

November 30, 2015

**California Bioenergy LLC's Submission to the  
California Sustainable Freight Action Plan Pilot Project Ideas Request**

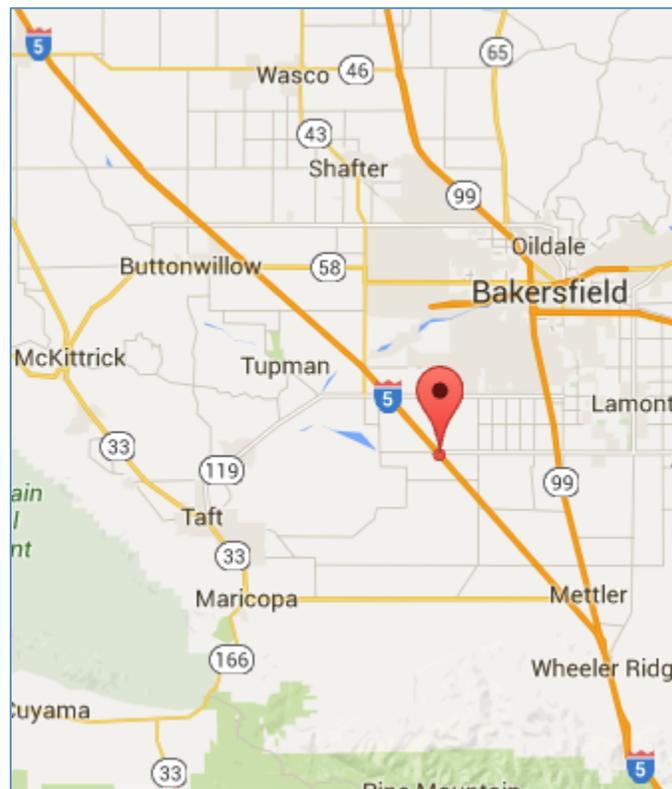
**Project title: "The Kern Dairy Biogas Cluster's R-CNG Sustainable Freight Pilot Project"**

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**Location of the Project:**

The Sustainable Freight R-CNG Pilot Project is in the center of the Kern County Dairy Biogas Cluster, near the intersection of Bear Mountain Blvd and Interstate 5, outside of Bakersfield, CA at Latitude: 35.208341, Longitude: -119.158358 (Option 1) or Latitude: 35.208223, Longitude: -119.139461 (Option 2)



