Providing Carbon Credit Revenue for the Adoption of Lagoon Covers on Hog Farms in North Carolina and Dairies in New York

Environmental Credit Corp.
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Final Report for Grant Period
September 2007-September 2011

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Deliverables Identified on the Grant Agreement

A. During the period of the award, the grantee is required to attend at least one meeting hosted by NRCS. The meeting will provide a forum for technical feedback among grantees and NRCS.

B. Expand the development and implementation of a market-based program that uses carbon credit incentives for adoption of lagoon cover technologies on 8-10 hog farms in North Carolina and 6-8 dairies in New York.

C. Supplement farm income on participating farms with carbon credit revenues.

D. Expand enrollment, verification, and registration of carbon credits resulting from best management practices in animal agricultural and nutrient management.

E. Reduce combined greenhouse gas emissions on these farms by 40,000 to 60,000 metric tons of CO_2 equivalents per year and substantially reduce other gaseous emissions and odors from lagoons.

F. Provide multiple educational seminars for animal producers, state and local agencies, environmental groups, and other stakeholders in North Carolina and New York.

G. Develop educational and promotional materials, including a manual and interactive web-based tools for expanding the program to other geographical areas.

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Executive Summary

- This Conservation Innovation Grant project successfully demonstrated an innovative market-based approach to enhancing the air quality of hog and dairy farms. The project employed innovative technology in the form of ambient temperature anaerobic lagoon cover digesters on typically-sized hog farms in North Carolina and dairy farms in New York to earn carbon credits through participation in a domestic voluntary carbon market. The project enhanced existing farms through reductions in greenhouse gas emissions, odors, and other volatile organic compounds; falling within the NRCS-designated priority area of atmospheric resources.

- The goals and objectives for this project (listed both on the title page as well as in the Introduction section) were to provide typically-sized hog and dairy farmers with the ability to benefit financially from voluntary carbon markets while making strategic enhancements to their on-farm manure management strategies. By capturing and destroying the methane generated from long-term manure storage lagoons, ECC was able to work with the farmers to monetize these emission reductions into carbon credits as well as enhance on-site emissions control. This project sought to create an enhanced environmental benefit from improved manure management systems – offering farmers with additional farm income.

- One of the overarching goals of this project was to examine how these ambient temperature lagoon cover digesters would perform on typically-sized hog farms in North Carolina and dairy farms in New York. The project sought to identify whether or not the carbon credit revenue (and other ancillary benefits such as beneficial end use of gas, use or marketing of byproducts like separated solids for bedding, etc.) were enough to justify the expense of the associated improvements in manure management systems. We also sought to evaluate and quantify the operation of lagoon cover digesters with regard to the capture and destruction of methane. This project accomplished all of this and more. The covers are all fully functional and generating carbon credits. The projects required minimal management from busy farmers and, compared to a traditional digester, were a small financial investment. The primary barrier this project faced was entirely out of control of all project participants, and was the low uncertain price of carbon credits in the voluntary carbon market. Based on expert projections at the time of the project proposal, ECC anticipated much higher carbon credit prices throughout the lifespan of the projects (and utilized this to help justify the expense at each project site); in reality, carbon prices have been much lower than anticipated during the conduct of the project.

- Dairy and hog farms across the country can and already have benefited from this project. These farms each stand as a demonstration site, an active learning environment in which farmers considering a lagoon cover digester can come to learn about how it works, see what it actually looks like, and talk firsthand to a farmer who operates with one now.

- Project funds were spent as anticipated. While the grantee initially hoped to utilize the grant dollars to support the construction of several additional projects, the cost of materials and time to construct were both a little more than anticipated.

- This project demonstrated an alternative manure management strategy to the current common practice for hog and dairy farms of this size in the United States. While many farms simply store their manure in open-air lagoons and land apply a few times a year, this project demonstrated that by creating an anaerobic digester within the existing lagoon, farmers could capture that gas and destroy it, with the ultimate financial cost or gain to the farmer depending on the operation of environmental markets.

- The quantifiable physical results from this project include the registration of 6,700 metric tons of carbon dioxide equivalent to date on both the Chicago Climate Exchange and the Climate Action Reserve, representing significant reductions in greenhouse gas emissions equivalent to taking 1,192 passenger cars off the road.

