Economic Feasibility of Dairy Digester Clusters in California: A Case Study

Prepared by
California Dairy Campaign
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1.0 Introduction

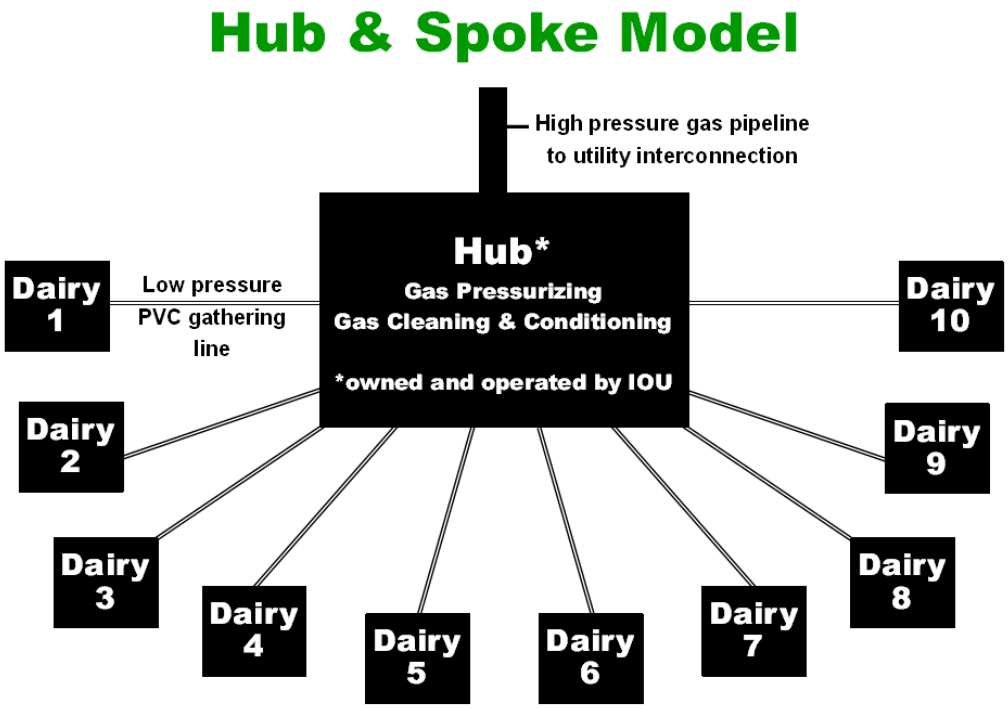
California is home to the nation's largest dairy industry, which includes approximately 1,600 dairies that house some 1.8 million milk cows and additional support stock. Most of these dairies are in the state's Central Valley and are among the largest, on average, in the nation. These dairies produce substantial quantities of dairy manure that can be processed by anaerobic digesters to produce biogas, a flexible renewable source of energy that can be converted into renewable electricity or upgraded to biomethane for use as a renewable natural gas (RNG) or renewable transportation fuel (renewable compressed natural gas or RCNG). Dairy manure converted to renewable energy offers not only the environmental benefits of offsetting fossil fuel use associated with typical renewable energy resources, but has the significant additional benefit of destroying methane that otherwise would be vented and contribute to global warming. Methane (CH_4) is a potent greenhouse gas (GHG), with a pound-for-pound impact on climate change that is more than 20 times greater than carbon dioxide (CO_2). This project alone has the potential to reduce GHG emissions by roughly 150,000 metric tons of carbon equivalent (MTCE) per year.

The technological feasibility of producing biogas from manure digesters is well established. However, despite a political and policy environment driving renewable energy production and greenhouse gas reductions, dairy digester development has lagged in California. Fewer than two dozen dairies in California have installed methane digesters and only roughly half of these projects are still operating. Expensive, uncertain and complex interconnection and permitting obstacles, high environmental compliance costs, lack of long-term economical energy purchase agreements, and high financing risk and costs have all contributed to the lack of success in California. As a result, commercialization of the dairy biogas industry has not occurred and project development has stagnated in recent years. At the same time, the regulatory environment surrounding dairy digester development in California continues to evolve and regulatory officials and policymakers are taking serious steps to encourage further growth of the industry.

Development of centralized dairy digester projects in California has also often been discussed as a model to help address obstacles and take advantage of economies of scale. Toward this end, the California Dairy Campaign sought a Value Added Producer Grant from the United States Department of Agriculture (USDA) Rural Development Agency to further explore the concept. This report is designed to further examine the financial and technical feasibility of developing dairy digester cluster projects in California, develop findings, draw conclusions and make recommendations to regulators and policymakers to further their potential development.

2.0 Overview, Methodology and Project Team

The dairy digester cluster concept, often described as a "**hub and spoke**" model, is fairly straight forward. The "**hub**" would involve a centrally located operation where raw dairy biogas could be gathered from a cluster of existing dairy operations. At the hub, the gas could be cleaned and conditioned to sufficient levels for use as fuel for electrical distributed generation (DG), upgraded to pipeline quality "biomethane" and sold as renewable natural gas (RNG) or upgraded for use as renewable compressed natural gas (RCNG) transportation fuel. The "**spokes**" would involve a gas gathering system of low-pressure PVC pipelines that interconnect the cluster of participating local dairies.



2.1 Methodology

The project team identified nine major task activities for the project as follows:

Task 1 – Daily administrative management and oversight of the project.

Task 2 – Identification of suitable dairy clusters in the four-county region – Fresno, Tulare, Kings & Kern.

Task 3 – Analysis of energy production opportunities, marketing and pricing of biomethane injection, renewable electricity generation and renewable transportation fuel production.

Task 4 – Analysis of cluster benefits, including potential economies of scale.

Task 5 – Analysis of permitting barriers and potential solutions.

Task 6 – Identification and analysis of project development costs.

Task 7 – Analysis of business model structure options, benefits and preferences.

Task 8 – Identification and analysis of project financing options, alternatives and costs.

Task 9 – Preparation of a final report with conclusions and recommendations.

An initial kick-off meeting was held with a broad range of stakeholders in April of 2012 in Stanislaus County, to gain vital input on project tasks and goals, (see Appendix A). Following that meeting, project staff conducted a comprehensive literature review to identify previous research, further inform the project and avoid unnecessary duplication. Extensive review of potential dairy clusters was conducted to identify a suitable project site(s) for further analysis. Regulatory officials were interviewed to identify requirements, issues and potential obstacles to permitting a centralized digester project. A second meeting was organized to bring regulators together to fully understand potential permitting issues (see Appendix B) and potential pathways.

The project team identified and researched three specific uses for the biogas created by the cluster project:

- Production of distributed generation (DG) renewable electrical energy
- Production of biomethane (renewable natural gas (RNG))
- Production of transportation fuel (renewable compressed natural gas (RCNG))

Renewable energy markets were extensively researched and additional revenue sources, including credits and other incentives, were explored. Financing options, including grants and loans, debt and equity financing, were also considered.

Digester costs for the Kern County cluster project were developed based on available data and the actual costs of two recent Central Valley digester projects. Hub costs were also fully explored. Hub development, operation and maintenance costs were based on estimated tariff options for gas gathering, cleaning and conditioning (Biogas Conditioning/Upgrading Service (BCS) tariff) recently proposed by the Southern California Gas Company.

Comprehensive financial analysis models were developed for the project by California Bioenergy, LLC, a dairy digester developer in California.

Finally, conclusions were drawn from the extensive research and analysis and recommendations were developed as part of the final report.

2.2 Project Team

Gary Bullard
Mr. Bullard served in the USDA Natural Resources Conservation Service for 30 years in two states and various staff positions. While at USDA, he gained valuable experience in resource conservation planning at the farm and ranch level, watershed and river basin planning, as well as environmental planning. For the past nine years he has served as the Environmental Project Manager for the California Dairy Campaign, where he has worked directly on dairy environmental sustainability efforts and programs.

Michael Boccadoro
As President and Managing Partner of The Dolphin Group, Mr. Boccadoro plays a key role in the development of strategies for the firm's energy, water and agricultural clients and oversees the firm's policy and regulatory affairs practice. Mr. Boccadoro has been extensively involved with the California dairy industry for the past 13 years on issues related to environmental compliance and sustainability and has directed the industry's successful Dairy Cares program.

Mr. Boccadoro also directs the Agricultural Energy Consumers Association (AECA), which has led efforts to develop net-energy metering (NEM) and feed-in tariffs (FiT) for dairy biogas and other agricultural renewable energy projects in California. He served on the Central Valley Regional Water Quality Control Board's Dairy Digester Technical Advisory Group in 2009-2010 and has assisted project developers in securing power purchase agreements (PPAs) with California utility service companies.

J.P. Cativiela
Mr. Cativiela is widely recognized as one of the state's leading experts on dairy environmental laws and regulations. He has successfully led efforts to secure environmental permits for several large dairy biogas digester projects in California. He also served on the Central Valley Regional Water Quality Control Board's Dairy Digester Technical Advisory Group in 2009-2010. Mr. Cativiela has more than 15 years in policy and regulatory affairs related to climate change, water quality and air quality issues for the dairy and rice farming industries in California. Since 2001, he has served as Program Manager for Dairy Cares, a statewide coalition of dairy industry groups with a mission to support the long-term sustainability of the California dairy industry.

Beth Olhasso
Ms. Olhasso has more than five years of experience working on environmental planning, water resource issues and renewable energy policy in California. She currently serves as Program Manager for the Agricultural Energy Consumers Association (AECA), where she has played a key role in the development of key renewable energy policies and programs for agricultural operations in California.

Neil Black and Ross Buckenham
California Bioenergy, LLC (CalBio)
California Bioenergy is a leading developer of state-of-the-art biomass to clean energy projects in California and is currently actively engaged in the development and operation of three dairy biogas projects in the state.

Mr. Black is President of CalBio and brings more than 20 years of senior management experience. For the past eight years he has been focused on energy and sustainability businesses. He is a former managing principal of GreenOrder, a leading sustainability consulting firm, and managing director of Class Green Capital Partners, an innovator in municipal and energy efficiency finance. Mr. Black currently serves as Chairman of the Bioenergy Association of California (BAC) and has extensive experience working with bankers and investors focused on renewable energy and sustainability. He has an MBA from the Harvard Business School and a BA from Yale University.

Mr. Buckenham is Chairman and CEO of CalBio. He has more than 25 years of general management and technology development experience in public and private companies including in the renewable energy sectors of biogas, wind and solar. He has raised over $20 million of debt and equity for development of CalBio and its dairy biogas projects and has led the company's development of these projects. He previously served as a consultant with Bain & Company, a global corporate strategy and implementation firm. He has an MBA from the Harvard Business School and a Bachelors Degree in Chemical Engineering from Canterbury University, New Zealand.

3.0 Background & Regulatory Environment

California is home to the nation's largest dairy industry and its largely family-owned and operated dairies produce substantial quantities of dairy manure that can be processed by anaerobic digesters to produce biogas, a flexible renewable source of energy. Once produced, raw dairy biogas can be converted into renewable electricity or upgraded to biomethane for use as renewable natural gas or transportation fuel for natural gas vehicles (NGVs).

Despite a regulatory environment encouraging renewable energy production and greenhouse gas reductions, dairy digester development has lagged in California. Fewer than two dozen dairies in California have installed methane digesters and only roughly half of these projects are still operating. Permitting obstacles and complexities, high environmental compliance costs, lack of long-term economical energy purchase agreements and high financing risk and costs have all contributed to the lack of success in California. As a result, the dairy biogas industry in California has stagnated in recent years. Lack of commercialization of the industry has also prevented cost of production efficiencies that can generally be expected from increased experience and scale.

3.1 Current Regulatory Environment

A number of current California regulatory programs support the development of dairy biogas projects in California.

California Cap-and-Trade Program

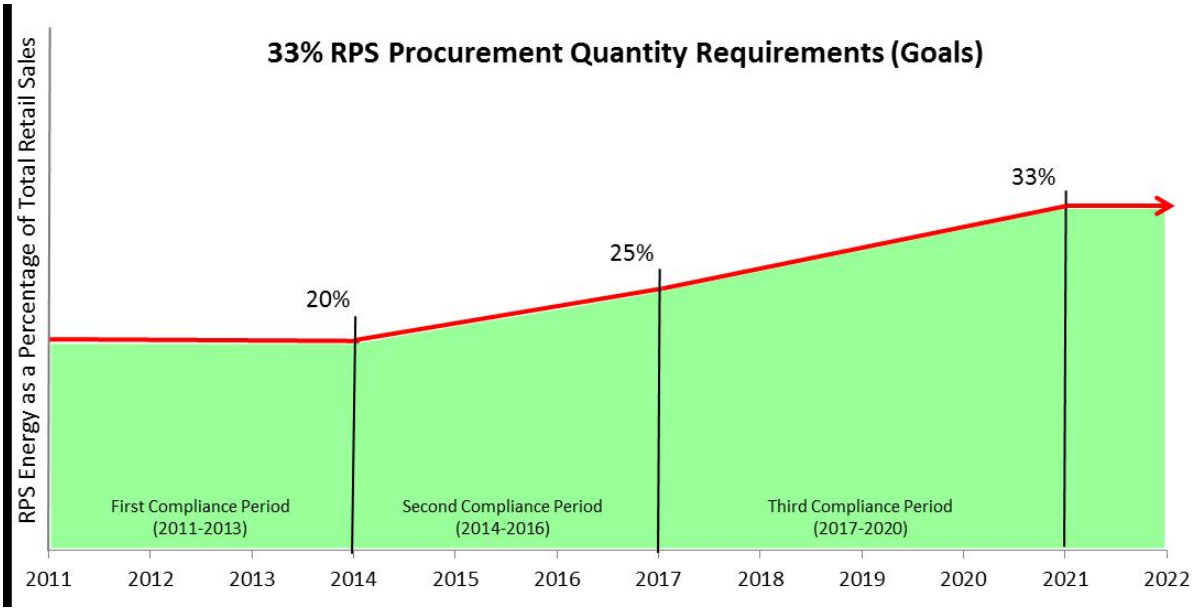
The program is a central element of California's Global Warming Solutions Act of 2006 (Assembly Bill 32, Chapter 488, Statutes of 2006) and covers major sources of greenhouse gas (GHG) emissions in the state, such as refineries, power plants, industrial facilities and transportation fuels. The program is designed to put California on a path to meet its goal of reducing GHG emissions to 1990 levels by the year 2020, and ultimately achieving an 80 percent reduction from 1990 levels by 2050. The regulation includes an enforceable GHG cap that will decline over time. The AB 32 Scoping Plan identifies the Cap-and-Trade program as one of the main strategies California will employ to reduce greenhouse gas (GHG) emissions that cause climate change. The program started on January 1, 2012, with the first enforceable compliance obligation beginning with 2013 GHG emissions.