**Figure 1: Location of Dairy Biogas R-CNG Pilot Project**

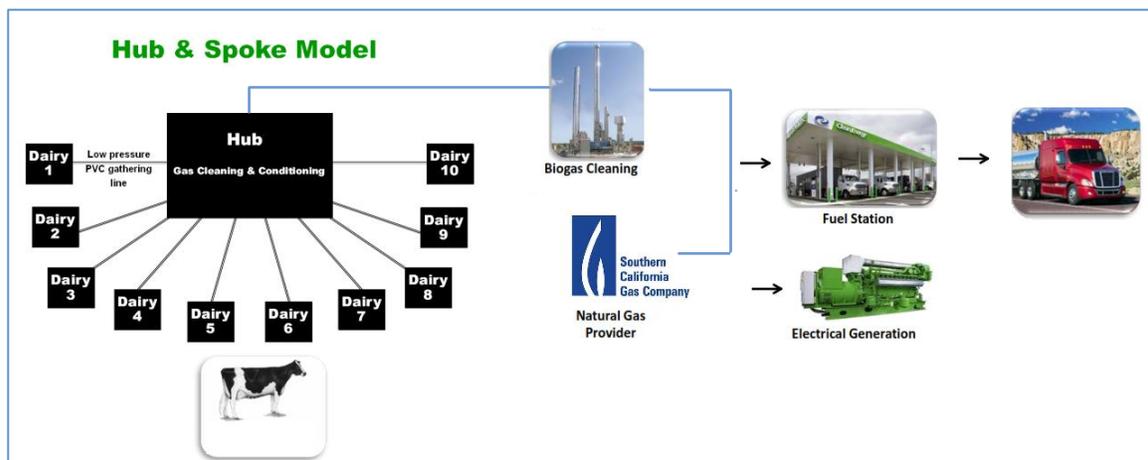
## **Executive Summary**

### **The Kern Dairy Biogas Cluster's R-CNG Sustainable Freight Pilot Project**

California Bioenergy LLC (CalBio) proposes to develop at the Kern County Dairy Biogas Cluster (Kern Dairy Cluster) a renewable CNG infrastructure, fueled with dairy biogas, to help advance the development of California's sustainable freight transportation system. The full name of the proposal is the "The Kern Dairy Biogas Cluster's R-CNG Sustainable Freight Pilot Project", referred to as the Pilot Project or Project. The Kern Dairy Cluster was the subject of a 2013 USDA Study. It is composed of 16 modern, clustered dairies, located southeast of Bakersfield. With approximately 100,000 cows, it has the capacity to generate 2.5 to 3 million SCF of biogas per day and 1.5 to 2.5 million diesel gallon equivalents (DGE) per year. It is a model for subsequent fueling centers utilizing the bio-methane from the state's 1500 dairies. The Kern Dairy Cluster is well located, adjacent to I-5 and near State Highway 99, the two main transportation corridors through the Central Valley. In addition, the project has identified property near an on-off ramp to I-5, suitable for locating the gas upgrading, pipeline interconnectivity and fueling station facilities. The cluster and the proposed project property are close to both a SoCal and a PG&E natural gas pipeline, which will supply the station with back-up natural gas and provide a secondary mechanism for the cluster to distribute its bio-methane for freight fuel use.

The build out of the cluster and the planning of the fueling infrastructure are underway. The first facility, at the Old River Dairy, began operating in December 2013 and is California's largest dairy manure digester. The next two digesters received CEC EPIC grant awards this year and are in final design and siting review. The subsequent digesters are in earlier phases of development. The initial projects are designed to utilize the biogas for both electricity and fuel. Dual use offers important benefits to the nascent dairy biogas industry: (1) it ensures financial viability, through long-term IOU electricity contracts utilizing the BioMAT; (2) at the same time it provides a potential upside to the farmers and investors from the less financeable LCFS and RIN credits; and (3) R-CNG use decreases NOx emissions from the electricity engines as well as from diesel trucks (see the SJVAPCD's support letter). This Pilot Project would seek grant funding (a) to lay the local pipeline from each digester to the centralized facility (see County support letter); (b) build the centralized gas clean-up facility (proposals are under review from leading solution providers); (c) build the fueling station (in partnership with one of the leading station operators) and (d) interconnect to the pipeline. The estimated costs are approximately \$12.5 million. Working in partnership with the dairy industry and with CALSTART, the Project has identified truck fleets to purchase the R-CNG. The plan is to begin construction in 2016 and initial use of the R-CNG in 2017, with a phased roll out in 2018 and 2019, concomitant with release of the larger CNG truck engines and the addition of new digesters. The project is located adjacent to disadvantaged communities and will result both in job creation and air pollution protection/odor control. In addition, since trucks will travel into the L.A. basin,

it will also result in air pollution advancement in a second non-attainment zone. Critically, the project will deliver carbon negative fuel to the truck fleets since the produced R-CNG is expected to have a carbon intensity value in excess of -100 g/MJ. Since dairy lagoons produce approximately 25% of the state's methane, the industry has the volume to be an important piece of the Sustainable Freight infrastructure plan in the Central Valley. In addition, the completion of the Pilot Project will help provide a roadmap to achieve ARB's goals currently under consideration in the SLCP Strategy of 20% reduction in lagoon methane by 2020 and 50% by 2025. The Project would work closely with ARB, the CEC, Department of Transportation, and the Governor's Office of Business and Economic Development. The goal of the Kern Dairy Cluster is to be a center of education, targeted research and experimentation, commercial demonstration and excellence. Future additions could include use of the dairy generated natural gas to replace diesel used in farm equipment and as a source of hydrogen fuel.



