy of net metering, which insures that the farmers can offset a significant portion of their electrical bill.¹³

Solids as Bedding. Three out of the five California farmers in the sample who have plug flow digesters said they use the recovered solids as bedding for their cows. The five who have covered lagoons do not have bedding-type recoverable solids—solids sink to the bottom of the lagoon and three said they have plans to sell them as compost. In contrast to the Farm Bill group, use of the digested solids was more of an afterthought for the California group, not a primary source of savings or income.

Challenges

The challenges encountered by the California farmers were in many ways similar to those faced by farmers across the country. Most notably, the greatest challenge encountered by the farmers in the California sample, like the Farm Bill group, was their interaction with the local utility. In contrast to the Farm Bill group, however, California farmers rated obtaining the necessary state and local permits as a greater challenge. There are a few other differences as well, mainly due to geographic variation.

Grant Process. The farmers in the California sample rated the DPPP grant process as a moderate challenge, similar to the rating of the USDA grant process by the Farm Bill farmers. One said of the DPPP grant, “Getting grant approval from the CEC was very challenging. They do a good job, but it is very time consuming. In particular, the details required sometimes did not relate to the project. Also, it is unrealistic in terms of the construction estimate and inflexible on time extension.” Another said, “It takes a long time to go through the approval process and then they want it built in six weeks.”

Local Opposition. One farmer in the California sample rated local opposition as “not a challenge,” as did the Farm Bill farmers overall. Eight of the California farmers did not even address local opposition as an issue. Only the wastewater treatment facility rated local opposition as very challenging, but the objection of neighbors was to the facility itself, not to the digester. According to the general

¹³ Net metering is a simplified method of metering the energy consumed and produced at a home or business that has its own renewable energy generator, such as an anaerobic digester. Under net metering, excess electricity produced by the digester will spin the existing farm electricity meter backwards, effectively banking the electricity until it is needed by the farmer. In California, this provides the farmer with the net value for all the electricity produced and consumed on the farm.

manager, “Residents are now more comfortable with it, once we walked them through the process.”

Financing. Although the California group rated arranging acceptable financing and selecting a specific AD system design to be less challenging than did the Farm Bill group overall, their experience was similar to the Farm Bill respondents who have operating digesters. The DPPP grant awards played a significant role in contributing to financing the digesters for the California farmers, a number of whom supplemented this with their own cash flow or money from business partners or outside investors. None of them talked about obtaining a bank loan.

AD Design. All of the California farmers used in-state AD designers, and were relatively satisfied, at least with the eventual outcome. The actual construction of the digester, or getting the system up and running, was a challenge mentioned by seven of the farmers, but as one said, “This is no different from running a dairy—when something breaks you fix it.”

Electricity. When the California farmers talked about their challenges, those most often mentioned were associated with electricity. The issues tend to fall into three categories that are very similar to those experienced by the Farm Bill group: problems negotiating an interconnect agreement with the utilities, dissatisfaction with the way net metering is set up, and the costs of upgrading their existing electrical system.

Negotiations

California farmers need to negotiate a power purchase agreement with their local utility, even though net metering is in place. These interactions with utilities resulted in delays and increased costs to the AD projects. Three farmers specifically complained about delays of 1½ years, another experienced a delay of six months, and one has been waiting 12 months so far to get an interconnect agreement. Many of the delays were attributed to frequent personnel changes at the utilities, accompanied by inefficiency and errors. Farmers interpreted this as unwillingness by the utilities to get things done. And one said that he has enough methane to put in a second generator, but he doesn’t want to because of the headaches he’s gone through with the utility on the first one.

Net Metering

All of the California farmers voiced concerns about the net metering system. Their complaints are related to the net generation rate, and the management of excess electricity that they generate.

Net generation rate

The energy credit available under net metering accounts for the generation component only (on the unbundled bill).¹⁴ All other charges, including transmission

¹⁴ An unbundled electric bill separates out the charges for a long list of items that constitute electrical service.

charges, distribution charges, taxes and metering costs, monthly customer charges, minimum charges, demand charges, and non-energy-related charges, are all calculated prior to the netting of energy supplied or produced and are charged on gross energy supplied to the dairy.

Six out of the ten California farmers complained about all these other charges. Two farmers said that the credit they get on energy use is only about half of their bill, because there are so many extra charges. Another farmer summed it up when he said, "There has to be a lot more economic incentive in it for farmers to want to generate power."