Under Cap-and-Trade, an overall limit on GHG emissions from capped sectors has been established and facilities subject to the cap are able to trade permits (allowances) to emit GHGs or utilize credits to offset emissions. Dairy digesters are able to produce GHG credits under one of only four California Air Resources Board (CARB) protocols currently approved

for the program. Production and sale of GHG credits provides an additional potential revenue source for dairy digester development in California.

California Renewables Portfolio Standard (RPS)

Established in 2002 under Senate Bill (SB) 1078, accelerated in 2006 under SB 107 and expanded in 2011, under SB 2, California's RPS is one of the most ambitious renewable energy standards in the country. The RPS program requires investor-owned utilities, municipal utilities, electric service providers and community choice aggregators to increase procurement from eligible renewable energy resources to 33 percent of total procurement by 2020.



Under the RPS, renewable generation facilities may sell energy and/or renewable energy credits (RECs) to a California retail seller of electricity to meet its RPS obligation, provided the facility meets all RPS eligibility criteria. Dairy digesters producing electrical generation are an RPS eligible technology. Additionally, dairy digesters can produce biogas, which can be cleaned, conditioned, compressed and injected into a natural gas transmission pipeline and "directed" to a natural gas-fired energy generation facility, which can produce RPS eligible electricity. The California Energy Commission (CEC) recently implemented AB 2196 (Chapter 605, Statutes of 2012), which allows in-state dairy digesters to continue injecting biomethane for RPS purposes. Under AB 2196, biomethane injection projects must meet several environmental standards to be eligible for RPS compliance (see section 3.2).

Low Carbon Fuel Standard

California's Low Carbon Fuel Standard (LCFS) was established by Executive Order S-1-07 on January 18, 2007. CARB adopted the LCFS regulation as a discrete early action measure under the California Global Warming Solutions Act of 2006 (AB 32). The regulation went into effect in 2011 and is designed to reduce GHG emissions by reducing the carbon intensity of transportation fuels used in California by an average of 10 percent by the year 2020.

The LCFS provides a framework for reducing the large amount of greenhouse gases, especially CO2, that are emitted from today's petroleum-based transportation fuel system. The standard is also aimed at reducing the state's dependence on petroleum, creating a market for clean transportation technology and stimulating the production and use of low carbon fuels in California. It is designed to facilitate the introduction of less carbon intensive fuels and incrementally lowering the carbon content of fuels in California in each subsequent year through 2020. Regulated entities can meet annual carbon intensity requirements with any combination of fuels they produce or supply, or with LCFS credits generated by other parties. Dairy biogas converted to transportation fuel (RCNG) is a low carbon fuel capable of producing significant LCFS credits.

3.2 Evolving Landscape

More recently, California policymakers and regulators have taken several actions that should further facilitate, encourage and nurture dairy digester development in California, including the following:

- **Passage of Assembly Bill 1900**
  AB 1900 (Gatto) was passed in 2012 to clarify and facilitate requirements for injection of biomethane into California's vast natural gas pipeline system. Prior to the enactment of AB 1900, state law prohibited landfill gas from being injected into the pipelines that carry natural gas across the state and utilities imposed strict quality and testing requirements on other sources of biogas, such as dairy biogas. As a result, pipeline injection was difficult in California. AB 1900 requires the California Public Utilities Commission (CPUC), in consultation with the Office of Environmental Health Hazard Assessment (OEHHA) and CARB, to develop standards for constituents in biogas to protect human health and pipeline integrity and safety. AB 1900 is currently being implemented by the CPUC and is expected to facilitate and streamline biomethane injection and promote in-state production and distribution of renewable natural gas (RNG).
- **Passage of Assembly Bill 2196**
  Early in 2012, the California Energy Commission established a moratorium on directed biomethane burned in California power plants for compliance under California's RPS program. AB 2196 (Chesbro) was subsequently passed in 2012 and established conditions

grandfathering existing biomethane contracts and set standards for future contracts. The California Energy Commission (CEC) recently implemented AB 2196 as part of the adoption of the Seventh Edition of the *RPS Eligibility Guidebook*.

AB 2196 also establishes RPS-eligibility requirements for any quantities of biomethane associated with biomethane procurement contracts executed on or after March 29, 2012, or for amendments made after March 29, 2012, to existing contracts. These RPS-eligibility requirements apply to biomethane used by an onsite generating facility, biomethane used by an offsite generating facility and delivered through a dedicated pipeline, and biomethane used by an offsite generating facility and delivered through a common carrier pipeline. With respect to the latter, AB 2196 imposes the following requirements:

- The biomethane is injected into a common carrier pipeline that flows within California or toward the generating facility.
- The biomethane source did not inject biomethane into a common carrier pipeline before March 29, 2012, or the source began injecting sufficient incremental quantities of biomethane after March 29, 2012, to satisfy the biomethane procurement contract requirements.
- The seller or purchaser of biomethane demonstrates that capture and injection of biomethane into a common carrier pipeline directly results in at least one of the following:
    - Reduces or avoids criteria air pollutant emissions in California
    - Reduces or avoids pollutants that adversely affect California waters
    - Alleviates local nuisance associated with odor emissions within California
- Retail seller or Publicly Owned Utility (POU) procurement of generation from facilities using biomethane under contracts initially executed on or after March 29, 2012, or for quantities of biomethane associated with contract amendments executed after March 29, 2012, shall be assigned to the appropriate portfolio content category based on criteria in Public Utilities Code Section 399.16.

AB 2196 also requires all biomethane sellers and purchasers of biomethane, irrespective of the date of the biomethane procurement contact, to comply with a system for tracking and verifying the use of biomethane, established by the CEC. In addition, for biomethane-based electricity generation to count for a retail seller or POU's RPS procurement requirements, AB 2196 requires that sufficient renewable and environmental attributes of the biomethane production and capture to be transferred to the retail seller or POU using the biomethane to ensure that there are zero-net emissions associated with the production of the electricity from the generating facility using the biomethane.

The CEC recently lifted the moratorium on directed biomethane use simultaneously with the adoption of the Seventh Edition of the *RPS Eligibility Guidebook*.

- **Passage of Senate Bill 1122**
  Finally, in 2012, the California Legislature passed SB 1122 (Rubio), a measure designed to encourage the development and incubate the commercialization of bioenergy in California. SB 1122 requires California's three investor-owned utilities (IOUs) to purchase 250 megawatts of bioenergy-based electricity from 3 megawatt (MW) or smaller distributed energy projects. The measure further sets aside 90 megawatts for agriculture and dairy biomass and biogas projects. This measure is currently being implemented by the CPUC. Power purchase agreements (PPAs) under SB 1122 are expected to provide much higher prices for electricity produced by dairy biogas projects than prices historically paid to these projects. A more thorough discussion of the SB 1122 Feed-in Tariff (FiT) program occurs in chapter 5 of this report.

- **California/Federal Dairy Digester Working Group**
  In May 2011, the U.S. Environmental Protection Agency (USEPA), U.S. Department of Agriculture (USDA) and California Department of Food & Agriculture (CDFA) convened the California/Federal Dairy Digester Working Group. This partnership of state, federal and local agencies has the common goal of identifying and removing barriers to wide-spread adoption of dairy digester systems in California. In addition to government representatives, the Dairy Digester Working Group includes stakeholders from academia, industry, non-profits and utilities that participated in subcommittees on economics, regulatory issues and technology. The ultimate purpose of this collaborative effort is to "**enhance widespread adoption of dairy digester systems to better manage manure and nutrients, help address air and water quality concerns, reduce greenhouse gas emissions and produce renewable energy, fertilizer and other value-added products**." One specific project of the collaboration was the creation of streamlined permitting for projects under the California Consolidated Permitting System (see chapter 6). The consolidated permitting system is designed to reduce permitting time and agency duplication and streamline the application process to enhance development of dairy digester projects in California.

4.0 Dairy Cluster Identification

Numerous public and private entities have identified potential dairy clusters in California. The project team utilized these extensive efforts as a starting point in identifying an ideal dairy cluster to review and conduct financial feasibility for this project. Key considerations included cluster size, energy production potential, proximity to natural gas pipelines, proximity to major transportation corridors and local land-use and permitting policies.

4.1 Selection Process

After extensive review and consideration, a large cluster was selected for purposes of further analysis and review. The "Kern Cluster" is ideally situated for a number of reasons, including, but not limited to, the following:

- Existing cluster of large modern dairies
- Roughly 50,000 milk cow equivalents in cluster
- Proximity of dairies to county roads facilitating right-of-way access
- Proximity of dairies to major transportation highways – the project is located less than two miles from Interstate 5 and close proximity to Highway 99
- Access to a Southern California Gas Company natural gas transmission pipeline
- Location in county with favorable renewable energy resource policies
- Local permitting experience with development of similar digester projects
- Access to dairies allowing for accurate assessments of biogas production and potential.

4.2 Project Location

The project is located in Kern County at the southern end of California's vast San Joaquin Valley agricultural production region.

4.3 Cluster Proximity

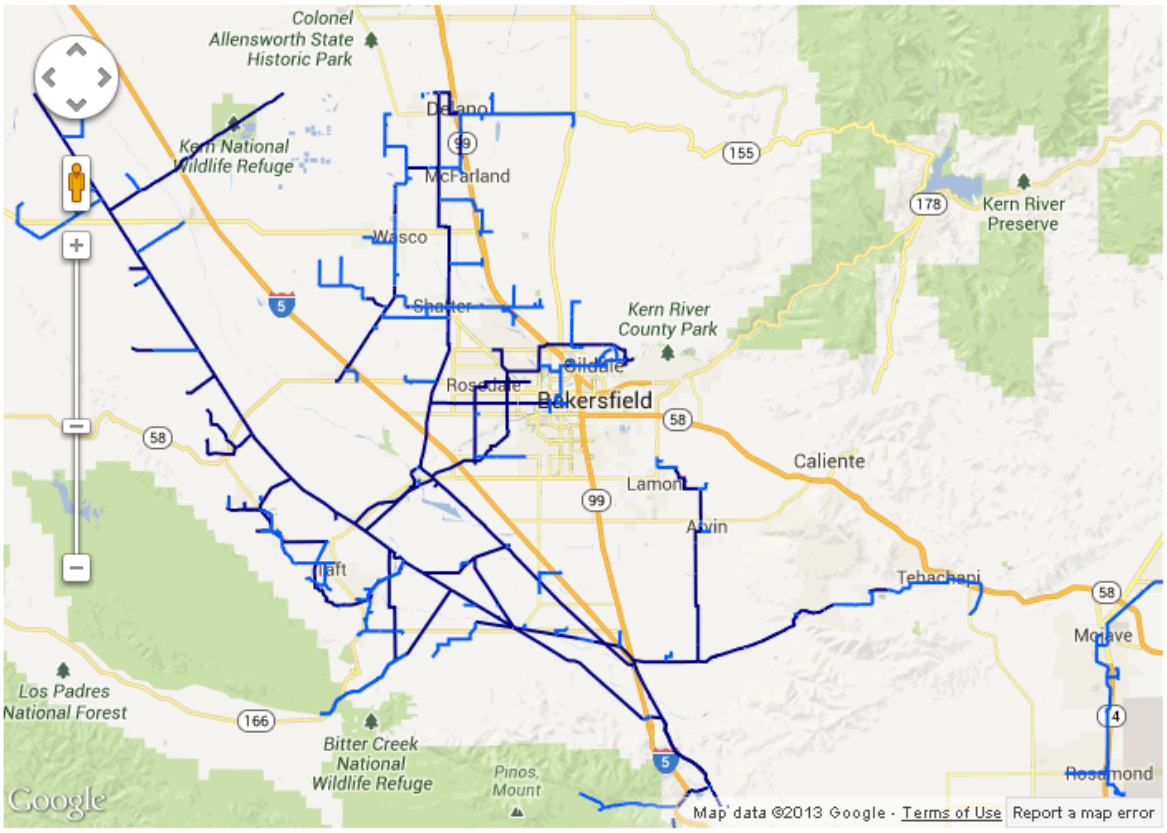
All of the dairies included in the analysis are located along or contiguous to Bear Mountain Blvd. and Old River Rd., facilitating gas gathering on existing rights of way.

Approximately 7-10 miles of gas gathering pipeline would be needed to connect all dairies to a centralized hub.

4.4 Proximity to Pipeline

The Kern Cluster is ideally located within a few miles of a SoCal gas pipeline.