*Detailed description of how the pilot project idea components will incorporate advanced technologies, alternative fuels, freight and fuel infrastructure, and local economic development; and advance goals of improving freight efficiency, transitioning to zero-emission technologies, and increasing competitiveness of California's freight system.*

## **I. Introduction**

California Bioenergy LLC ("CalBio") is pleased to provide this Pilot Project Ideas submission. Per Executive Order B-32-15, the Pilot Project proposal advances the state's sustainable freight transportation objectives. If funded and developed, the Project will utilize advanced technologies and alternative fuels, help further the freight and fuel infrastructure, and advance local economic development.

The Project, based outside of Bakersfield, will convert dairy biogas into renewable CNG (R-CNG) for freight fleets, serving the San Joaquin Valley and into the Los Angeles basin. These are core freight corridors, along both I-5 and State Highway 99, among the most heavily trafficked freight corridors in the state.

In addition the Cluster and truck routes are adjacent to and through economically disadvantaged communities, with among the worst air pollution conditions in the state and country. "State law (Senate Bill 535, De León, Chapter 830, Statutes of 2012) requires focused investment in communities disproportionately impacted by pollution. Many of these communities, especially in the Central Valley, along freight corridors, and in rural parts of the State, stand to benefit from dedicated action and investment to reduce emissions of SLCPs."<sup>1</sup> In these communities, the Project will create jobs and improve air quality and reduce odor. It is a model that can be replicated multiple times in the San Joaquin Valley and can get underway in 2016.

The Project provides these benefits while it advances the goals of reduced NO<sub>x</sub>, particulate and Greenhouse Gas (GHG) emissions:

- 1) The goal of the Sustainable Freight initiative is for zero or near zero emissions of NO<sub>x</sub>, particulates, and carbon emissions from the movement of freight. With regards to NO<sub>x</sub> the Pilot provides an integrated strategy of reduced emissions from truck fleets and a reduction from electricity engines (see #3 below). In addition, dairy generated R-CNG is better than zero emissions; it is carbon negative. Trucks will be fueled by bio-methane that is currently vented into the atmosphere.

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<sup>1</sup> *Short-Lived Climate Pollutant Reduction Strategy (Draft)*, September 2015, Page 68

- 2) By capturing and utilizing this methane for freight, the Pilot will provide a model for advancing ARB's Short-Lived Climate Pollutant (SLCP) reduction goals from the dairy industry. Dairy manure-lagoons produce approximately 25% of the state's methane and ARB has targeted, in the SLCP Draft Strategy, reductions of 20% by 2020; 50% by 2025 and 75% by 2030. Once completed, the Cluster will destroy approximately 200,000 metric tons of CO<sub>2</sub>e per year.
- 3) By building the first commercial facility for dairy generated R-CNG, it will offer a complementary and/or alternative pathway, as explained below, to electricity generators that pose the risk of increased NO<sub>x</sub> emissions, a by-product of the destruction of methane in internal combustion engines. The project is estimated to generate 1.5 to 2.5 diesel gallon equivalents (DGE) per year.

This is an inter-departmental initiative building upon established relationships and creating new ones. Agencies and departments that would be actively involved include the Air Resources Board (ARB), the San Joaquin Valley Air Pollution Control District (Air District), the California Energy Commission (CEC), California Department of Food and Agriculture (CDFA), the Department of Transportation (Caltrans), the Governor's Office of Economic Development as well as Kern County. (Also see Section IX)

- ARB plays a central in the Sustainable Freight Strategy and the SLCP Strategy, with its goals for dairy methane reduction.
- The Air District is the agency responsible for local air quality and has been the lead agency on permitting CalBio's projects to date. It is a supporter of this Pilot Idea's submission (See support letter, Attachment 1).
- The Air District and Caltrans would play a key role in grant funding to truck fleets for CNG conversion as part of the Pilot Project.
- The CEC has provided initial grant funding, through EPIC funds, for two dairy digesters serving the Kern Dairy Cluster, projects that envisioned adding R-CNG. In addition, the CEC AB 118 team will potentially play an important role in the Pilot Project.
- Kern County (See Attachment 2, letter of support from the Director of the Planning and Community Development Department) recognizes the economic development and improved air quality benefits of the Project and will play a key role in the permitting of the Pilot Project components.
- CalBio has worked closely with CDFA (including receipt of CDFA funding for a non-Cluster project) and is the anticipated administrator of future digester grant programs utilizing GGRF funding.
- The Governor's Office of Business and Economic Development will play a central role in facilitating permitting and creating the conditions to replicate the model throughout the Central Valley.