- The project allowed a detailed evaluation of the economic costs of lagoon cover improvements to existing manure management systems as well as valuable lessons about the design of successful financial transactions between farmers and project investors. In this case, farmers were insulated from fluctuations in the carbon market with a guaranteed minimum annual payment in return for a portion of carbon rights. The costs associated with materials, carbon credit registration, and ongoing maintenance proved to be higher than anticipated. However, we expect that in the future, and under some circumstances even today, with greater price certainty and a higher price on carbon, similar projects could indeed be profitable, even without a federal or state cost-share.

- Federal, State, or local programs to implement this project on a broader scale are worth serious consideration. Currently, farmers lack the capital to invest in these projects and often fear how implementing a project such as this will impact the operation and productivity of their farm. With these concerns, a Federal or State program to help with financing or technical support from NRCS County officials could help increase the adoption of lagoon cover digesters on hog and dairy farms.

- We conclude that ambient temperature anaerobic lagoon cover digester systems on typically-sized hog and dairy operations in much of the eastern United States can prove to be financially viable (under favorable financing conditions and carbon pricing) as well as creating significant benefits for the local and global environment. The project employed innovative technology in the form of ambient temperature anaerobic lagoon cover digesters on typically-sized hog farms in North Carolina and dairy farms in New York to earn carbon credits through participation in a domestic voluntary carbon market. The project enhanced existing farms through reductions in greenhouse gas emissions, odors, and other volatile organic compounds. Local improvements occur in enhanced odor and emissions control, as well as in improved manure effluent and storm water management. Globally, the decrease in atmospheric emission of methane contributes to reduced agricultural emissions of greenhouse gases. Projects like this are dependent on appropriate environmental markets and reliable market prices for the environmental commodities produced (in this case, carbon credits).

Introduction

This CIG project sought to expand the development and implementation of an innovative, market-based carbon credit program to cover manure lagoons, reduce methane and other emissions, and provide additional farm income to hog farms in North Carolina and dairies in New York. This project was a collaborative effort, drawing on the project management and implementation expertise of a team of individuals at Environmental Credit Corp. The project's success also relied heavily on the active participation of the farmers. In addition to the farmers, ECC worked closely with the Chicago Climate Exchange, the platform on which the credits generated through these projects were registered and monetized as well on the National Pork Producers Council and the National Milk Producers Federation for early input and design for projects.

Here are brief descriptions of key personnel and their qualifications:

- **Environmental Credit Corp.** - ECC is a leading supplier of carbon credits to US and international markets, and is experienced in developing GHG offset projects, protocols, and emission reduction quantification methodologies. ECC was the first offset aggregator to register US dairy and hog methane reduction projects with the Chicago Climate Exchange. For this project, ECC handled all project design and administration, producer recruiting, contracting of lagoon cover and equipment installation, monitoring and reporting of project data, coordinating independent project verification, preparing and submitting project documentation and registration materials, and managing the sale or transfer of carbon credits.
- **Chicago Climate Exchange** – The CCX was the world's first voluntary, legally-binding rules-based greenhouse gas emission reduction and trading system, and was the only such platform in North America for much of the tenure of this project. The CCX assisted in the initial determination of producer and site eligibility, processing of project documentation, project registration and carbon credit issuance, and the evaluation of project aggregation to improve efficiency and reduce transaction costs while enhancing program and credit credibility.
- **National Pork Producers Council** – The NPPC provided early producer input related to project design and implementation and also evaluated the overall project performance from the hog producers' perspective.
- **National Milk Producers Federation** – The NMPF had a role similar to that of NPPC, providing broad representation within the US Dairy industry. They provided early assistance with producer selection in New York and helped with the evaluation of project performance as well.

This team worked together to develop projects on hog and dairy farms that would not only improve manure management practices on-farm, but also contribute to decreased odor and gaseous emissions. Participating farms had their manure lagoons covered so that the gas generated from the decomposition of animal manure could be harnessed and destroyed, as opposed to the baseline occurrence of those gases being released to the atmosphere.

The project goals and objectives identified in this grant were as follows:

- The goal of this project was to stimulate the development and implementation of an innovative, market-based carbon credit program to cover manure lagoons, reduce methane and other emissions, and provide additional farm income to hog farms in North Carolina and dairies in New York.