Gas Transmission and High Pressure Distribution Pipeline- Kern



Dark Blue — Transmission Lines: Generally large diameter pipelines that operate at pressures above 200 psi and transport gas from supply points to the gas distribution system.

Light Blue — High Pressure Distribution Lines: Pipelines that operate at pressures above 60 psi and deliver gas in smaller volumes to the lower pressure distribution system.

For additional information about gas transmission and high pressure distribution pipelines in the 4-county region, visit the following websites:
http://www.socalgas.com/safety/pipeline-maps/
http://www.pge.com/pipelinesafety/transmissionpipelines/

4.5 Cluster Specifics

There are currently 14 individual dairies and approximately 50,000 milk cows in the identified cluster. Two dairies were not included in the analysis because of their small size. One of the largest dairies (7,000 milk cows) is also not part of the cluster analysis since it is already developing an onsite dairy biogas to renewable electricity project. All three dairies would be potential participants in the cluster at a later date, depending upon the ultimate project configuration when developed. For purposes of the financial analysis, 50,000 milk cow equivalents were analyzed, assuming some manure from support and replacement stock.

Kern Dairy Cluster Specifics

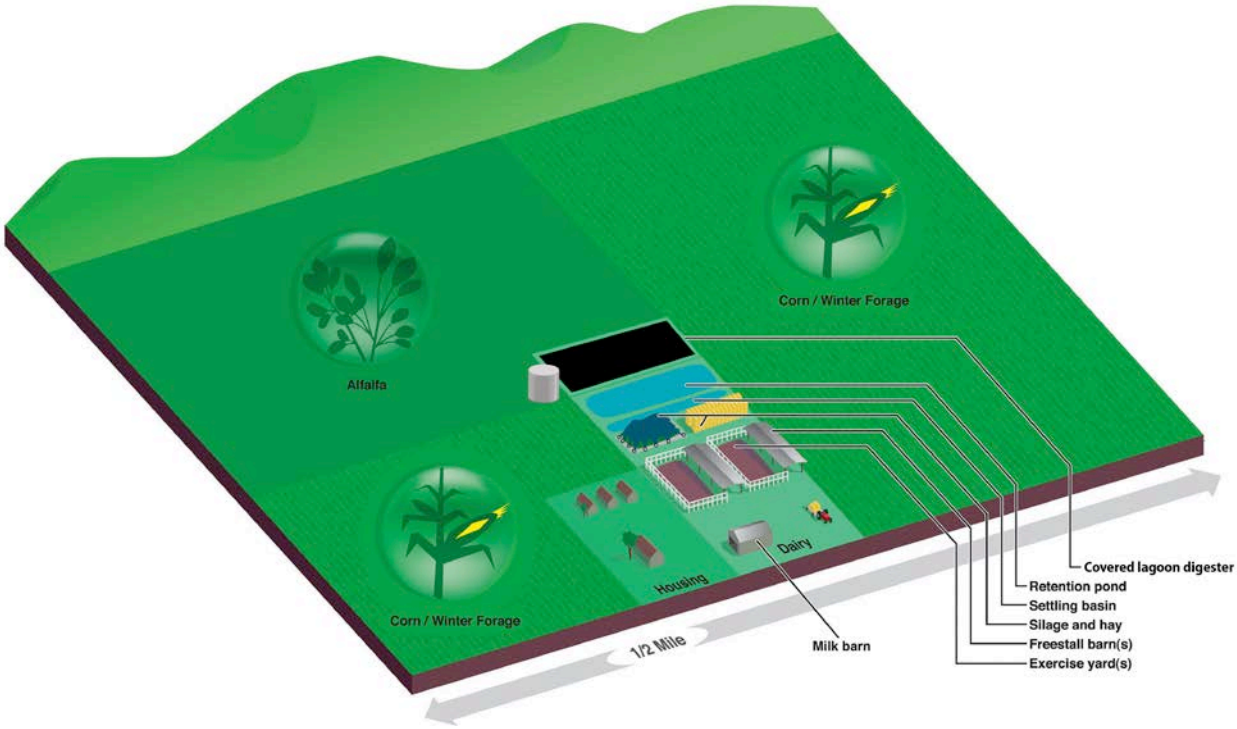
	Milk Cows	Manure Collection System
Dairy 1	4,320	Flush
Dairy 2	4,500	Flush
Dairy 3	4,000	Flush
Dairy 4	3,500	Flush
Dairy 5	6,000	Flush
Dairy 6	3,200	Flush
Dairy 7	3,500	Flush
Dairy 8	3,000	Flush
Dairy 9	3,500	Flush
Dairy 10	2,500	Flush
Dairy 11	2,500	Flush
Total Milking Cows	40,520	

4.6 Energy Production Potential

The energy production potential of the Kern County Cluster is significant:

DG Renewable Electricity	Biomethane (RNG)	Diesel Gallon Equivalent (DGE)
50,842,000 kWh/yr	**519,354 MMBtu**	**3,739,348 DGEs/yr**

4.7 Dairy Configuration



For purposes of analysis, each dairy is assumed to install a new Tier 1 (double-lined) lagoon with cover for digestion and biogas production. The distributed electricity generation model also assumed the installation of onsite electrical generation capacity sized to energy production potential and capable of meeting all local air quality permitting requirements. Caterpillar internal combustion engines with SCR NO_X reduction were utilized.

5.0 Energy Production Opportunities

Dairy biogas produced through anaerobic digestion can be burned in a generator to produce renewable electricity to be used onsite or sold to the grid or can be refined into biomethane for use as renewable natural gas or transportation fuel.

This study analyzes all three potential energy production opportunities. Following is a brief discussion of each.

5.1 Electricity Production

Nearly all dairy digesters developed in California and elsewhere in the nation have utilized biogas to produce electricity for onsite use or sale to the grid. This is generally the least capital intensive and most economical means to convert biogas to usable energy. State and federal policies also directly and indirectly encourage this end use for dairy biogas.

Expiring federal policies have provided significant subsidies for producing electricity from biogas. The main examples include the US Treasury 1603 Cash Grant and Investment Tax Credit (ITC), which provide known and quantifiable capital cost reduction and the Production Tax Credit (PTC), which provides defined revenue streams that can be counted on for the life of the project. California also has several electricity procurement programs, four are discussed below, that are designed to facilitate electricity production from renewable energy sources, including dairy biogas.

Net Energy Metering (NEM)

Dairies that install biogas digesters (1 MW or less) to serve all or a portion of onsite electricity needs are eligible for the state's Net Energy Metering (NEM) program. NEM allows a customer-generator to receive a financial credit for power generated by their onsite system and fed back to the utility. The credit is used to offset the customer's electricity bill, including all aggregated customer service accounts on contiguous property (coming soon with implementation of SB 594 (Wolk, 2012) by the CPUC).

The "retail" electricity price that farmers currently pay to meet their on-farm needs determines a maximum economic value for their potential electric cost savings earned by self generation. Currently, the typical "retail" electricity price facing dairies in California ranges from $0.12/kWh to $0.18/kWh, depending on the utility providing the service and the applicable rate schedule. During peak periods, the electricity price can exceed $0.26/kWh (source: Agricultural Energy Consumers Association). NEM is very limited in its application, however, and is not an economically viable alternative for typical California dairies. First, NEM is limited to 1 MW and biogas generation projects must be sized to load, which

eliminates larger dairies and greatly limits electricity generation. A typical dairy digester can generally produce two to four times the energy usage associated with dairy farm operations in California greatly exceeding on-site usage and resulting in the flaring of usable biogas if project size is limited to the participating dairy farm's load on the grid.

Renewable Auction Mechanism (RAM)

The Renewable Auction Mechanism (RAM) is a simplified market-based procurement mechanism for renewable distributed generation (DG) projects greater than three MW and up to 20 MW on the system side of the meter. The CPUC adopted RAM as the primary procurement tool for system-side renewable DG because it "will promote competition, elicit the lowest costs for ratepayers, encourage the development of resources that can utilize existing transmission and distribution infrastructure, and contribute to RPS goals in the near term." The CPUC has authorized the state's investor owned utilities (IOUs) to procure 1,299 MW through RAM by holding auctions over two years. RAM is a unique program because it streamlines the procurement process for developers, utilities and regulators. It allows bidders to set their own price, provides a simple standard contract for each utility and allows all projects to be submitted to the CPUC through an expedited regulatory process. Initial RAM auctions have resulted in significant renewable electricity procurement. The bulk of this procurement, however, has been solar, wind and geothermal energy to date.

The RAM program has not proven to be an effective mechanism for dairy digester projects since most individual dairy projects are below three MW in size. The average price point for DG contracts under the RAM program is also quite low, averaging below $0.09/ kWh in the initial auctions. As a result, the RAM program is not expected to be an effective program for dairy digester development projects in California, including dairy cluster projects.

Renewable Feed-in Tariff (FiT)

California's renewable feed-in tariff (FiT) program has undergone numerous revisions in the short time since its original adoption by the Legislature in 2006 (AB 1969 – Yee). The original program authorized contracts for the purchase of eligible renewable generation from public water and wastewater facilities that are 1.5 MW or less. In implementing the program, the CPUC authorized additional tariffs beyond those authorized by AB 1969 for all customers in IOU territories. Under the program, eligible renewable generation projects are able to receive standard procurement rates and contracts for 10, 15 or 20 year periods. These "Feed-in Tariffs" (FiTs) or standard contracts are designed to provide a simple mechanism for small renewable generators to sell power to the utility at predefined terms and conditions without contract negotiations. The FiT was again amended in 2009 (SB 32 – Negrete-McLeod) to further expand the program to 750 MW, increase the size of projects from 1.5 to

three MW in size and require publicly-owned utilities (POUs) to also participate. The CPUC, on May 23, 2013, recently adopted Decision (D) 13-05-034, creating a revised standard contract and tariffs for the Section 399.20 renewable FiT program. Under the newly revised program, a new pricing mechanism (the Renewable Market Adjusting Tariff or ReMAT) will be utilized. To date, the FiT program has not been effective in providing contracts to new dairy digester projects in California. Similar to the RAM program, contracts under the FiT program have not provided sufficient energy procurement rates and revenue to encourage dairy biogas project development.

SB 1122 Bioenergy FiT

On September 27, 2012, Governor Brown signed SB 1122 (Rubio) into law, creating a 250 MW bioenergy incubation program in the state's FiT program. Under SB 1122, the state's investor owned utilities must procure 250 MW of bioenergy from projects sized at 3 MW or less, including:

- 110 MWs for biogas from wastewater treatment, municipal organic waste diversion, food processing and co-digestion
- **90 MWs for dairy and other agricultural bioenergy**
- 50 MWs for bioenergy using byproducts of sustainable forestry management

As part of the CPUC's efforts to implement SB 1122, Energy Division staff commissioned a study by engineering firm Black & Veatch to facilitate implementation. The report provides a high-level overview of the SB 1122 eligible small-scale bioenergy market in California, including an evaluation of resource potential and costs. The CPUC is currently implementing SB 1122 within the state's existing FiT program structure and an on-line date has not yet been determined.

As designed, SB 1122 is expected to provide much higher energy procurement contracts for dairy biogas projects. SB 1122 recognizes that bioenergy projects are not yet commercially viable and therefore are unable to compete fully with other long-subsidized renewable energy technologies, such as wind and solar. SB 1122 is designed to "incubate" bioenergy projects in the short-term with the goal of commercializing the industry in order to facilitate long-term price competitiveness with other RPS technologies.

Discussion

While California has a plethora of renewable electricity programs designed to facilitate development of small distributed renewable electricity generation, these programs have not led to widespread dairy digester development. Programs such as NEM require projects to be sized to load and limit projects to 1 MW, greatly limiting their applicability to dairy digester

development. The existing FiT and RAM programs have not provided opportunities for dairy digesters due to the low energy generation prices they offer (below $0.10/kWh).

The structure of California's renewable electricity generation purchase programs also effectively precludes the centralized hub and spoke concept for electricity production. Dairy cluster projects seeking to produce electricity from a centralized facility will be forced to compete in the RAM program due to the amount of generation potential (above 3 MW) and, as a result, will likely receive a much lower price for their electrical energy generation compared to distributed generation projects eligible for the SB 1122 FiT program. As a result, this project analyzed electrical energy production only as on-site generation. Centralized electrical energy production was determined to be economically infeasible because of higher costs associated with gas gathering and the lower energy prices associated with the RAM. Onsite energy production also allows waste heat from energy generation to be fully utilized.

Dairy digester development moving forward in California is directly tied to the successful implementation of the SB 1122 Bioenergy FiT program. The Bioenergy FiT program promises to provide higher energy production contracts (greater than $0.17/ kWh), which will be necessary to spur short-term dairy digester development in the state.

5.2 Renewable Natural Gas (RNG)

Dairy biogas can be purified (or "upgraded") to nearly pure methane with the removal of carbon dioxide and other contaminants. Known as biomethane or renewable natural gas (RNG), once cleaned, conditioned and compressed, it can be injected into California's existing vast network of natural gas pipelines. Once injected into a common-carrier pipeline in California, biomethane can be directed to an electrical generation facility to produce RPS eligible renewable electricity. The passage of AB 2196 modified the RPS eligibility requirements for these facilities. New requirements have been added for tracking and verifying such use of biomethane, including tracking and verifying the quantities and sources of biomethane and the related environmental and renewable attributes, and the deliveries of biomethane. The CEC recently implemented the new requirements with the adoption of the Seventh Edition of the *RPS Eligibility Guidebook* and concurrently lifted the March 28, 2012 suspension of eligibility for biomethane. Under the new requirements, biomethane can be converted to renewable electricity at both onsite and offsite generating facilities that result in at least one of the following environmental benefits to California:

1) Reduction or avoidance of the emission of any criteria air pollutants (or their precursors) in California
2) Reduction or avoidance of pollutants that could have an adverse impact on any surface water or groundwater in California; or

3) Mitigating a local nuisance in California associated with the emission of odors.