## **II. Background**

California's 1,500 dairies produce approximately 20% of the country's milk. It is the largest agricultural commodity in the state. It is also responsible for approximately 50% of the state's methane. Fifty percent of that amount, 25% of the total, results from the methane emissions from dairy manure lagoons. (The other 50% is from 'enteric' emissions, such as burping.) ARB's goals, as outlined in the SLCP Draft Strategy, is to achieve a reduction of 20% by 2020, 50% by 2025, and 75% by 2030 of lagoon-generated methane emissions. This is an immense and ambitious undertaking, since to date less than 2% of lagoon biogas is captured and destroyed, from the current 13 operating digesters.

Dairy methane can be destroyed in three ways: onsite electricity generation; use as a fuel at a local fueling facility; or injection into the natural gas pipeline system, for use as a fuel or in electricity generation. To date, all of the state's projects are electricity production (with one exception, the Hilarides Dairy, where a small amount of biogas is used as R-CNG for the dairy's vehicles, an important, but noncommercial installation).

As a result of (a) ARB's SLCP goals and the anticipated availability of future grant funding and (b) the start of the BioMAT electricity-generation feed-in tariff program, projects will have the required economics, to attract the complementary private capital, to be built. The BioMAT provides the requisite 10 to 20 year Power Purchase Agreements (PPAs) with IOUs, providing the dependable revenue streams for private capital investment.

### **Problems and Solutions**

However, the use of digester biogas to create onsite electricity emits NOx. The situation is particularly problematic in that the vast majority of dairies are located in the San Joaquin Valley, a nonattainment zone. Contributing to NOx emissions, through wide-scale digester electricity projects, at the levels needed to achieve the SLCP goals, would make it nearly impossible for the Air District to meet its goals and EPA requirements. One path is for continued development of low NOx engines and control systems. This will be an important approach, but it is currently an uncertain path.

By utilizing the biogas as R-CNG, the dairy industry will advance both the goals of the state's Sustainable Freight Action Plan and the SLCP Draft Strategy to limit NOx and GHG emissions. However, there are two problems with R-CNG use as a fuel, prohibiting market development on its own and requiring Pilot Projects such as this one, made possible with grant funding:

- 1) There is no demonstrated, commercial-scale dairy biogas to R-CNG facility in California (and only one in the U.S.). Hands on experience, proof of successful project construction and successful operations are needed.

- 2) There are no long-term, contracted revenue streams from R-CNG as there are with electricity. The Bio-MAT provides 10 to 20 contracts and does so at a substantially above market price. In addition electricity projects are able to sell critical carbon credits, providing the upside essential for farmer, developer and equity capital interest.

With fuel projects, the value available for the renewable natural gas component is the commodity price for the fossil fuel, which is expected to continue at historic lows. There is no special dairy or bioenergy-based methane price comparable to the BioMAT. However, fuel projects have the upside of two credits: Federal Renewable Identification Number credits (RINs) and California's Low Carbon Fuel Standard (LCFS) credits. Combined, they offer the potential for substantially more value than carbon credits available to electricity projects. The problem is that these are volatile markets with uncertain futures, which are contracted on short-term basis, making project financing extremely difficult.