  As conservation incentive programs driven by emerging carbon markets are new in the United States, and not well-understood by farmers, technology providers, and the agricultural financial community, this project sought to overcome the uncertainties associated with structuring these projects with the carbon credit revenue in mind as a payback opportunity. There were (and are)

many barriers to the adoption of these lagoon covers that this grant funding helped alleviate including uncertain transaction costs, small quantities of benefits per farm, performance risk and liability, new and uncertain markets, and poor information. While the conservation technology of lagoon cover manure management has many benefits to offer adopters, these barriers were often too great without the additional incentive of grant support to be overcome.

- Specific objectives of the project included:

    - Expand the development and implementation of a market-based program that uses carbon credit incentives for the adoption of lagoon cover technologies to 8-10 hog farms in North Carolina and 6-8 dairies in New York.
    - Supplement farm income for participating farms with carbon credit revenues.
    - Expand enrollment, verification and registration of GHG credits resulting from the best management practices in animal agriculture and nutrient management.
    - Reduce combined greenhouse gas emissions on these farms by 40,000 – 60,000 metric tons of CO_2 equivalent per year and substantially reduce other gaseous emissions from lagoons.
    - Provide multiple educational seminars for animal producers, state and local agencies, environmental groups and other stakeholders in North Carolina and New York.
    - Develop educational and promotional materials, including a manual and interactive web-based tools for expanding the program to other geographical areas.

- The scope of the project tasks included the identification of potential project sites for lagoon cover gas collection systems, the design and construction of viable lagoon cover gas collection systems, and the ongoing monitoring and maintenance of those systems for the purposes of keeping them operating at peak performance and for maintaining the necessary records to ensure carbon credit issuance. More broadly, the project really sought to determine whether these lagoon cover gas capture systems offered a unique, economically viable opportunity for typically-sized animal operations to break into the carbon credit market.

- This project was facilitated through several business and academic relationships. ECC hired Environmental Fabrics, Inc. (EFI) to engineer, design, and construct the lagoon cover and gas collection systems on each of the project sites in both states. ECC has worked extensively with EFI on lagoon cover installations and was confident in the quality of their work and their expertise in the field. In addition to working closely with EFI, ECC also worked with researchers at Cornell University who were collecting data on several of the New York farms for a separate research project.

- This project was funded through a roughly 50% (46.2%) cost share with NRCS through this Conservation Innovation Grant Program. The remaining funds necessary to complete this project were provided by ECC. ECC operates lagoon cover manure digester projects on a success-based model, leveraging funds to develop the project against the future sale of the carbon credits it can generate.

Background

- This project sought to identify a way for smaller animal operations to participate in the emerging carbon market in the United States. While traditional mechanical digesters are prohibitively expensive for smaller farms, lagoon cover anaerobic digesters offer a more cost-effective opportunity to capture and utilize the methane generated from the decomposition of manure in long-term storage. In addition to being a more cost-effective option, lagoon cover anaerobic digesters also require less daily and long-term maintenance than a mechanical digester, another key factor for smaller farms with more limited staffing capabilities. Lagoon cover anaerobic digesters offer additional co-benefits to farmers including increased odor control, protection from rainwater issues in the lagoons, the potential to utilize or sell separated solids for animal bedding, and beneficial end use of the gas, either on-farm or sold back to the utility provider.

- As the US carbon market was so relatively new when this project was implemented, there hadn't been previous attempts to incorporate typically-scale farms, only the largest. However, typical and smaller animal operations represent a relatively large portion of the potential mitigation opportunities for greenhouse gas emissions from animal production, so finding a way to work with smaller farms has the potential to be a win-win scenario for the farmers (who benefit from carbon credit revenue) and the environment (from the reduced greenhouse gas emissions).

- Traditionally, farms of this size (dairy farms representing about 1,000 milking cows, and hog farms with several thousand finishers – or their equivalent) utilize a flush or scrape system to move manure from the animal housing areas to a long-term storage lagoon. Then, several times a year, these long-term storage lagoons are drawn down and the manure is land applied to crops.

- The agricultural sectors benefiting most from this project are dairy producers and hog producers. Dairy and hog manure represent the current best opportunities for capturing and utilizing gas from manure. The environmental sector benefiting from this project is that of air quality, both in terms of odor control as well as the emission of various gases, including greenhouse gases.

- Natural resource issues addressed in this project include the exclusion of rainwater from entering long-term storage lagoons as well as the production of viable bedding material from previously wasted material.