Biomethane produced by a dairy digester cluster operating in Kern County, as described in this study, would be eligible for production of RPS eligible electricity under the new requirements. As a result, the biomethane would have significant increased value over conventional natural gas. Investor owned utilities (IOUs), publicly owned utilities (POUs) and other retail service providers subject to RPS requirements will pay a premium for the biomethane since it can easily be converted to cost-effective renewable electricity at an existing natural gas fired generation facility. Equally important, the renewable electricity produced in this manner can be used to balance the load of other, more intermittent, sources of renewable energy, such as wind or solar.

Discussion

Markets for California-based biomethane production are expected to emerge and expand. Biomethane fired renewable electricity production is a cost effective, storable and reliable source of renewable energy, with little or no new generation capital investment required by the IOU or other RNG purchaser.

One drawback is that standard energy purchase agreements are currently not available for biomethane and a bi-lateral agreements must be negotiated with a willing buyer. However, as a result of the new requirements for RPS eligibility, California produced biomethane should be in a better position to fill biomethane needs for RPS regulated entities in the state.

As a general of thumb, $10/MMBtu RNG can produce roughly $0.09/kWh renewable electricity. Given the benefits of RNG produced electricity and limited supplies under AB 2196, gas marketers expect the price to climb in the future.

5.3 Vehicle Fuel

Conversion of biogas to vehicle fuel is similar to the creation of RNG. Raw dairy biogas must be upgraded using one or more of several commercial technologies to remove carbon dioxide, hydrogen sulfide and other gases and trace contaminants. It can then be compressed and dispensed to vehicles at the production site, liquefied for truck transport to fueling stations, or injected into a natural gas pipeline as biomethane and then removed, compressed or liquefied onsite at vehicle fleet maintenance or fueling locations.

At least two dairy biogas projects are producing biofuels for transportation use. The Hilarides Dairy, in Tulare County, California, has been successfully running two milk hauling trucks on biogas from its manure digester for several years. On a much larger scale, the Fair Oaks Dairy, in Indiana, is producing enough RCNG to fuel 42 trucks daily that haul milk to

processing plants in Indiana, Tennessee and Kentucky. The Fair Oaks Dairy fleet represents the largest NGV fleet using agricultural waste for fuel in the nation.

Purified RNG is interchangeable with conventional natural gas as vehicle fuel, but with a distinct advantage. Dairy RNG is a low polluting and extremely low carbon vehicle fuel that can replace either gasoline or diesel in vehicles equipped with natural gas engines. If used to displace diesel used in older trucks and buses, dairy RNG vehicle fuel also significantly reduces emissions of fine particulates (soot) and nitrogen oxides, air pollutants that are closely linked with respiratory and cardiovascular diseases and cancer.

Renewable Identification Numbers (RINs)

Dairy biogas to RCNG is an eligible biofuel under the Federal Renewable Fuel Standard (RFS), created under the Energy Policy Act of 2005. A Renewable Identification Number (RIN) is a serial number assigned to each gallon of renewable fuel as it is introduced into U.S. commerce. RIN credits were created by USEPA as part of the RFS to track progress toward reaching the energy independence goals established by the U.S. Congress. RIN credits are used by obligated fuel providers to certify compliance with mandated renewable fuel volumes. All fuel produced for U.S. consumption must contain either adequate renewable fuel in the blend or the equivalent in RIN credits. As a result, RINs are tradable environmental credits with significant potential value.

Low Carbon Fuel Standard (LCFS) Credits

Similar to RINs in the federal RFS program, LCFS credits can be purchased by oil refineries and vehicle fuel distributors to ensure the mix of fuel they sell in the California market meets the established targets for GHG reductions under the LCFS program. LCFS credits are based on life-cycle analysis of the alternative fuel. Dairy biogas to RCNG vehicle fuel is considered a low carbon transportation fuel and, as a result, is eligible to generate significant tradable LCFS credits.

Discussion

Dairy biogas to vehicle fuel projects, although not technically complex, involve the balancing of long-term diverse interests and components. Unless a dedicated fleet is part of the project, such as in the Fair Oaks Dairy model in Indiana, off-take agreements must be structured with Natural Gas Vehicle (NGV) fleet owners to provide a stable revenue stream. Long-term off-take agreements (10 years or more with credit-worthy entities) are essential to financing vehicle fuel projects.

While RNG as a vehicle fuel continues to emerge in California and the U.S., a number of limiting factors confronts the use of dairy biogas as a transportation fuel. First and foremost, is the small size of NGV markets. The small number of NGVs results in relatively high vehicle prices and also restricts the potential markets for producers of RCNG. The number of NGV fueling stations is also limited, but growing, in California. Pipeline access has also been a limiting factor for potential RNG producers, but is being addressed, as discussed previously. Finally, RNG costs more to produce than the price it can command as vehicle fuel and directly competes with conventional natural gas wholesale commodity prices. As a result, dairy biogas to vehicle fuel projects will continue to be dependant on RINs and LCFS credits to provide adequate revenue streams, but these markets remain volatile and uncertain.

Potentially offsetting these market deficiencies, one distinct advantage of dairy biogas to vehicle fuel projects is the potential to enjoy eligibility for California's Alternative and Renewable Fuel and Vehicle Technology Program (AB 118). Dairy digester projects converting biogas to electricity or RNG are not eligible for AB 118 program funding.

6.0 – Permitting and Interconnection Requirements

6.1 Overview

Constructing a multi-dairy "hub-and-spoke" biogas digester project requires both selecting a location with appropriate land use policies and potentially securing an array of new or modified government permits, depending on details of the project configuration. In the project area (the southern portion of the San Joaquin Valley encompassing Fresno, Kings, Tulare and Kern counties[1]), permitting agencies may include local environmental health, planning and land use authorities, and regional air and water quality protection agencies. Construction, installation and operation of digester system equipment on a dairy may trigger requirements for additional permits not normally needed by a dairy farm without a digester, or modification of existing dairy permits to include additional conditions. Certain permits or permit modifications may also necessitate additional environmental review and potentially additional permit conditions.

A multi-dairy "hub-and-spoke" digester project will additionally require construction of and permitting for a centralized facility (hub) serving a group of dairies as a point to collect, treat, process and deliver biogas-related outputs at economies of scale, whether these are biomethane, electricity, vehicle fuels, heat or any combination of these products. Such a centralized facility could be located on or adjacent to a dairy farm or at an offsite (non-dairy) location connected to the system.

A successful project also requires execution of an interconnection agreement with a natural gas or electricity utility – a process that has been described as sometimes difficult, complex and expensive.

Permitting and interconnection requirements will vary by location and project configuration. Increasingly complex projects may result in additional permit requirements or even additional regulatory agencies becoming involved. A project involving multiple cooperators will likely result in a need for multiple business or ownership entities to apply for and secure permits, either independently or in coordination. This section provides an overview of permitting agencies for a hypothetical project located in Kern County, typical basic permitting and environmental review requirements and digester system features that may result in comparatively more (or fewer) permit and environmental review requirements. Interconnection procedures and opportunities to overcome barriers were also discussed.

[1] While this is the project area for purposes of this project analysis, findings here are largely applicable to other Central Valley counties with a high population and concentration of cattle, including Stanislaus and Merced counties. For purposes of the permitting analysis, we focus on a hypothetical project in Kern County; projects in neighboring counties within the project area are expected to face largely similar permitting conditions although these will vary by project configuration and jurisdiction.

6.2 Project Assumptions

For purposes of analysis, this section assumes the Kern County Cluster project:

- Is located in Kern County
- Utilizes between 11 and 14 existing dairies as part of the cluster network
- Biogas from anaerobic digesters located at each dairy and the digester will be either a covered manure/wastewater retention pond or an above-ground tank digester
- Dairies will utilize onsite energy generation facilities or, low-pressure PVC pipes to carry gas to a centralized gas gathering facility that is located on or immediately contiguous to one of the participating dairies
- Gas could be cleaned and conditioned at the centralized facility for one or more of the following uses:
    - Fueling an electrical power generator with interconnection to the electrical grid
    - Injection into a natural gas pipeline for delivery to renewable natural gas customers (including potential customers who will use the gas to generate RPS compliant electrical energy at an offsite plant)
    - Injection into a natural gas pipeline for delivery to natural gas vehicle fueling stations for use as a renewable CNG

6.3 Local Agency Permitting Responsibilities and Authorities

Local municipalities typically permit, regulate and enforce rules related to land use, zoning, building codes, environmental health and nuisances. Dairies within the project area are rurally located, so county governments, rather than cities, serve as the local agency regulators.

Counties establish land use policy through general plans and implement that policy through zoning ordinances and issuance of both discretionary (approved by elected or appointed bodies) and ministerial (approved by county staff) permits. In most of the four county project review area, new or expanding dairies are not a "by-right" use and, therefore, must apply for and receive a conditional use permit from the county government (the exception is in Kings County, where dairies within an established "dairy zone" may seek modified permits through a ministerial process, so long as certain conditions are met). Thus, virtually all dairies within the Central Valley either already have a conditional use permit granted by their county, pre-existed such requirements and are considered a "grandfathered" (legal) use or operate by-right within an established dairy zone.

Because conditional use permits must be issued by the elected board of supervisors or its appointed planning commission, these are "discretionary" permits that require environmental review in compliance with the California Environmental Quality Act (CEQA). Dairies operating "by-right" are not subject to discretionary proceedings so long as they comply with the county's zoning and other requirements.

There are few operating dairy digesters in the project review area (one digester operating in Tulare County and another just-launched operation in Kern County). For the purposes of this project, permitting requirements that would likely be required for a hypothetical multi-dairy project located in Kern County were analyzed.

Generally, throughout the project review area, construction of biogas digesters on existing dairies is a by-right use, so long as certain county conditions are adhered to and any other necessary permits are obtained from air and water quality agencies. For example, in Kern County, existing dairies in the "Exclusive Agriculture" zone may construct an electrical power generator (or generating plant) on or immediately contiguous to the dairy facility provided that:

- The plant does not exceed 10 megawatts rated capacity.
- No offsite dwellings are located within 500 feet.
- The generator is powered only by biogas produced on the dairy or other nearby dairies.
- Storage lagoons are covered prior to digestion (open air lagoons are allowed post digestion.

These configurations could only be constructed in the Exclusive Agriculture Zone of Kern and not in other zones, which either do not allow dairies, do not allow power generation facilities or do not allow either use.

Air Quality Permitting Responsibilities and Authorities

The San Joaquin Valley Air Pollution Control District (SJVAPCD) is a regional air district governmental body serving an eight-county area from Bakersfield to Stockton, including most of Kern County (that is, all of the portions of the county within the air basin of the Central Valley). All dairies within Kern County are also under the jurisdiction of SJVAPCD. SJVAPCD is responsible for enforcing many provisions of federal and state air quality laws, especially related to stationary and area sources. The district also has its own rules pertaining to stationary and area sources of air pollution, including dairies, stationary engines, flares, boilers and other components of digester systems.

SJVAPCD regulates dairies with or without digesters. Dairies and digesters are regulated directly and indirectly through several rules and regulations, though not all apply to all dairy or digester situations. These include:

- Rule 2201, New Source Review or NSR, which requires that any new or expanding source of pollution apply for and receive an Authority to Construct (ATC) permit before commencing construction if the project will result in an increase of more than two pounds per day of any criteria pollutant or precursor to formation of a criteria pollutant.
- Rule 4570 regulates confined animal facilities, including dairies, and requires management measures to reduce emissions of Volatile Organic Compounds (VOCs) from cattle, manure and silage.
- Rule 4550 regulates emissions of fine particulate matter (PM_{10}) from fugitive dust and other typical farming activities.
- Rule 4702 regulates stationary engines (such as biogas-fired generators).
- Rule 4311 applies to flares.
- Rules 4304-8 and 4351 apply to boilers.
- Rule 4301 applies to fuel burning equipment including furnaces, boilers and stacks.

Determining which of the above rules applies in any given situation depends partly on where the project is located (on or off the dairy) and partly on the equipment configuration. Critical trigger points for air district permits include:

- Installation of any pollution-emitting stationary equipment (boilers, flares or stationary internal combustion engines).
- Other modifications to dairy operations (including changes in manure management) that increase emissions of federal criteria pollutants or their precursors more than two pounds per day within an emission unit (that is, within a regulated segment of a dairy operation). These include nitric oxides (NO_X), volatile organic compounds (VOCs) or particulate matter (PM_{10} or $PM_{2.5}$).
- If it is unclear whether the operational changes contemplated on or off a dairy will result in triggering the Rule 2201 NSR requirement or modification of other existing permits, air district staff should be consulted for guidance. Failure to undergo NSR can result in significant penalties.

Water Quality Permitting Responsibilities and Authorities

The Central Valley Regional Water Quality Control Board (CVRWQCB) is generally responsible for enforcing state and federal laws related to water quality protection within the Central Valley of California. These laws protect both surface water and groundwater. CVRWQCB establishes Water Quality Control Plans (Basin Plans), which identify beneficial uses of water

bodies and standards for protecting the uses (water quality objectives). CVRWQCB regulates dischargers who release waste to surface waters or to groundwater, including application of waste to land, through a variety of methods. These include "Waste Discharge Requirements" (WDRs), which function as conditional permits to discharge. WDRs can be issued to single dischargers (individual order WDRs) or to a group of similar dischargers (general order WDRs).