### **The Pilot Idea**

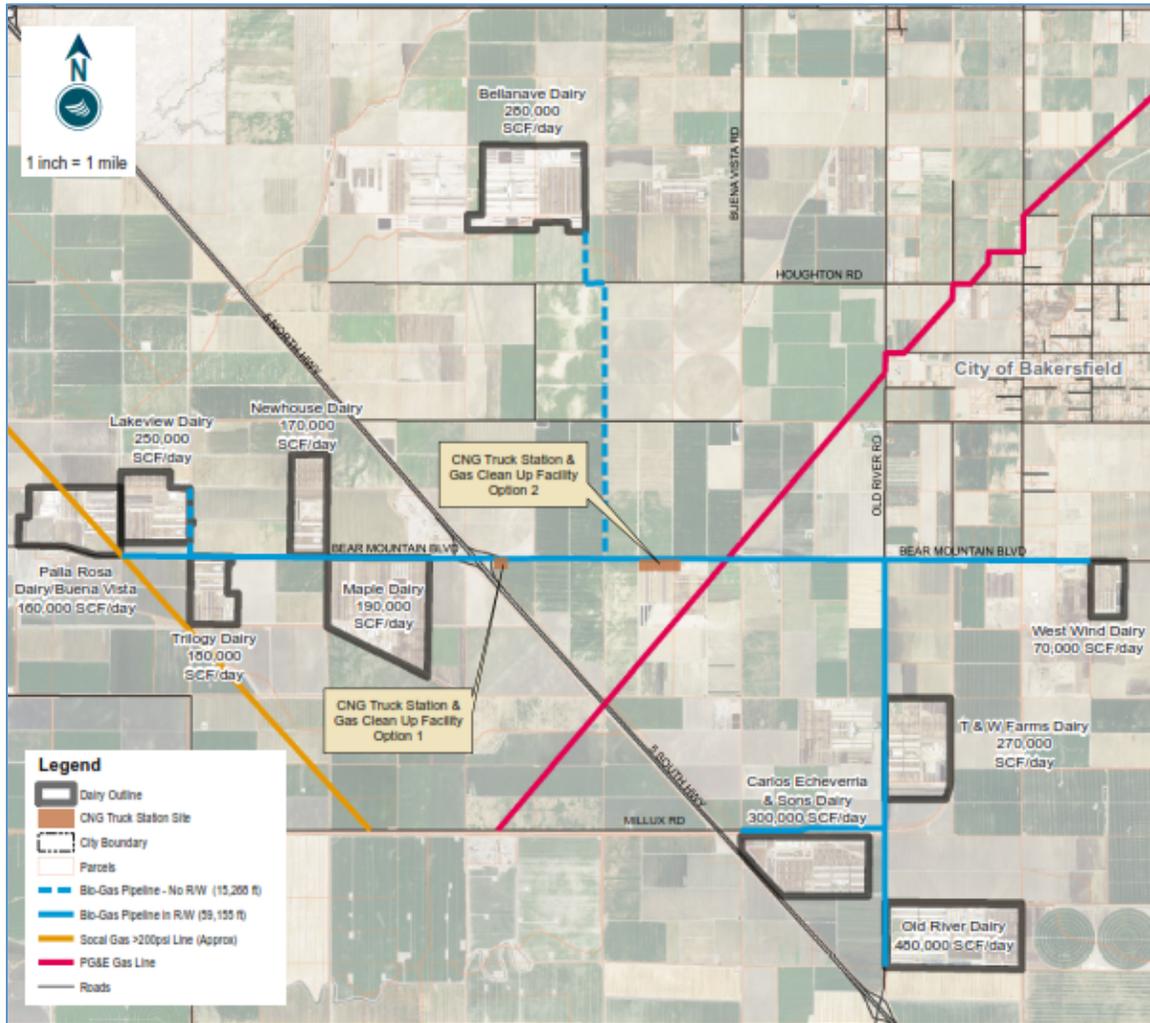
Over the next few years, the future of the federal RINs program may become clearer. In addition, and more importantly, California will advance its LCFS program and may develop long-term contracting mechanisms or floors to support R-CNG based projects. But these are likely a number of years away. The success of the Dairy Pilot Project will in fact likely help advance these program developments.

In the interim the Dairy Pilot Project provides the opportunity to advance this learning in the near term of 2016 to 2018. The Dairy Pilot Project plan, which has been in development for three years, follows a simple strategy of dual use of the biogas: some will be used for electricity and some for fuel. The electricity PPA enables financing the construction of the digester projects. The fuel use results in NOx reductions and provides a potential financial upside to the dairies and investors. In addition it provides the critical experience needed for future financial support. As discussed below, the electricity generation will be onsite at the dairies (or in mini-hubs of adjacent dairies) and the biogas cleanup to R-CNG will be in a central hub location. This dual approach, of electricity and R-CNG, was the basis of an initial grant application by CalBio to the CEC's EPIC program and for the Air District's and the County's letters of support.