- Negative effects of long-term manure storage for relatively small animal operations focus primarily on neighbor relations for most of the farmers in this project. As development in surrounding areas increases, farmers find themselves under more pressure to control the odors associated with their operations. Low milk prices in the past several years have also made it quite challenging for dairy farmers to invest in new management practices, so the supplemental income generated from carbon credits (and the sale of separated solids as bedding) offer a new opportunity to consider upgrades to manure management practices. Specifically with this project, farmers were insulated against the fluctuations of a young carbon market through a guaranteed minimum payment from ECC, regardless of the volume of credits generated or the price at which they were sold.

Review of Methods

- The adoption of lagoon cover anaerobic digesters on typically-sized dairy and hog farms is an innovative approach to manure management at this scale. The funding model for the adoption of these projects is also unique, leveraging future carbon credit revenue potential to justify the initial capital investment. In the case of the farms included in this grant, farmers incurred no up-front or maintenance costs – this burden rests with ECC as the project and equipment owner. Because farmers were insulated from potential maintenance costs and fluctuations in carbon prices, the barriers to adoption of this innovative manure management practice were insignificant. The farmers serving as project partners negotiated contract terms with ECC such that ECC was able to put up the funding (beyond what was covered by this CIG grant) to design, install, and maintain these systems in exchange for a percentage of future carbon credit revenue.

- The adoption of lagoon cover anaerobic digesters requires relatively minor changes in management of existing livestock operations. Reduced storm water input into completely covered lagoons reduces the volume of manure effluent to be land applied without reducing nutrient value (in fact, nitrogen value may be increased, since nitrogen volatilization from the lagoon is reduced significantly), and therefore slightly lowers overall manure management effort and costs. Installation costs are typically up to a few hundred thousand dollars, depending on lagoon size, and maintenance costs of the lagoon cover digesters may only be a few thousand dollars a year.

  However, carbon credit verification and transaction costs represented a substantial recurring cost that impacts the effectiveness of carbon credits as a financial incentive. Verification costs alone may range from a few thousand dollars to over ten thousand dollars annually, depending on the requirements and design of particular offset programs. Generally, offset programs that impose elaborate monitoring, verification and bureaucratic requirements substantially reduce or eliminate the financial incentives for doing the projects in the first place. During much of the project period, the price of carbon credits was not sufficient to overcome transaction costs for all but the very largest hog and dairy operations in the US.

- In the case of this CIG project, the primary alternative product marketed was that of agricultural methane carbon credits. ECC is a leading agricultural methane project developer, and had done extensive work with larger farms prior to this award. Recognizing the untapped value in the collective emission reduction capability of smaller farms, ECC sought to implement smaller-scale anaerobic digester projects for the purpose of carbon credit revenue. At the time the project began, the US political landscape appeared ripe for the adoption of a mandatory cap on carbon emissions, likely in the form of an economy-wide cap and trade system. This system would include the emission reduction from projects on farms, like the ones implemented with this grant, and would have the potential to earn anywhere from $10-50 per ton, depending on what estimates were used.

  Once the projects were operational and generating carbon credit revenue, ECC worked (and continues to work) to seek out buyers in the voluntary US carbon market (and the now mandatory market that exists in California). Credits were verified and registered and then sold, initially on the Chicago Climate Exchange. Earlier in 2011, all of the projects were moved to the Climate Action Reserve where they can command a higher per credit price for the farmers and for ECC.

- ECC and EFI worked diligently to ensure that the participating producers would not have to wholly change their operations to accommodate the implementation of the project. However, in order for the project to function successfully, the producers' full cooperation was (and remains) key. One of

the primary adjustments to the producers' routine was that of data monitoring and collection. In order to have the projects pass the rigorous third party verification process necessary to register carbon credits, the producers and ECC are required to keep detailed records about the numbers of animals, the methane concentration of the gas produced, and the operational status of the system. This data collection requirement proves to be somewhat cumbersome on the farmers, and while ECC initially thought it would be more cost-effective and simple to do manually, each farm is now equipped with automatic, remotely-accessible dataloggers. This cuts down substantially on the demand on the producers to deliver this data.

- For a schedule of events, please see Appendix E.

- Maps of the project locations are included in Appendix F.