Though some dairies operate under individual WDRs, most Central Valley dairies are regulated under General Order R5-2007-0035, "Waste Discharge Requirements for Existing Milk Cow Dairies." This order established requirements for all Central Valley dairies existing as of October 2005. Requirements include:

- An engineered Waste Management Plan (WMP) to ensure that manure and other wastes generated by the dairy are stored and managed to minimize impacts to water quality.
- A Nutrient Management Plan (NMP) to ensure that manure generated by the dairy, when applied as a crop fertilizer, is done in a way that does not exceed the crop's requirements and prevents excess infiltration of nutrients to groundwater.
- Environmental testing and monitoring , including sampling of irrigation water, storm water discharges, soil, manure and other media necessary to implement the NMP and to assure that management practices are sufficiently protective of groundwater.

The CVRWQCB allows digesters to be constructed on dairies covered by the General Order without conditions, so long as only manure is digested and the project does not require construction of new ponds or expansion of existing ponds. If new ponds are constructed (or existing ponds expanded), they are required to meet construction standards in the General Order; and design and construction of the ponds is subject to approval of the CVRWQCB. If management of manure changes substantially as a result of a digester, such as changes in the volume or character of the waste generated, these changes must be reported to the CVRWQCB and may be subject to additional conditions before the discharge can begin.

Typically, the CVRWQCB is most interested in the following aspects of digester systems:

- Method of impoundment of waste (manure), both pre- and post-digestion to prevent excessive infiltration to groundwater that may degrade water quality. Retention ponds must be designed, operated and maintained to standards that prevent or minimize such infiltration and may require monitoring to assure groundwater protection.
- Changes in manure management (e.g. converting from a flush system to a vacuum/scrape system, changes in volume of water to the lagoon, changes in manner manure is applied to land) that might impact water quality.

- Changes in the nutrient or salinity characteristics of the waste, especially in volume that may impact ability to implement an effective NMP (e.g. co-digestion, which may add additional nutrients or other constituents to the waste stream).

In the above cases, the CVRWQCB may continue to regulate the dairy under the general order, but require that certain technical reports be provided by the discharger to ensure compliance with the order. Alternatively, the CVRWQCB may require the discharger to submit a new Report of Waste Discharge and seek coverage under an individual WDR or under a separate general order designed for digesters and co-digesters.

6.4 Potential Permitting Barriers

The above permitting processes require project participants to meet numerous conditions, which requires time, effort and investment. One purpose of this report is to identify those unique areas where – because regulatory schemes may not yet have fully contemplated a "hub-and-spoke" model digester project – there may be especially significant barriers to permitting. Another objective of this report is to identify persistent issues that remain barriers to permitting digesters, despite previous efforts to resolve them. The following sections describe how permitting barriers develop, identify examples and discuss potential solutions.

Processes Leading to Permitting Barriers

Significant barriers to permitting digester projects can arise from any of the agencies (or types of agencies) identified above. They are usually the result of one of two factors: a finding of inconsistency with established land uses or land use policies within the proposed project location; or an expected increase in environmental impact from one or more digester project components that is not or cannot be mitigated to the satisfaction of one or more of the agencies.

With regard to land use policy, the key is generally locating a project in an area of zoning where other land uses are consistent. However, a hub-and-spoke digester model contains elements of both agriculture and industrial uses, uses that are often zoned separately. As such, these projects, especially when large scale or creating new business enterprises that are not incidental to dairying, may pose issues for a local land use authority. This is discussed in more detail below.

Of the range of the environmental impacts assessments that must be conducted by agencies during consideration of permits, the California Environmental Quality Act (CEQA) requirements are the most comprehensive. CEQA requires permitting authorities to analyze, consider and reasonably mitigate all significant environmental impacts before granting

discretionary permits. As such, CEQA applies to all of the agencies described in section 6.3, including to the county planning and land use authorities as well as regional air and water quality agencies. Typically, the county acts as the lead agency in performing a CEQA analysis for a given project, but relies on so-called "responsible agencies," including the air and water quality agencies, to participate in the analysis of the impacts and mitigation. In turn, the air and water quality agencies often rely on the CEQA analysis performed by the county as lead agency to support their own compliance with CEQA in issuing any permits related to the same project, when those permits require such an analysis.

Other non-CEQA statutes require air and water quality agencies to evaluate impacts that exceed certain established thresholds. For example, before issuing an Authority to Construct (ATC) permit, SJVAPCD must conduct New Source Review (Rule 2201) when a new or expanding project will increase emissions of a criteria pollutant by more than two pounds per day. Likewise, the CVRWQCB, to comply with State Water Resources Control Board Resolution 68-16 and other provisions of state law, must conduct an analysis of any projects that are expected to degrade water quality to ensure that reasonable efforts have been made to control the degradation and that such degradation is in the "best interests of the people of California" and that a nuisance or condition of pollution is not created.

Land Use Challenges and Solutions

A multi-dairy hub-and-spoke biogas digester project may contain elements that both look and behave like traditional agriculture uses (livestock housing, farming, etc.) and other elements more traditionally associated with industrial uses, such as large electricity generating equipment, flares, and gas storage tanks. This can pose land use and zoning compatibility challenges for large or complex biogas projects.

For example, in Kern County, an Exclusive Agriculture ("A" District) zone was created to allow for agriculture and prevent encroachment of potentially incompatible land uses. Dairies are generally limited to this district. Meanwhile, large electrical power generation projects are generally limited to the industrial zones (M1, M2 and M3, or light, medium and heavy industrial respectively), where dairies are not located or allowed. Meanwhile, large capacity storage tanks for CNG, even if used as a vehicle fuel, are typically limited to medium and heavy industrial zones and must be kept away from residential areas and commercial hotels and motels, while other vehicle fueling stations (diesel, gasoline) are allowed uses in commercial and in or near residential areas.

Following are four brief examples of potential permitting barriers that might face a hub-and-spoke project in Kern County, and potential solutions:

- **Limit on generation capacity**. Kern County's zoning ordinance, chapter 19.12.130 section G, allows, as a by-right use, construction of an electrical power generating

plant on or contiguous to a confined animal facility, so long as the power plant does not exceed 10 MW capacity. While this capacity limit would not be an issue for a single dairy, it becomes a design limit when considered in the context of a hub-and-spoke project. An array of eight to 14 dairies could potentially produce more than the 10 MW limit at a centralized generating station. If the ordinance is enforced strictly, the generating capacity would have to be reduced to or below 10 MW, or could not be constructed in the Exclusive Agriculture Zone. ***Potential solutions:*** The zoning ordinance allows for issuance of a variance so long as the applicant can: 1) show special circumstances that explain why the variance is needed; 2) demonstrate that granting the variance is not a "special privilege" that would not be granted to another applicant in a similar situation; and 3) show that the granting of the variance will not materially affect the health and safety aspects of the project. Examples of methods to meet the terms of a variance include:

  - Special circumstances could likely be demonstrated by explaining the unique configuration of the project as a multi-dairy network rather than a single dairy;
  - Special privilege findings could be made if the county made a finding that it would grant a similar variance to another project in the same circumstances; and
  - So long as the project applicant can demonstrate, and the county finds, that impact to health or safety would not be increased by the variance, the project could meet the basic terms needed for a variance.

- **Injection of natural gas to a pipeline at a centralized facility.** A wide variety of utility transmission uses (pipelines, electrical transmission lines, etc.) are allowed in the Exclusive Agriculture zone when conducted by a utility that is regulated by the CPUC. However, when these activities are undertaken by non-CPUC-regulated entities, they may be limited to industrial zoned areas. As such, if the hub-and-spoke project proposes to deliver raw biogas to a centralized location, where it will be cleaned and conditioned for delivery to a utility-owned pipeline, this use may not be allowed by right unless the operation is completely owned and operated by a CPUC-regulated entity. This might preclude the centralized facility from being controlled, operated and maintained by private individuals, such as a group of dairy owners or other business partners. ***Potential solutions:*** The applicant could apply for a conditional use permit for the centralized facility. So long as the centralized facility did not produce significant, unmitigated environmental impacts, CEQA analysis could result in a negative declaration. Even though this would require a public hearing process, given previous county policy support for similarly configured projects and the overall environmental benefits, this could be seen as a good candidate for a conditional use permit. Alternatively, the applicant could request that the county planning director make a "determination of similar use" – i.e. a decision that an injection site is

essentially a similar use to the "electrical power generating plant" explicitly allowed in Kern Zoning Chapter 19.12.130(G).

- **CNG fueling facility.** A CNG storage and fueling operation at the centralized facility, if commercial in nature (e.g. not incidental to the dairy business but supplying fuel to outside buyers) or if requiring use of a tank larger than 2,000 gallons capacity, would constitute a use that is normally allowed only in an medium industrial zone (M2) with a conditional use permit, or a heavy industrial zone (M3) without a conditional use permit. As such, this could not be located in the Exclusive Agriculture zone. Notably, such a facility could also not be located on or near Interstate 5, even though it is common to locate gasoline and diesel fueling stations in such areas. Safety of pressurized tanks is an issue and these are not allowed within one-half mile of residentially zoned areas or areas where hotels or motels are located. ***Potential solution:*** The applicant could request consideration of special zoning (sometimes called "spot zoning") for the centralized facility, classifying the zone as either M2 or M3. If the classification of M2 was achieved, a conditional use permit would also be needed. The county would still likely require that a distance of one-half mile to any residentially zoned areas or to any hotel or motel be maintained.
- **Co-digestion with agriculture wastes.** Co-digestion involves the process of adding starchy or fatty waste materials (co-digestion substrate) to manure in an anaerobic digester for the purpose of utilizing the additional waste material to increase gas production. A small amount of material (roughly one part by volume co-digestion substrate to six parts manure) added can increase gas production by 300 to 400 percent, also creating a use for organic materials that would otherwise be disposed of in landfills or otherwise wasted. The federal Resource Conservation and Recovery Act (RCRA) defines "agricultural waste" as a non-hazardous solid waste that is returned to the soil as fertilizers and is produced from "the growing and harvesting of agricultural crops" and the "raising of animals, including animal manures." Although the CVRWQCB has adopted a general order for dairies utilizing digesters and co-digesters, it is not clear whether co-digestion is a by-right use at existing dairies, even if co-digestion materials are produced at the dairy. In cases where co-digestion substrate is produced off the dairy then delivered to the dairy for use, it appears that county review and a conditional use permit is likely to be required. In addition, the county may require ongoing inspections and monitoring to assure that only approved materials from approved sources are being delivered to and disposed at the site. ***Potential solution:*** Work with county officials to identify mutually acceptable materials, sources and assurance methods that also meet the requirements of the CVRWQCB.

Water Quality Permitting Barriers and Potential Solutions

From a water quality perspective, a hub-and-spoke model digester project does not appear to pose significant or new barriers compared to a conventional single dairy anaerobic digester-electricity generation model. However, the multi-dairy model must also address the existing challenges related to single-dairy projects:

- **Pond expansion or reconstruction.** If constructing the digester involves expanding an existing manure/process water retention pond, the pond will need to be designed, constructed and operated to specifications in General Order R5-2007-0035 (Tier 1 double liner with leachate collection or Tier 2 engineered construction). In addition, the CVRWQCB will review and approve or request modifications of design, construction and operation and maintenance plans. In the case of Tier 2 ponds, groundwater monitoring may be required. ***Potential solutions:*** If a manure-only digester can be accomplished in an existing retention pond, some of the above requirements may be avoided. Alternatively, an above-ground tank digester and alternative manure collection method (scrape or vacuum) may avoid the need to reconstruct lagoons.
- **Co-digestion or other changes to volume and quality of waste stream.** Using co-digestion (see section 6.4 for a definition of co-digestion) substrates will mean that the dairy can no longer be covered under General Order 2007-0035. The dairy can seek coverage under General Order R5-2010-0130, but additional requirements must be met. The most significant of these is a requirement that all ponds where co-digestion occurs, or where effluent is stored post digestion, must meet Tier 1 or Tier 2 pond standards as defined above in "Pond expansion or reconstruction." In addition, co-digestion creates a need to demonstrate to the CVRWQCB that the new materials are adequately accounted for in both balance and the implementation of the Nutrient Management Plan (NMP). Co-digestion of certain materials is barred by the order, as follows: "The use of biosolids, human waste (e.g., sludge, septage, domestic and municipal wastewater), or mammalian tissue (except as contained in compostable material from the food service industry, grocery stores, or residential food scrap collection), as a co-digester feedstock, or application of these materials to a land application area, is prohibited."

  Besides co-digestion, other changes in manure collection and management may occur as a consequence of installing a digester. For example, installation of an above-ground tank may result in changing the way manure is collected (e.g. via flush to scrape). The changes must be accounted for in the NMP. ***Potential solutions:*** Co-digestion can significantly increase biogas production, but its potential consequences to retention pond requirements and NMP requirements should be carefully analyzed before a decision is made to utilize co-digestion. Similarly, alterations to the way

manure is collected, stored and applied to crops as a consequence of a digester installation should be carefully analyzed before proceeding.