### **III. Cluster Project Design**

The Kern Dairy Cluster is located 15 miles southwest of Bakersfield on both sides of the I-5 and a short distance east of State Highway 99. It is composed of sixteen dairies within a six-mile radius. The initial build out is based on twelve dairies, with possible expansion to the other four. The cluster is made up of approximately 100,000 dairy cows, generating approximately 2.5 to 3 million standard cubic feet (SCF) per day of

biogas, which is roughly 60% methane. The project is estimated to generate 1.5 to 2.5 million DGEs per year. A map of the cluster is provided in Figure 2.



**Figure 2: Pilot Project Detailed Map of Dairy Digester Biogas Plants, Low Pressure Pipeline, Gas Conditioning Plant, CNG Station and Utility Pipelines**

The plan is to build digesters on each dairy in the cluster. With one exception, the dairies in the cluster are “flush” dairies, moving the manure with water into the storage lagoons. It is cost-prohibitive and energy intensive to move manure water into a central digester, while it is efficient to move the biogas. As planned the digesters will be double-lined, covered lagoons, with the exception of the vacuumed dairy, which will likely be a plug-flow or tank system.

The Project is broken into two stages. Stage 1 reflects the completion of five main components:

- 1) The construction of the first five digesters (reflecting 50% of the dairy herd). The Old River Dairy project was completed in 2013 with the support of U.S. Treasury 1603 funding. Two projects, at Lakeview Farms Dairy Biogas and CE&S Dairy Biogas, both awarded CEC grant funding, will begin construction in 2016.
- 2) Laying a local low-pressure pipeline from each dairy to the centrally located gas conditioning/clean up system. In Stage 1, the system will be laid to collect biogas from both Stage 1 dairies and Stage 2 dairies. (See Figure 2)
- 3) The construction of the gas upgrading system. The facility will be located in the center of the cluster on one of two available parcels of land.
- 4) The construction of a fueling station located near I-5 and near the gas conditioning system, on one of the two available parcels.
- 5) Interconnection to a natural gas pipeline for supplemental supply to the fueling station and the ability to inject bio-methane generated by the Cluster.

Stage 1 can be completed in 2016-2017, based on grant funding availability. An initial timeline is provided in Section VII.

As described above, at the first five digesters, the Project plans to install reciprocating engines to generate electricity for export to the grid, through the BioMAT (SB 1122). Stage 2 will involve development of additional dairy digesters on the remaining dairies.

### **GREET Pathway**

A critical component to the long-term viability of R-CNG to dairies will be the value of the LCFS (and RIN) credits. A prospective GREET 1.8b LCFS pathway for CalBio's cluster project is currently under consideration by the Fuels Evaluation section of the ARB. When finalized later this year, it is expected to show that renewable CNG produced from California dairies has a significant negative carbon intensity value in excess of -100 g/MJ.

## **IV. Advanced Technologies**

The Pilot Project will deploy proven and emerging advanced technologies:

### **1. Biogas Gathering Infrastructure**

The Project will construct a local gas-gathering infrastructure composed of low-pressure pipeline and blowers, meters, analyzers, valves and other components.