- Many lessons were learned through the completion of these projects. In regard to the farms in New York, utilizing an ambient temperature anaerobic lagoon digester system proved to yield far less carbon credits than anticipated. Also, the importance of consistent, reliable data cannot be overemphasized as it relates to the verification process for carbon credits. This includes accurate sampling analysis for the methane concentration of the gas at each site. For example, if one farm has an unusually low sampling result for methane concentration, that can negatively impact the quantity of carbon credits that can be registered and verified for that time period. There were several equipment problems from site to site along the way that arose and had to be corrected and which have been documented through our semi-annual progress reporting. These included…..

- If the project were to be started today, several things could be done differently to ensure a smoother implementation. First, the projects would each automatically be outfitted with remotely-accessible continuous data monitoring for flare operation. In too many instances, the flare would not be operational for a period of time before the project partner alerted ECC. This resulted in a decrease in the number of carbon credits that could be registered and verified for that time period. Because farmers did not own the equipment and were guaranteed a base payment each year despite the project's actual performance, it created a lack of incentive for being active and engaged in ongoing upkeep and maintenance. In the future, structuring these agreements differently and giving the farmer more responsibility might result in a more active relationship between the farmer and project operations, as would higher carbon prices.

  More generally, however, the bigger lesson learned from this project is that making these smaller-scale lagoon cover anaerobic digester projects work is challenging at relatively low carbon prices (e.g., between $1 and $8 per metric to of CO_2), even with a 50% cost share. The price of carbon credits would need to both increase significantly and become more stable to attract outside investment.

Quality Assurance

- Project sites are illustrated in Appendix F.

- Quality assurance and control practices were an integral part of the project, and were critical to successful quantification, verification and crediting of methane emission reductions. For the items listed below, we followed detailed project protocols of either the Chicago Climate Exchange or the Climate Action Reserve in quantifying and reporting each project's performance. In addition, quantification methodologies and results were verified against these protocols by independent registry-certified carbon offset project verifiers. Example project protocols and verification reports are attached and address the following issues.

    - Sampling design
    - Sampling procedures
    - Custody procedures
    - Equipment calibration
    - Sample analysis, quality control
    - Data reduction, analysis, review, and reporting

Findings

1. Lagoon cover digesters provide relatively low cost and effective control of odor, greenhouse gas and other emissions, and improve both manure effluent and storm water management on US hog and dairy operations with existing manure lagoons. Farmer satisfaction with the design, installation, operation and maintenance of the type of lagoon cover digester used in this project has been high.

2. Installation and maintenance costs of the lagoon cover digesters can be supported, in part or in whole, by monetizing the environmental benefits associated with the methane emission reductions they create. However, absent mandatory regulatory programs or price supports that maintain both adequate carbon prices and price-stability, it is unlikely that a carbon market-based approach will create sufficient incentives for this otherwise successful project type to flourish

3. However, absent mandatory regulatory programs or price supports that maintain both adequate carbon prices and price-stability, it is unlikely that a carbon market-based approach will create sufficient incentives for this otherwise successful project type to flourish – largely due to the long term investment horizon for projects and the relatively high transaction costs associated with monetizing environmental benefits for voluntary markets.

4. Careful and deliberate monitoring, quantification and documentation of project operation and methane emission reductions, according to specific project protocols, is necessary for fully monetizing a project's emission reductions within established voluntary domestic carbon markets.

5. Current methodologies for estimating methane generation from hog lagoons, based on EPA and IPCC models, appear to significantly overestimate actual methane production, at least for the finishing operations we evaluated in North Carolina. The same models appear to provide reasonable estimates of actual methane generation from dairy lagoons.

6. Seasonal methane production in lagoon cover digesters, in both North Carolina and New York, presents challenges to developing biogas utilization options that could add value to these projects.

7. Adoption of lagoon cover digesters, financed by carbon credits, may provide an important first step in the development of biogas utilization technologies for on-farm production of renewable energy. Although renewable energy production was not within the scope of this CIG project, all seven of the participating farms have actively pursued follow-on projects for energy production from the biogas produced and captured by the lagoon cover digesters. Two of the projects have already installed gensets for production of electricity, and the remaining five have made significant progress toward financing similar investments in on-farm energy production.

Conclusions and Recommendations

Lagoon cover digesters provide relatively low cost and effective control of odor, greenhouse gas and other emissions, and improve both manure effluent and storm water management on US hog and dairy operations with existing manure lagoons. This project successfully demonstrates a practical, farmer-friendly and widely replicable model for project finance and operation of lagoon cover digesters.