One farmer was not as concerned about the rate as he was about the way net metering is reconciled. He explained that in California your electricity offset gets stored up and your electrical bill is figured out once a year, so the bill can be "huge." He would rather see it done in quarterly or monthly payments. He is able to offset 90% of the cost of electricity on his main dairy meter; on another building, the "electricity bill used to be about \$3,000-\$4,000 per month and now it is down to zero."

Excess electricity

Unlike some other states, California does not require utilities to purchase excess energy produced by an AD system. Three farmers were discouraged by not getting paid for any excess electricity they generated. Three others mentioned that they could generate two to three times the electricity that they can use but, as one said, "Why give it to the utility for free?" One farmer had a positive outlook, saying that he was very proud to be able to give the utility his excess power at times when they most need it, even though he does not have a purchase agreement.

Upgrades

Unlike the Farm Bill group, most of the farmers in the California sample already had three-phase power coming to their farms, though one described spending \$40,000 for a line upgrade, including power poles, transformers, and an engineering study. Four others were surprised that their existing electrical system would have to be upgraded for the AD system, and that they would be responsible for covering all of the costs. For example, one expressed dismay at having to spend \$70,000 to rewire his dairy.

Another farmer mentioned that he had expected to pay a lot less on his electricity bill, but he is still paying about half because he has not put in the necessary wiring. His advice was to "get your electrical lines situated so you power your dairy off of the electricity you produce." He only has a couple of electrical irrigation wells on net metering right now.

Finally, two farmers mentioned having problems with faulty meters that resulted in them giving free electricity to the utility. One estimate was nearly \$12,000.

Permits. Timing was a critical factor that affected California farmers' permitting experience. The California farmers in Phase II rated obtaining the necessary state and

local permits for their AD system to be more challenging than did the Farm Bill farmers, though they did not voice any specific complaints. As one said, “It was a long process but it wasn’t that bad.” He said it was about the same as getting other permits for his dairy. Their higher rating of obtaining permits as a challenge simply may be due to the greater number of permits that are required in California. Only one respondent described an unusually long delay—2½ years to get a county siting permit—but this was because he needed to do mitigation to site his AD system in a wildlife habitat area.

On the other hand, the permitting experiences of this sample were different from what was experienced by the California farmers included in the Phase I sample who received Farm Bill funding. This current sample consists of farmers with operational digesters who received their water-quality permits at least two years ago prior to a change in regulations, so they avoided the permitting delays that have beset the California farmers in the Phase I group.

V. Conclusions

Across the US, farmers who are interested in AD technology share similar motivations and challenges. This is particularly true of the farmers who were able to successfully build and operate their AD systems.

The California farmers in this sample, like the farmers who received grants under the Farm Bill, were motivated to install an AD system because of the advantages it offers in manure management and air and water quality control. However, due to differences in climate, AD design, and manure management practices specific to California, this group was not motivated by the benefits of odor reduction or using recovered digested solids as bedding, as were the farmers in the Farm Bill sample.

Regarding challenges, both groups shared their frustration by rating negotiating an acceptable agreement with the local utility as their greatest challenge. This California sample rated obtaining permits as more difficult than did the Farm Bill group most likely because of the greater number of permits required, not because they were particularly difficult to obtain. This is in contrast to the California farmers who started their process later through the Farm Bill and are all experiencing a delay in implementing their AD projects because of changes in water-quality regulations.

All of the farmers in this California sample have operating digesters and nine out of the 10 said they would install an AD system if they had it to do over again. The lone dissenter is one who is not seeing a significant decrease in his electrical bill. This compares directly to the proportion of the Farm Bill group (92%) who said they continue to be in favor of AD technology.

VI. Recommendations

This report is intended to relate the experiences of farmers who received funding awards from the state of California to install an AD system; the study was not

designed to elicit information on policy changes or amendments. However, during the open-ended interviews two recommendations surfaced—both regarding financial considerations.

Farmers appreciated the DPPP awards and emphasized the necessity of financial support. As one said, “I was thinking about putting in a digester for the last 20 years but couldn’t do it until I got the [DPPP] grant.” The up-front expense of AD systems means that funding is critical for most projects to be successful. This is no different in California than it is across the country; the advantage for this sample has been the availability of the DPPP awards.

Economic incentive to implement an AD system is another critical factor for farmers in California as well as across the US. This sample is highly motivated to generate electricity, but not without compensation for what they produce. Explained one farmer, “It’s an issue of fairness.”