Air Quality Permitting Barriers and Potential Solutions

From an air quality perspective, a hub-and-spoke model digester project does not appear to pose significant or new barriers compared to a conventional single dairy anaerobic digester-electricity generator model. However, as with water quality, the multi-dairy model must also address the existing air quality challenges related to single-dairy projects:

- **Combustion-related issues with engines, flares and boilers.** Production of biogas as a source of energy generally necessitates that the gas be combusted at some point in the process to produce power (electricity, heat or mechanical energy). This can be at the dairy, at a centralized facility in an electric generator or in a vehicle powered by a CNG-burning engine. Gas can also be used to fuel boilers or to produce heat in homes, however these uses are not analyzed here. It is also normal at biogas facilities to utilize flares to release excess gas pressure from digesters, pipelines or other equipment, as needed. Combustion produces criteria pollutants including oxides of nitrogen (NOx) and fine particulate matter (smoke or soot). Raw biogas contains impurities, such as hydrogen sulfide, that must be removed prior to combustion to reduce pollution in the exhaust. Exhaust from engines is often also treated through catalytic devices to further reduce pollutants. The SJVAPCD requires permits for virtually all stationary gas-burning engines and flares. Emissions standards in the San Joaquin Valley are among the most stringent in the nation. As a result, to receive a permit, costly emissions control may be required, as well as potential offsets when emissions are particularly large. Conversely, digesters also reduce some emissions, such as VOCs, by destroying them in combustion or preventing volatilization. The SJVAPCD typically takes emissions reductions resulting from installation of a digester into account when determining permit requirements. ***Potential solutions:*** Avoiding some types of combustion needed to generate power could avoid some of the more stringent permitting requirements. For example, collecting gas at a centralized facility and injecting it into a pipeline for use offsite or utilization as vehicle fuel, essentially transfers much of the emissions control responsibilities to the end users. In a configuration where electricity is generated as part of the project, generation via a stationary engine or engines at a centralized facility may nevertheless create a benefit via economy of scale by applying the technology standards for emission control to fewer, larger engines. This also results in fewer permits needed. For example, if 11 to 14 dairies feed gas to two to three large engines at a centralized site, fewer permits would be needed than if a generator was located at each dairy. However, flares and permits are likely to be required at most locations. Permit

requirements should be carefully considered at both the dairies and at the centralized facility.

6.5 Additional Efforts to Streamline Permitting

Several California state agencies and the Governor's Office have expressed strong support for encouraging dairy biogas digester development in California. These include, but are not limited, to the Cal EPA, CARB, SJVAPCD, Cal Recycle, CDFA and the CVRWQCB. We note here two specific actions taken intended to streamline permitting and encourage dairy digesters:

- In January 2013, Cal EPA and the Governor's Office launched a "Consolidated Permitting" process that allows applicants to request all of their state environmental permits be issued by one agency. The process is initiated by the applicant notifying the Cal EPA Secretary that he or she requests the secretary to "designate a consolidated permit agency to administer the processing and issuance of a consolidated permit." The designated agency is responsible for technical review of the permit application, coordinating among agencies and ensuring efficiencies. Participating agencies have already designated a Biodigester Permitting Team. While counties are not obligated to participate in the voluntary process, the consolidated permitting process appears to have significant potential to assure that dairy digester projects receive attention and priority in permitting processes and also demonstrates broad support from all levels of government.
- In 2010, the CVRWQCB adopted General Order R5-2010-0130, "Waste Discharge Requirements General Order for Dairies with Manure Anaerobic Digester of Co-Digester." Accompanied by a programmatic Environmental Impact Report, the purpose of the effort was to set standard requirements for dairy digesters and co-digesters to remove uncertainty and streamline the permitting process for dairy digesters.

6.6 Utility Interconnection

Electric Interconnection Process

The electric interconnection process is governed by the CPUC under Electric Rule 21, which describes the interconnection, operating and metering requirements for generation facilities to be connected to the utilities distribution system. The interconnection process is one that has received significant scrutiny and concern from independent generators of electricity. The process has historically lacked a timely, cost effective and transparent process and has resulted in significant obstacles for dairy digesters and other small distributed generation projects, particularly in rural areas of the state.

Interconnection Process and Fees

While each Investor Owned Utility (IOU) has a slightly different process, Rule 21 acts as a guide that the IOUs follow very closely. Following are the requirements for Pacific Gas & Electric (PG&E):

- **Pre-Application Report**
  A Pre-Application Report Request and a $300 processing fee is the first step. The Pre-Application Report Request requires a proposed point of interconnection, generation technology and fuel source.

  The proposed point of interconnection is required to be identified by latitude and longitude, site map, street address, utility equipment number (e.g. pole number), meter number, account number or some combination of the above sufficient to clearly identify the location of the point of interconnection.

- **Study Process Selection**
  An applicant may select one of two interconnection evaluation processes in accordance with the following eligibility requirements:

  - **Fast Track Eligibility**
    Non-exporting and NEM generating facilities are eligible for fast frack evaluation regardless of the gross nameplate rating of the proposed generating facility. Exporting generating facilities with a gross nameplate rating no larger than 3.0 MWs on a 12 kV, 16 kV or 33 kV interconnection for Southern California Edison, 1.5 MW on a 12 kV interconnection for San Diego Gas & Electric, and 3.0 MW on a 12 kV or higher interconnection for PG&E are also potentially eligible for Fast Track evaluation.

    For an exporting generating facility, such as a dairy biogas project, the applicant must agree to the installation of distribution provider-approved protective devices to ensure net export will never exceed the Fast Track eligibility limits. These applicants are also required to complete supplemental review and are required to pre-pay for this review at the time the interconnection request is submitted. In practice, however, biogas fueled synchronous generators required on biogas projects do not allow these biogas projects to participate in Fast Track since this technology has not reached the scale where providers offer full UL certified equipment.

  - **Detailed Study Eligibility**
    Generating facilities that are not eligible for Fast Track evaluation must apply for Detailed Study. Detailed Study requires either (i) an Independent Study Process, (ii) a Distribution Group Study Process, or (iii) a Transmission Cluster Study

Process. The specific study process used will depend on the results of the electrical independence tests for the transmission and distribution systems.

- **Interconnection Request**
  All applicants must file an Interconnection Request and a nonrefundable $800 interconnection request fee. Applicants are required to submit a separate Interconnection Request for each point of interconnection.

- **Detailed Study Deposit**
  To proceed with Detailed Study, applicants are required to submit a Detailed Study deposit. For a generating facility with a gross nameplate rating of 5 MW or less, applicants are required to provide a $10,000 deposit for the Interconnection System Impact Study, and an additional $15,000 for a generating facility Interconnection Facilities Study. Generating facilities with a gross nameplate rating above 5 MW are required to deposit $50,000 plus $1,000 per MW of electrical output of the generating facility.

- **Next Steps**
  Once the Detailed Study is completed, the facility receives a report and estimate of what upgrades the utility will need to make in order to interconnect the facility. Each utility has separate cost guides that outline each potential upgrade and the cost to project developer. Generally, those costs can range from a low of $100,000 to well over $1,000,000 and are site specific based on the interconnection location. Upgrade cost guidelines can be found at:

  http://www.caiso.com/informed/Pages/StakeholderProcesses/ParticipatingTransmissionOwnerPerUnitCosts.aspx

  For purposes of this report, electric system interconnection costs were estimated for the project based on input from PG&E and from actual experience with other dairy digester projects in the San Joaquin Valley. Actual costs may vary.

Gas Pipeline Interconnection Process

Access to California's natural gas pipeline infrastructure is governed by CPUC Rule 39. Under Rule 39, the IOU is required to provide non-discriminatory open access to its system to any party desiring to deliver natural gas subject to specified terms and conditions including gas quality requirements. The interconnect and gas flows shall not jeopardize the integrity of, or interfere with, normal operation of the IOU's system. All costs associated with interconnection are the responsibility of the party seeking interconnection.

Following are the specific steps and typical range of costs associated with interconnection to the SoCal Gas pipeline system. It should be noted that actual costs are project specific and

may be different than those discussed here. SoCal Gas Company provides step-by-step estimates to project developers.

- **Step 1- Interconnection Capacity Study**

  This study determines the utility's downstream capability to take natural gas away from the interconnection point and the associated utility facility enhancement costs. (Cost range: $5,000-$10,000)

- **Step 2: Preliminary Engineering Study**

  Upon completion of the Capacity Study, a more detailed Preliminary Engineering Study is required to determine the cost estimates for land acquisition, site development, right-of-way, metering, gas quality, permitting, regulatory, environmental, unusual construction costs, as well as operation and maintenance costs. (Cost range: $80,000-$100,000)

- **Step 3: Detailed Engineering Study**

  Finally, the utility will prepare a Detailed Engineering Study that will: 1) describe all costs of construction, 2) develop complete engineering and construction drawings, and 3) prepare all construction and environmental permit applications and right-of-way acquisition requirements. (Cost range: $80,000-$100,000)

Once the Detailed Engineering Study is complete, a customer can pay the estimated costs and have the utility complete the necessary facility. The developer also has the option of installing the necessary facilities themselves under the direction of the utility. Once complete, ownership of the facility must be transferred to the utility.

For purposes of this report, gas pipeline interconnection costs were estimated for the project based on estimates provided by the SoCal Gas Company. Actual costs may vary.

7.0 Project Funding and Financing

7.1 Overview

Securing funding and financing is a critical and sometimes difficult step for any renewable energy project, particularly for dairy biogas projects. The process is magnified for a large cluster project, like the one proposed, because of the significant debt and equity financing required for such a large capital project.

Since early 2009, the ability of renewable power projects to secure both equity and debt financing dropped precipitously due to the systematic upheaval in national and global financial markets. As the economic crisis continues to lessen, prospects for financing should continue to improve. However, a multiple-year downturn in dairy economic performance in California and the expiration of key federal government renewable energy funding programs will have an opposite, negative effect on financing.

7.2 Dairy Economic Downturn

California's dairy industry has experienced a severe economic downturn over the past few years, resulting in the loss of a significant number of dairies and a tremendous reduction in equity for those that have survived. The problems started in 2009, when milk prices bottomed out and grain prices soared, in no small part due to the federal government's ethanol mandate. Then, in 2012, the worst drought in half a century struck the Midwest and corn prices nearly tripled. Even though milk prices have slowly come up, farmers are lucky to be breaking even because of grain and hay costs. All total, more than 300 dairies have gone out of business in California since 2009 and more are expected.

7.3 Expiration of Key Federal Government Funding Programs

The looming expiration of two key federal government funding programs, the US Treasury 1603 Cash Grant Program (1603) and the Production Tax Credit (PTC), will have a major impact on the availability of both project funding and finance. Eligibility for both programs expires for projects not in operation at the end of 2013. The 1603 program, authorized by the American Recovery and Reinvestment Act (ARRA), provided biogas projects with the ability to receive a cash grant equal to 30 percent of the qualified project costs. Under the production tax credit, qualifying biogas projects were initially eligible for $0.015/kWh in production incentives, with the incentives keeping pace with inflation.

While a host of other funding assistance programs at the federal, state and local level (discussed later in this section) remain available, the direct benefits they can realistically provide are far below those provided by the 1603 and PTC programs. Equally important, several of the potential state funding sources are not yet fully defined and implemented, which poses both uncertainty and potential opportunities for dairy biogas development in California.

7.4 Overview of Project Finance

Primary factors influencing renewable energy project financing generally include, but are not limited to, the following:

- Projected future cash flows
- Commercial terms and credit-worthiness of the power purchase agreement (PPA) or off-take agreement
- Perceived technology risk
- Availability of federal and state tax and non-tax incentives

A long term PPA or off-take agreement is essential for renewable energy project development and financing. Dairy cluster projects, such as envisioned in this report, will not be financeable without economical, long-term PPAs or off-take agreements. Project financing loans are generally non-recourse or limited-recourse in nature, meaning debt is secured only by project assets and paid off by the projected cash flow. Unless that cash flow is guaranteed under a PPA or off-take agreement, the risk will be too high for debt providers.

7.5 Equity

A component of essentially all project financing, project equity is invested by project sponsors or other private equity investors. Generally, direct equity investors provide a specified amount of capital in a project in return for a share of the project's future cash flows.

Expected returns on equity investments vary widely by project size and type of renewable technology deployed. Biogas projects are at the high end of the scale and generally require a return on investment of 15 to 18 percent. Based on conversations with project financers, the expected return for a dairy cluster project, as envisioned, would command the higher end of that range.

7.6 Debt financing

Project debt is supplied by a bank or other financial institutions or partners and is lent against the expected future cash flow of a project and secured only by project assets associated with the loan. Like equity investments, loan rates vary by technology sector, project size and risk associated with the project. Debt rates are currently averaging about seven percent.

7.7 Government Funding Opportunities

Most dairy digesters developed in California have received considerable government funding assistance. Dairy digesters qualify for a number of federal, state and local programs promoting renewable resource development and clean-tech projects. Governmental assistance can take many forms, including grant funding, production incentive payments, low-interest financing, tax exemptions and incentives and permitting assistance. Individual dairy digester projects must qualify for the various government assistance programs on a case-by-case basis, depending on the technology employed and what form of energy is being produced. Many programs are also competitive and may only be able to provide assistance to a handful of projects during any given year, precluding or limiting participation by dairy cluster projects. Following is a discussion of the various primary government assistance programs for dairy digester projects.

State Programs

AB 32 Cap and Trade Allowance Auction Proceeds

In order to implement AB 32, the California Global Warming Solutions Act of 2006, the California Air Resources Board (CARB) adopted a "Scoping Plan" that includes a "Cap and Trade" program. High Greenhouse Gas (GHG) emitters either have to reduce emissions or purchase allowances to comply with the GHG limits set in the program. The allowances are purchased in an auction coordinated by CARB. While some of the revenue is returned to IOU ratepayers, a portion of the revenue is to be appropriated through the state budget process to fund programs that reduce GHGs throughout California. CARB has adopted an Auction Proceeds Investment Plan and the Department of Finance (DOF) predicts that the auction proceeds will produce about $500 million between Fiscal Years (FY) 2012 and 2015. As the cap lowers and more entities need to purchase allowances, revenue could, and will likely, increase.