Installation and maintenance costs of the lagoon cover digesters can be supported, in part or in whole, by monetizing the environmental benefits associated with the methane emission reductions they create. Under favorable environmental market conditions, i.e., stable markets with long-term price certainty and sufficiently high prices for carbon credits, domestic lagoon cover digester projects can provide a reliable source of additional on-farm income and can be attractive for third-party investment based on the value of greenhouse gas emission reductions created over time.

However, during the conduct of this project, US voluntary carbon markets lacked certainty (with regard to programs, rules, and price), largely due to political ambivalence and uncertainty about future regulatory programs for greenhouse gases. As a result, economic incentives were not adequate for most farmers to undertake such projects on their own, and financial returns to potential third-party investors were not sufficiently attractive to stimulate their development. Absent a mandatory regulatory program that supports both adequate carbon prices and price-stability, it is unlikely that a carbon market-based approach will create sufficient incentives for this otherwise successful project type to flourish (i.e., not surprisingly, market-based approaches will require active, sufficient and stable markets to succeed). Recent developments in California that explicitly accept carbon offset credits from livestock manure methane capture projects as compliance instruments within their State mandated GHG cap-and-trade program may spur the development of additional lagoon cover projects throughout the US similar to those demonstrated in this project. In the short-term, however, to stimulate broad adoption of this technology and financial model, government or industry provided financial supplements or price supports may be necessary to mitigate the price uncertainty associated with current domestic voluntary markets for carbon credits.

Careful and deliberate monitoring, quantification and documentation of project operation and methane emission reductions, according to specific project protocols, is necessary for fully monetizing a project's emission reductions within established voluntary domestic carbon markets. In particular, automated monitoring systems and program-specific data management tools can improve reporting and verification accuracy, reduce costs and ultimately improve a project's yield of verified credits.

However, carbon credit verification and transaction costs represent a substantial recurring cost that impacts the effectiveness of carbon credits as a financial incentive. Verification costs alone may range from a few thousand dollars to over ten thousand dollars annually per project, depending on the requirements and design of particular offset programs. Generally, offset programs that impose elaborate monitoring, verification and bureaucratic requirements substantially reduce or eliminate the financial incentives for doing the projects in the first place. During much of the project period, the price of carbon credits was not sufficient to overcome transaction costs for all but the very largest hog and dairy operations in the US. Not only would low prices and high transaction costs impact investment in new projects, but also the effort and expenditure applied to the operation and maintenance of existing projects.

There is also a need for continual improvement of methodologies for estimating baseline methane emissions from livestock operations. Current methodologies for estimating methane generation from hog lagoons, based on EPA and IPCC models, appear to significantly overestimate actual methane production, at least for the finishing operations we evaluated in North Carolina. The same models appear to provide reasonable estimates of actual methane generation from dairy lagoons.

Adoption of lagoon cover digesters, financed by carbon credits, may provide an important first step in the development of biogas utilization technologies for on-farm production of renewable energy. Although renewable energy production was not within the scope of this CIG project, all seven of the participating farms have actively pursued follow-on projects for energy production utilizing the biogas produced and captured by the lagoon cover digesters. Two of the projects have already installed gensets for production of electricity, and the remaining five have made significant progress toward financing similar investments. Even when it is necessary to install additional heated anaerobic digester capacity (due to the seasonal variability in biogas production from the ambient temperature lagoon cover digesters), familiarity with lagoon cover digester technology, as well as the increased overall biogas collection efficiency achieved by coupling a primary heated digester with a secondary covered lagoon digester, appear to be important factors in overcoming operational and financial risks associated with additional investments in on-farm renewable energy production.

Appendix A: Verification Reports (raw data, laboratory reports, testing methods, specifications for manufactured equipment or parts, and process flow charts)

Data, laboratory reports, testing methods, specifications for manufactured equipment, and process flow charts from this project are described, evaluated and summarized in detailed monitoring and verification reports.

All carbon offset verification reports for this project are required to be stored at the project site as well as by ECC for at least seven years following the termination of the project. Verification reports associated with Climate Action Reserve (CAR) registration are publicly available at the CAR website.

Example project verification reports from Chicago Climate Exchange and CAR registrations are included herein.

Appendix B: Project Protocols

The included project protocols were used in the verification process of these projects. Project protocols are developed by the registration entity for use within their program.

Appendix C: Supporting material from public stakeholder engagement

See included materials from the North Carolina stakeholder event held in September 2008.

- An article published in Cape Fear Country Magazine about the stakeholder workshop and site visit to Butler Farms.
- Cover page to Welcome Packet given to attendees
- Workshop Agenda
- Collection of photos from the Workshop and site visit to Butler Farms

Appendix D: Budget Information

Here is a summary of how the money was spent on each project. For a more detailed summary on a per bi-annual reporting period basis, see included Progress Reports.

Coyne			
Budget Category	Budget Cost	Total Cost	NRCS Share (46.62%)
Equipment	121,333.33	166,293.82	77,526.18
Personnel	7,200.00	25,157.47	11,728.41
Fringe	720.00	3,070.28	1,431.36
Travel	2,573.33	3,707.21	1,728.30
Supplies	1,200.00	1,167.14	544.12
Contractual	3,066.67	23,517.05	10,963.65
Other	6,906.67	17,922.50	8,355.47
Total	**143,000.00**	**240,835.47**	**112,277.50**

Butler (2 lagoons covered)			
Budget Category	Budget Cost	Total Cost	NRCS Share (46.62%)
Equipment	242,666.67	311,860.43	145,389.33
Personnel	14,400.00	22,993.29	10,719.47
Fringe	1,440.00	2,741.93	1,278.29
Travel	5,146.67	3,387.01	1,579.02
Supplies	2,400.00	1,200.44	559.65
Contractual	6,133.33	20,409.25	9,514.79
Other	13,813.33	15,550.83	7,249.80
Total	**286,000.00**	**378,143.18**	**176,290.35**

Fessenden (2 lagoons covered)			
Budget Category	Budget Cost	Total Cost	NRCS Share (46.62%)
Equipment	242,666.67	227,239.62	105,939.11
Personnel	14,400.00	26,351.76	12,285.19
Fringe	1,440.00	3,176.01	1,480.66
Travel	5,146.67	4,647.19	2,166.52
Supplies	2,400.00	1,474.53	687.43
Contractual	6,133.33	23,826.66	11,107.99
Other	13,813.33	20,385.34	9,503.65
Total	**286,000.00**	**307,101.11**	**143,170.54**

Black (2 lagoons covered)			
Budget Category	Budget Cost	Total Cost	NRCS Share (46.62%)
Equipment	242,666.67	284,162.75	132,476.67
Personnel	14,400.00	22,843.42	10,649.60
Fringe	1,440.00	2,738.88	1,276.87
Travel	5,146.67	3,387.01	1,579.02
Supplies	2,400.00	1,200.44	559.65
Contractual	6,133.33	20,160.25	9,398.71
Other	13,813.33	15,426.33	7,191.76
Total	**286,000.00**	**349,919.08**	**163,132.28**

Ridgecrest			
Budget Category	Budget Cost	Total Cost	NRCS Share (46.62%)
Equipment	121,333.33	224,053.79	104,453.88
Personnel	7,200.00	27,163.09	12,663.43
Fringe	720.00	2,950.01	1,375.29
Travel	2,573.33	4,578.56	2,134.52
Supplies	1,200.00	1,506.72	702.43
Contractual	3,066.67	28,113.08	13,106.32
Other	6,906.67	19,667.98	9,169.21
	143,000.00	**308,033.23**	**143,605.09**

Van Slyke			
Budget Category	Budget Cost	Total Cost	NRCS Share (46.62%)
Equipment	121,333.33	232,821.33	108,541.30
Personnel	7,200.00	15,641.75	7,292.18
Fringe	720.00	1,864.50	869.23
Travel	2,573.33	883.27	411.78
Supplies	1,200.00	0.44	0.21
Contractual	3,066.67	9,695.23	4,519.92
Other	6,906.67	6,472.90	3,017.67
Total	**143,000.00**	**267,379.42**	**124,652.29**

Will-O-Crest			
Budget Category	Budget Cost	Total Cost	NRCS Share (46.62%)
Equipment	121,333.33	254,996.23	118,879.24
Personnel	7,200.00	19,158.41	8,931.65
Fringe	720.00	2,466.03	1,149.66
Travel	2,573.33	1,865.66	869.77
Supplies	1,200.00	300.44	140.07
Contractual	3,066.67	19,582.05	9,129.15
Other	6,906.67	8,278.35	3,859.37
Total	**143,000.00**	**306,647.17**	**142,958.91**