CARB has adopted a three-year investment plan that outlines recommended funding categories to the Governor and Legislature as they develop future state budgets. It will be up to the Governor and the Legislature to allocate specific amounts, if any, to the funding

categories each Fiscal Year. The Investment Plan adopted by CARB for FY 13/14 and FY 15/16 includes a potential investment category for bioenergy. Specifically, the investment plan recommends providing competitive grants for bioenergy production, with program design, development and oversight criteria left up to state agencies, such as the California Energy Commission (CEC) and the California Department of Food and Agriculture.

The recommendation remains broad and dependent on legislative and gubernatorial action to fund or not, but inclusion in the investment plan is a positive indication that bioenergy projects, including dairy digesters, could receive funding from the Cap and Trade allowance auction revenues in the future. The Legislature and Governor deferred funding any investments in the 2013-2014 state budget.

AB 118 Program: Alternative and Renewable Fuel and Vehicle Technology Program

The purpose of the AB 118 program is to fund the development of transportation-related low carbon biofuels and advanced technology vehicle projects. About 25 percent of the funding is allocated to biofuel production. Dairy digester projects are eligible for funding, provided a clear nexus to transportation fuel use can be drawn. Funding is provided on a project-by-project basis.

The AB 118 investment plan is annually released by the CEC, which established dollar amounts for specific funding categories. The AB 118 program is scheduled to sunset in 2014, unless reauthorized by the Legislature. Legislation to extend the program is currently pending.

SB 71 Program: Advanced Transportation and Alternative Source Manufacturing Sales and Use Tax Exclusion Program

The SB 71 program authorizes the California Advanced Transportation Financing Authority to approve sales and use tax exemptions for eligible projects on property utilized for the design, manufacture, production, or assembly of advanced transportation technologies or alternative source including energy efficiency products, components or systems, but excludes the purchase of equipment for power generation.

EPIC: Electric Program Investment Charge

The CEC and the CPUC have been working to adopt and implement the three-year investment plan for the Electric Program Investment Charge (EPIC) program. EPIC, formerly the Public Goods Charge, was established to fund electric public interest investments in applied research and development, technology demonstration and deployment and market facilitation for clean energy technologies. The program will administer competitive grants to

projects with a 20 percent match. Approximately $162 million is available annually for the EPIC program. Roughly $9 million of the funds are set aside annually, specifically for bioenergy technology demonstration and deployment. However, bioenergy projects can apply in other categories.

Eligible projects must demonstrate clean energy technologies and approaches that provide electricity ratepayer benefits, defined as promoting greater reliability, lower costs, and increased safety. The program also includes complementary guiding principles, such as efficient use of ratepayer monies, societal benefits, greenhouse gas emissions mitigation, low emission transportation/vehicles and economic development for the electric consumers of the IOUs.

The EPIC Program is still being implemented and faces a significant legal challenge from one of the state's IOUs. Program Opportunity Notices are expected to be released annually by the CEC, once the program commences.

California Pollution Control Financing Authority (CPCFA)

As a "conduit issuer" of tax-exempt private activity bonds, the California Pollution Control Financing Authority (CPCFA) is able to facilitate low cost financing to qualified waste and recycling projects. Other projects to control pollution can qualify for tax-exempt financing as allowed by federal tax law. Examples of recent assistance include projects to purchase clean-air vehicles by waste companies, recycle used oil, convert animal waste to clean burning fuel, and develop construction and demolition debris recycling programs.

CPCFA works with participating financial institutions to assist small business with loans up to $2.5 million.

CPCFA programs fund the acquisition, construction, or installation of pollution control, waste disposal and resource recovery facilities through lowered interest rates on total project costs.

Regional Programs

There may be funding opportunities at the local and regional level. For example, the San Joaquin Valley Unified Air Pollution Control District Advanced Technology Program can provide grants for dairy digester projects to fund the purchase of equipment, installation and emissions testing for emissions reduction tools.

The Central Valley Regional Water Quality Control Board also offers several funding opportunities for digester projects that would help improve water quality.

USEPA Region 9 has funding built into the Farm Bill that is waiting federal reauthorization. The program would be administered by the San Joaquin Valley Air Pollution Control District and would award $50,000 towards a dairy digester project.

Federal Funding Opportunities

USDA Rural Development Value Added Producer Grants

The United States Department of Agriculture (USDA) provides grants to rural development projects that meet certain criteria. Projects must change the product's physical state, have differentiated production or marketing, have product segregation and produce renewable energy. Grants range from $50,000 to $300,000, awarded in an annual competition at the national level. USDA notes that the more cost effective projects are and the more matching funds the applicant provides, the more competitive the application will be.

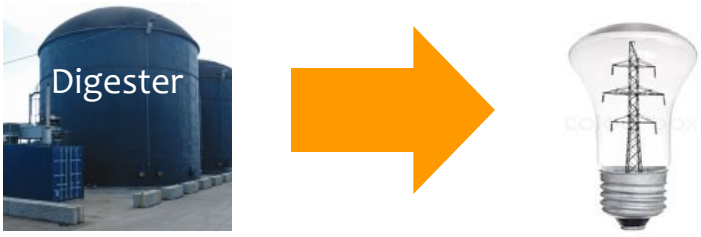
USDA Rural Development Renewable Energy and Energy Efficiency Grant and Loan Guarantee Programs

USDA also provides grants and loan guarantees to rural renewable energy and efficiency projects. This consists of two separate programs. The grant program provides $2,500 to $500,000 grants, for eligible projects. The loan guarantee program provides guarantees, not to exceed $10 million, for 75 percent of total eligible project costs. The programs are designed to fund the purchase of renewable energy systems and make energy efficiency improvements. Eligible renewable energy projects include biogas projects.

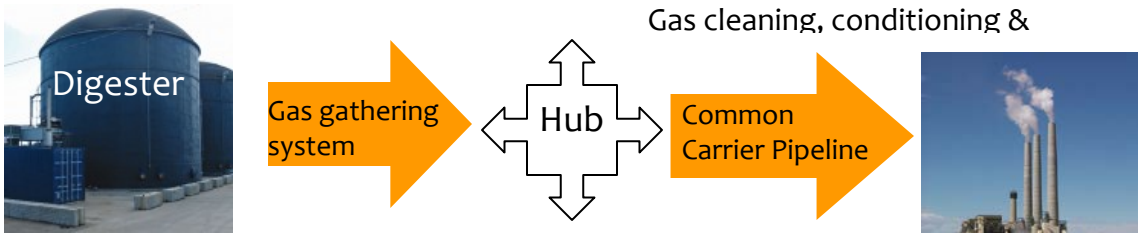
8.0 Project Development Costs/Financial Analysis

This report models three specific energy production opportunities as follows:

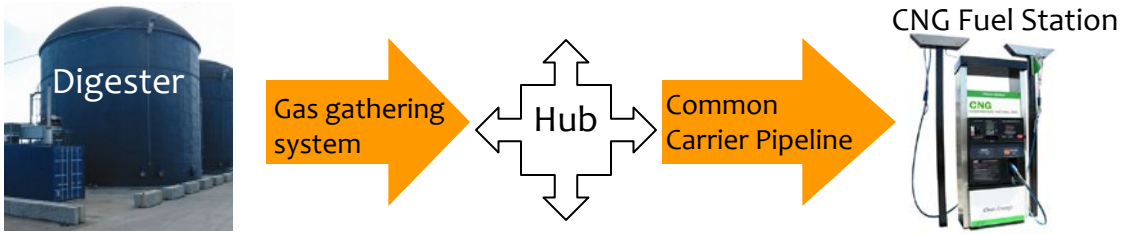
Electricity



Renewable Natural Gas (RNG)



Vehicle Fuel (RCNG)



8.1 Project Costs and Revenues

An economic model was developed for the dairy cluster project by California Bioenergy using a variety of data sources, including the recent development of two Central Valley digester projects. The costs of a gas gathering system and biogas cleaning, conditioning and compression are based on an estimate from SoCal Gas Company. The costs of utility interconnection are based on estimates provided by Pacific Gas & Electric (electricity) and the SoCal Gas Company (natural gas). Estimated energy production prices are based on

extensive review of CPUC data and conversations with utilities, energy services providers and vehicle fuel providers. Finally, revenues for GHG credits, LCFS and RINs are based on a historical and predictive view of the various markets and conversations with numerous experts. "Base Case" modeling was conducted using conservative estimates (existing rates) for the various revenue streams associated with each of the various energy pathways. A second, "Forecast Case" modeling was done for each pathway using likely estimates for rates available in the foreseeable future.

Sensitivity modeling was also conducted and is presented in this report to show the economic implications of grant funding availability, higher energy rates and more robust markets for GHG, LCFS and RINs credits.

Following are the basic assumptions made in the economic modeling in each of the following categories:

- System productivity assumptions
- Cost of production estimates
- Financial parameters, including financing, taxes and grants

System Productivity

System productivity is calculated based on actual experience with operating dairy manure digesters specific to the anaerobic digestion process described in the report. A covered lagoon system was analyzed. An average of 31 cubic feet of methane per cow per day was utilized. This is slightly below California Energy Commission (CEC) estimates of an average of 36 cubic feet and EPA estimates of 38.5 cubic feet of methane per cow per day due to manure handling practices on the cluster dairies.

Key Production Assumptions

	Electricity DG Project	Biomethane Project	Transportation Fuel Project
Biogas Production	925,846,537 cu/ft	925,846,537 cu/ft	925,846,537 cu/ft
Methane Content	601,800,245 cu/ft	601,800,245 cu/ft	601,800,245 cu/ft
Electricity Production	50,839,250 kWh/yr	n/a	n/a
Biomethane Production	n/a	519,354 MMBtu	519,354 MMBtu
Diesel Gallon Equivalent	n/a	n/a	3,739,348 DGEs/yr
GHG Credit Production	127,050 MTCE/yr	127,050 MTCE/yr	127,050 MTCE/yr
LCFS Credit Production	n/a	n/a	45,000/yr
RIN Credit Production	n/a	n/a	@ 6,000,000 D 5 RINS/yr

Key Cost Assumptions

	Electricity DG Project	Biomethane Project	Transportation Fuel Project
Dairy Digester Construction	$36,025,000	$36,025,000	$36,025,000
DG Electricity Construction	$21,809,700	n/a	n/a
Hub Construction/permitting	n/a	$750,000	$750,000
O & M Costs	1,231,417 annually	$342,843 annually	$342,843 annually
Interconnection Costs	$5,500,000	$2,000,000	$2,000,000
Contingency/other fees	$5,575,000	$2,750,000	$2,750,000
Financing Costs*	$5,567,993	$5,117,885	$5,117,885
Biogas Gathering, Conditioning & Upgrading Services (SoCal Gas)	n/a	$4,093,400 annually	$4,093,400 annually

*Assumes base case (no grants)

Key Financial Assumptions

Inflation	1.875% revenues / 2.5% expenses / 4% energy costs
Debt Ratio	75%
Equity Ratio	25%
Interest Rate	7%
Debt Terms	10 years / 12 year amortization
Target Equity IRR	18.0%
Tax Rate	35% federal / 9% state
Depreciation	MACRS

FINANCIAL ANALYSIS
DG Electricity Project
Base Case

$0.089 kWh Electricity
$10 MTCE
No Grant ($0)

Capital Cost	
Digester systems including energy generation	$63,663,997
Connection to utility transmission system	$5,500,000
Total Project Costs	**$69,163,997**
Annual Expenses	
Operating and Maintenance (O & M)	$1,231,417
Administrative, taxes and other expenses	$1,488,043
Annual debt service	$6,401,425
Total Annual Expenses	**$9,120,885**
Annual Revenues	
Electricity Production	$5,766,907
GHG Credits	$1,188,000
Total Annual Revenue	**$6,954,907**
Model Results	
Revenue Surplus (Shortfall)*	($2,165,978)
Capital Grant required to meet adequate revenues**	60%
Energy price to reach adequate revenues**	$0.19
GHG credit price to reach adequate revenues**	$60/MTCE

* Assumes 18% equity IRR
** Assumes all other factors held constant

FINANCIAL ANALYSIS
DG Electricity Project
Forecast Case

$0.17 kWh Electricity
$15 MTCE
10% Grant ($6,687,155)

Capital Cost	
Digester systems including energy generation	$63,663,997
Connection to utility transmission system	$5,500,000
Total Project Costs (with Grant)	**$61,894,391**
Annual Expenses	
Operating and Maintenance (O & M)	$1,231,417
Administrative, taxes and other expenses	$1,488,043
Annual debt service	$5,728,592
Total Annual Expenses	**$8,448,052**
Annual Revenues	
Electricity Production	$11,015,441
GHG Credits	$1,823,250
Total Annual Revenue	**$12,838,691**
Model Results	
Revenue Surplus (Shortfall)*	$4,390,639
Capital grant required to reach adequate revenues	10%
Energy price to reach adequate revenues	$0.17
GHG credit price to reach adequate revenues	$15/MTCE

* Assumes 18% IRR

FINANCIAL ANALYSIS
Biomethane Injection Project
Base Case

RNG = $10 MMBtu

$10 MTCE

No grant ($0)

Capital Cost	
Digester Systems	$48,447,361
Hub Development	$750,000
Connection to Utility Pipeline/Flare	$2,000,000
Total Construction Costs	**$51,197,361**
Annual Expenses	
Operating and Maintenance (O & M)	$342,843
Annual SoCal Gas Tariff Service	$3,120,000
Electricity usage	$973,440
Administrative, taxes & other costs	$1,186,991
Annual Debt Payment	$4,700,844
Total Annual Expenses	**$10,324,118**
Annual Revenues	
Biomethane (RNG) Production	$5,390,120
GHG Credits	$1,188,000
Total Annual Revenue	**$6,578,120**
Model Results	
Revenue Surplus (Shortfall)*	($3,745,998)
Capital grant necessary to achieve adequate revenues	87%
Energy price to achieve adequate revenues	$22.75/MMBtu
GHG credit price to achieve adequate revenues	$65/MTCE