TOTAL			
Budget Category	Budget Cost	Total Cost	NRCS Share (46.62%)
Equipment	1,213,333.33	1,701,427.97	793,205.72
Personnel	72,000.00	159,309.19	74,269.94
Fringe	7,200.00	19,007.64	8,861.36
Travel	25,733.33	22,455.91	10,468.95
Supplies	12,000.00	6,850.15	3,193.54
Contractual	30,666.67	145,303.57	67,740.52
Other	69,066.67	103,704.23	48,346.91
Total	**1,430,000.00**	**2,158,058.66**	**1,006,086.95**

Appendix E: Schedule of events

Butler Farms:

7/2008	Project completed
9/2008	EFI on site to address moisture trap drainage
	ECC conducted site tour for a CIG Stakeholder Workshop event
	ECC visited site to download data
	EFI on site to repair inlet pipe
12/2008	ECC visited site to download data
	ECC installed gas sampling ports
	ECC took methane concentration samples
1/2009	EFI on site to check datalogger
3/2009	EFI on site to check datalogger and ignition system
6/2009	ECC visited site to perform calibration check on flow meter
	EFI on site to install remote monitoring system
2010	Evaluating engine use for collected gas
2011	Evaluating small heat digester option to increase gas production for beneficial end use

Black Farms:

7/2008	Project completed
9/2008	EFI on site to address moisture trap drainage
	ECC visited site to download data
12/2008	ECC visited site to download data
	ECC installed gas sampling ports
	ECC took methane concentration samples
1/2009	EFI on site to check datalogger
3/2009	EFI on site to check datalogger and ignition system
6/2009	ECC visited site to perform calibration check on flow meter
	EFI on site to install remote monitoring system
9/2009	EFI on site to switch out flow meter
2010	Evaluating engine use for collected gas
2011	Evaluating small heat digester option to increase gas production for beneficial end use

Fessenden Dairy:

4/2009	Battery undersized for datalogging system, power lost for data logging for the month.
10-11/2009	Battery undersized for datalogging system, power lost for data logging for the time period.
Fall 2009	Tear in cover repaired
12/ 2010 – 1/2011	Battery undersized for datalogging system, power lost for data logging for the time period.
9/8-9/14/2010	Datalogger malfunction
Fall 2010	Tear in cover repaired
4/27 – 6/1/2011	Gas valve closed to prevent gas from escaping during cover repair
6/1/2011– present	Gas valve opened for normal operation
9/2011 – 11/2011	Datalogger was missing sections of data. Datalogger was reprogrammed to correct the issue.

Coyne Dairy:

11/2008 – 1/ 2009	Solar panel and battery undersized for datalogging system, power lost for datalogging over this period.
4/2009 – 4/2010	Gas pipe broken during farmer activity in April 2009, didn't discover break until addition work was done on the system in April 2010.
1/2010 – 11/2010	Occasional periods of zero flow due to moisture trap flooding
Spring 2010	Small hole in cover repaired
9/8-9/14/2010	Datalogger malfunction
11/23/2010 – 8/11/2011	Gas valve alternated between being closed to prevent gas from escaping and then being opened to allow cover venting to prevent over-inflation
Spring 2011	Small hole in cover repaired
8/11/2011 – Present	Gas valve open for normal operation

Will-O-Crest Dairy:

9/2009	System put into service
7/2009 – 8/2009	Datalogger malfunction
1/2011 – 3/2011	Ice damming occurred, preventing the flow of gas. All gas was collected and stored under the cover.
5/29/2011 – 6/6/2011	Datalogger malfunction on 5/29, gas was venting until 6/6.
6/6/2011 – 8/17/2011	Gas valve closed to prevent gas from escaping during datalogger troubleshooting.
8/17/2011 – present	Gas valve open for normal operation

Van Slyke Dairy:

4/2010	Cover installation complete.
4/2010 – present	Project has been operating normally.

Ridgecrest Dairy:

8/12/2008	Cover installation complete.
8/12/2008 – present	Project has been operating normally.

Appendix F: Maps of project locations and equipment locations

Butler Farms, Lillington North Carolina

Black Farms, Lillington North Carolina

Fessenden Dairy, King Ferry New York

Coyne Dairy, Avon New York

Will-O-Crest Farms, Clifton Springs New York

Ridgecrest Dairy, Genoa New York

Van Slyke, Portageville New York