***** Assumes 18% equity IRR

****** Assumes all other factors held constant

FINANCIAL ANALYSIS
Biomethane Injection Project
Forecast Case

RNG = $12 MMBtu

$15 MTCE

10% Grant ($5,081,994)

Capital Cost	
Digester Systems	$48,447,361
Hub Development	$750,000
Connection to Utility Pipeline/Flare	$2,000,000
Total Project Costs (with Grant)	**$45,737,946**
Annual Expenses	
Operating and Maintenance (O & M)	$342,843
Annual SoCal Gas Tariff Services	$3,120,000
Electricity usage	$973,440
Administrative, taxes & other costs	$1,186,991
Annual Debt Payment	$4,195,551
Total Annual Expenses	**$9,818,825**
Annual Revenues	
Biomethane (RNG) Production	$6,468,144
GHG Credits	$1,823,250
Total Annual Revenue	**$8,291,394**
Model Results	
Revenue Surplus (Shortfall)*	($1,527,431)
Capital grant necessary to achieve adequate revenues**	63%
Energy price to achieve adequate revenues**	$20/MMBtu
GHG credit price to achieve adequate revenues**	$50/MTCE

* Assumes 18% equity IRR

** Assumes all other factors held constant

FINANCIAL ANALYSIS
Vehicle Fuel System
Base Case

RNG = $4 MMBtu
RINS = $9.20 MMBtu
LCFS = $3.3 MMBtu
$10 MTCE
No Grant ($0)

Capital Cost	
Digester Systems	$48,447,361
Hub Development	$750,000
Connection to Utility Pipeline/Flare	$2,000 ,000
Total Project Costs	**$51,197,361**
Annual Expenses	
Operating and Maintenance (O & M)	$342,843
Annual SoCal Gas Tariff Services	$3,120,000
Electricity usage	$973,440
Administrative, taxes & other costs	$1,186,991
Annual Debt Payment	$4,700,844
Fuel Sales Fee	$1,643,830
Total Annual Expenses	**$11,967,948**
Annual Revenues	
Gas-Fuel Revenue ($16.50/MMBtu)	$8,647,968
GHG Credits	$1,188,000
Total Annual Revenue	**$9,835,968**
Model Results	
Revenue Surplus (Shortfall)*	($2,131,980)
Capital grant necessary to achieve adequate revenues**	68%
Gas-Fuel price to reach required revenues**	$29.80/MMBtu
GHG Credit price to reach required revenues**	$54/MTCE

* Assumes 18% equity IRR
** Assumes all other factors held constant

FINANCIAL ANALYSIS
Vehicle Fuel System
Forecast Case

RNG = $6 MMBtu
RINS = $12 MMBtu
LCFS = $3.3 MMBtu
$20 MTCE
25% Grant ($12,566,032)

Capital Cost	
Digester Systems	$48,447,361
Hub Development	$750,000
Connection to Utility Pipeline/Flare	$2,000,000
Total Project Costs (with Grant)	**$37,698,096**
Annual Expenses	
Operating and Maintenance (O & M)	$342,843
Annual SoCal Gas Tariff Services	$3,120,000
Electricity usage	$973,440
Administrative, taxes & other costs	$1,186,991
Annual Debt Payment	$3,451,429
Fuel Sales Fee	$2,007,372
Total Annual Expenses	**$11,082,075**
Annual Revenues	
Gas-Fuel Revenue ($21.30/MMBtu)	$11,180,182
GHG Credits	$2,458,500
Total Annual Revenue	**$13,638,682**
Model Results	
Revenue Surplus (Shortfall)*	$2,556,607
Capital grant required to reach adequate revenues	25%
Energy price to reach adequate revenues	$21.30/MMBtu
GHG credit price to reach adequate revenues	$20/MTCE

* Assumes 18% equity IRR

9.0 Findings, Conclusions and Recommendations

9.1 Findings

1. Despite a regulatory environment generally encouraging renewable energy resource production, dairy digester development has lagged in California.
2. California's evolving regulatory landscape, including the passage of significant legislation in 2012, continues to further remove obstacles to dairy biogas projects.
3. Large dairy clusters in the San Joaquin Valley represent a flexible renewable energy resource that can be converted into electricity, natural gas or vehicle fuel.
4. The current downturn in the California dairy industry increases project financing risk. Long-term project success is dependent on a continuous manure waste stream from economically viable local dairy partners.
5. On-site electricity production remains the most financially feasible short-term opportunity for expansion of dairy biogas projects in the state.
6. Electricity procurement under the soon to be implemented SB 1122 Feed-in-Tariff (FiT) program represents the best short-term opportunity for dairy biogas production. The existing RAM, FiT and NEM procurement programs have not been effective.
7. Due to the low electricity procurement prices associated with the RAM program (less than $0.09/kWh) centralized dairy cluster electrical production is not an economically feasible option. The added costs of biogas gathering and lower effective procurement contract prices for larger DG projects preclude centralized electricity production.
8. While obstacles to biomethane injection are being eliminated, the high cost of gas gathering, cleaning and conditioning and lack of government assistance programs appear to limit opportunities in the short term.
9. Vehicle fuel production (RCNG) provides an interesting opportunity for significant, but highly uncertain, revenue production. Given the volatility and lack of long-term markets for environmental credits, biogas to vehicle fuel projects cannot realistically be financed at this time.
10. Permitting requirements remain difficult in California. However, most permitting hurdles can be overcome by the various project configurations and ongoing cooperation from local and state permitting authorities.
11. Interconnection costs represent a potential significant barrier to entry for dairy biogas projects. Time delays, lack of transparency and uncertainty over final costs are also problematic for widespread project development.

12. Co-digestion of food waste can potentially increase biogas production and improve project economics; however, the introduction of outside waste streams poses waste discharge problems for most of the dairies in the cluster and is not a viable option.
13. Federal grant funding opportunities favor electrical energy production, while state programs clearly favor vehicle fuel production. Renewable natural gas is eligible for only limited financial support
14. Availability of long-term power purchase agreements provide significant advantages to electrical energy and renewable natural gas projects. Long-term PPAs or off-take agreements are critical for project development and financing.
15. Some economies of scale can be achieved by dairy cluster projects to benefit biomethane injection and vehicle fuel projects. In addition, all projects benefit from operations & maintenance (O & M) cost economies and potential savings from coordinated interconnection opportunities.
16. RIN and LCFS credits represent significant revenue opportunities for vehicle fuel not enjoyed by RNG production projects. However, these revenue streams are both volatile and uncertain.
17. The limited scale of natural gas vehicle (NGV) markets in California provides a significant potential obstacle to vehicle fuel projects in the short-term. As NGV use expands, the opportunity for longer-term off-take agreements should also grow.

9.2 Conclusions

1. Dairy digester projects provide significant environmental benefit opportunities that far exceed other renewable energy resources, such as wind and solar. In addition to the benefits of fossil fuel replacement, dairy digester projects provide significant "front-end" GHG capture and destruction. Dairy biogas to transportation fuel projects also provide significant criteria air pollutant benefits when used to displace heavy-duty vehicle diesel use.
2. State and federal government assistance will need to play a significant ongoing role to encourage additional dairy biogas development, including cluster projects, in California. Most of the project scenarios reviewed had high energy production costs or limited revenues and, as a result, are not economically viable without ongoing assistance.
3. Timely and effective implementation of the SB 1122 FiT Program is essential for near-term dairy digester development in California.

4. While significant opportunities exist to generate revenue from RIN, LCFS and GHG credit production, volatility and long-term uncertainty of these markets make project financing difficult, if credits are a primary, or even significant, revenue stream.
5. Experience curve based financial analysis suggests significant potential to reduce dairy digester capital, financing, and O & M expense. Increased biogas development in the state and commercialization of the industry will improve price competitiveness with other renewable energy resources in the long-term.
6. Unless addressed, significant costs associated with interconnection of both electrical and biomethane injection projects represent a major barrier to wide-scale adoption and successful commercialization of the industry in California. Clustering provides an opportunity to spread costs over multiple projects, improving economic viability.
7. Successful project finance requires long-term contracts to ensure a relatively consistent revenue stream, including sufficient margin coverage ratios. Financing will only be available to projects with low projected risks and guaranteed cash flows.
8. Development of dairy biogas to vehicle fuel (RCNG) projects represents a tremendous long-term opportunity with the potential to provide significant environmental and societal benefits including meeting state goals for energy security, clean air, reduced GHG emissions and an expanded California-based biofuels industry.
9. The expiration of key federal assistance programs (1603 ITC and PTC) will have a significant impact on the ability to both fund and finance dairy cluster projects, as well as individual dairy biogas projects in the future.
10. Cash grants for renewable energy projects are significantly more efficient than other government assistance and tax-incentive programs.

9.3 Recommendations

1. California policymakers should utilize EPIC and Cap and Trade Investment Plan funding to develop cash grant opportunities, similar to the expiring federal 1603 program, to encourage and incubate dairy digester development in California. Dairy biogas projects have the potential to substantially reduce GHG emissions and generate credits for the Cap & Trade program. Given the financial challenges of dairy digester industry, continued government support is expected to remain an important economic driver for future dairy digester development for the foreseeable future. Grants could be directly tied to participation in the SB 1122 FiT program to ensure effective participation and further enhance ratepayer benefits.

2. State policymakers interested in successful commercialization of the dairy biogas industry in California must ensure timely and effective implementation of SB 1122 (Rubio) by the CPUC. The SB 1122 Bioenergy FiT program provides the best opportunity for near-term development of a significant number of dairy digester projects. Successful development of projects under the SB 1122 FiT is the key to reducing production costs through increased experience and commercialization. Successful development under the 1122 FiT program will also open the door to longer-term opportunities with biomethane (RNG) and vehicle fuel (RCNG) projects.
3. CARB and other state agencies should develop programs to encourage development of long-term markets and minimum guaranteed prices for carbon credits (LCFS and GHG). Facilitation of long-term consistent revenue streams from LCFS and GHG credits would greatly enhance project financing and encourage the further development of dairy biogas projects allowing the state to achieve significant environmental benefit.
4. Facilitation of long-term off take agreements will be necessary to encourage successful development and financing of dairy biogas to vehicle fuel projects. Government assistance in connecting RNG producers to vehicle fuel consumers through outreach to private fleet-owners and government agencies as potential long-term contract partners will be helpful.
5. Creation of low-cost financing programs, such as loan guarantee programs, could greatly reduce financing risk and bring down costs accordingly. High financing costs remain a significant obstacle to successful dairy biogas project development.
6. Efforts to increase transparency, improve certainty, streamline the process and reduce the high costs of interconnection should continue as a top priority of regulators. Interconnection costs, in particular, remain a key barrier to long-term commercialization of the dairy biogas industry.
7. Targeted use of AB 118 program funds should be considered to facilitate development of initial dairy biogas to vehicle fuel projects in California. Dairy biogas to vehicle fuel projects provide unparalleled opportunities for significant GHG emissions reduction, reduced dependency on foreign oil and significant reductions in criteria air pollutants.

Appendix A: April 2012 Kick-Off Meeting Attendees

John Bidart	Cal Bio
Neil Black	Cal Bio
Julia Levin	California Natural Resources Agency
Mike Levin	Flex Energy
Cara Peck	USEPA
Paul Sousa	Western United Dairymen
Mike Tollstrup	CARB
Diane Moss	Renewables 100 Policy Institute
Kyle Goehring	MT-Energie
Jacqui Gaskill	USDA
Rupi Gill	San Joaquin Valley Air Pollution Control District (SJVAPCD)
Karl Longley	Central Valley Regional Water Quality Control Board (CVRWQCB)
Ted Strauss	USDA-NRCS
V. John White	CEERT
Su Anne Huang	Flex Energy
Garry O'Neil	CEC
Marco Lemes	SMUD
Steven Klein	Central Valley Regional Water Quality Control Board (CVRWQCB)
Kevin Abernathy	Milk Producers Council
Joe Choperena	Sustainable Conservation
Rob Williams	UCD/CA Biomass Coalition
Dara Salour	Alternative Energy Systems Consulting
Gantam Barua	CalBio
Christoph Dobert	MT-Energie
Michael Boccadoro	AECA/Dolphin Group
Gary Bullard	CA Dairy Campaign
J.P. Cativiela	Dolphin Group
Beth Olhasso	AECA/Dolphin Group

Appendix B: December 2012 Permitting Meeting Attendees

Steven Klein	Central Valley Regional Water Quality Control Board (CVRWQCB)
Doug Patterson	Central Valley Regional Water Quality Control Board (CVRWQCB)
Dave Warner	San Joaquin Valley Air Pollution Control District (SJVAPCD)
Cara Peck	USEPA
Sheraz Gill	San Joaquin Valley Air Pollution Control District (SJVAPCD)
Ramon Norman	San Joaquin Valley Air Pollution Control District (SJVAPCD)
Frank Ramirez	Governor's Office
John Blue	CalEPA
Christine Karl	CalRecycle
Ken Decio	CalRecycle
Scott Denny	Kern County
Jim Lucas	SoCal Gas
Michael Boccadoro	AECA/Dolphin Group
Beth Olhasso	AECA/Dolphin Group
JP Cativiela	Dolphin Group

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