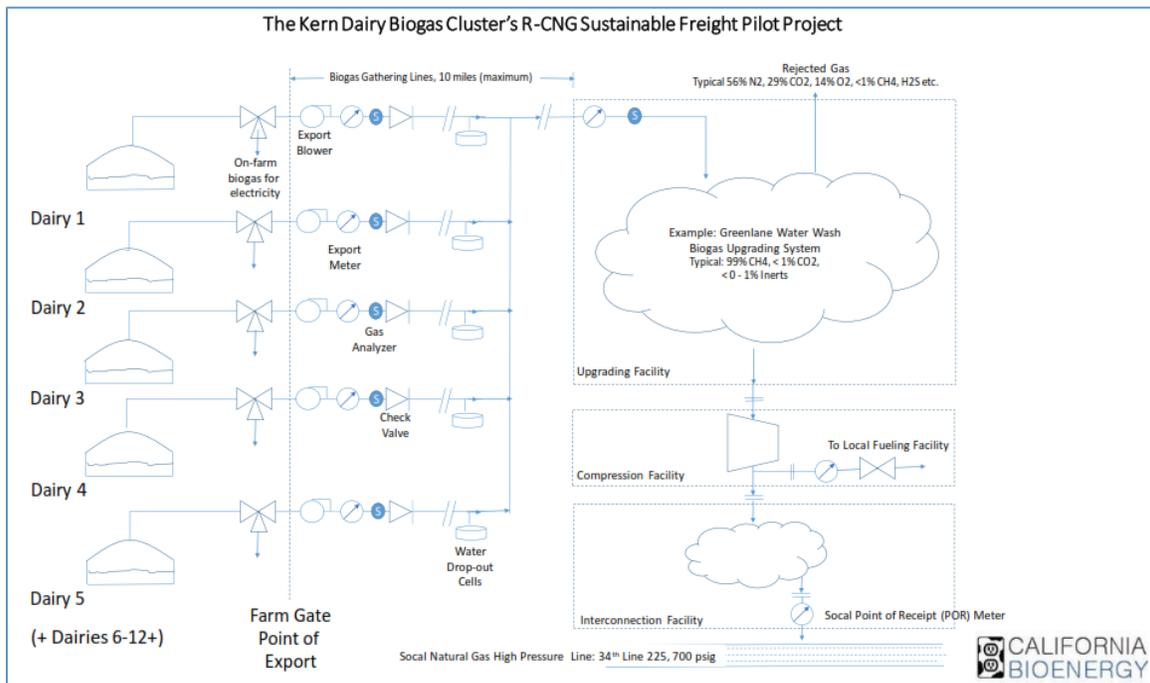
To bring the gas from each dairy to the central facility, the Project plans to run an inexpensive low-pressure pipeline (likely made from a plastic such as HDPE or PVC), interspersed with steel piping for crossing public roads and right of ways. CalBio is working with its farm partners (who are the local landowners), the County, and its local engineering partner to determine the most cost-effective route.

Each dairy will utilize a low-powered blower to move the fuel portion of its produced biogas through the gathering pipeline to a centralized upgrading system.

Each dairy’s exported biogas will be metered and analyzed for its constituent parts (methane, carbon dioxide, nitrogen, oxygen and hydrogen sulfide) at the farm-gate transfer point. As a result each digester project can be compensated for its net methane contribution.

The Project also benefits from built-in biogas storage. Each covered lagoon digester is able to store biogas for several days. This provides important storage capacity during routine maintenance and other outages.

An overview is provided below.



**Figure 3: Draft Process Flow Diagram for Cluster**

## 2. Biogas Upgrading

At the central facility a biogas-upgrading system will be installed. Reflecting the Cluster’s increasing biogas production volume, the upgrading facility will need to be

flexible and initially capable of processing a few hundred scfm of biogas, yet scalable to several thousand. CalBio is currently evaluating technologies and will conduct, as part of the Pilot Project, a competitive solicitation. Black and Veatch will provide technical guidance. In addition, CalBio is partnering with CALSTART, which has a long track record of successful clean transportation project implementation.

To date CalBio has conducted significant review of various biogas-upgrading systems, with the most detailed analysis provided by Greenlane. Greenlane has dairy experience at the Fair Oaks facility in Indiana and is currently building a system for CR&R in Southern California, where it will upgrade raw biogas, produced from the anaerobic digestion of food and other organic matter, to pipeline quality gas. One unit under consideration by CalBio can clean up from 12.5% to 37.5% of the Cluster’s biogas, which corresponds well with the initial targets for both Stage 1 and Stage 2. CalBio has also reviewed the opportunity with SoCal and will include SoCalGas’ tariff offering in the competitive review.

### 3. Interconnection

The Pilot Project will be the only operating dairy biogas to pipeline interconnection project in state. The project is near both PG&E and SoCal pipelines. More advanced discussions have been held to date with SoCal, however proximity to PG&E may result in a more economical solution and will be fully considered.

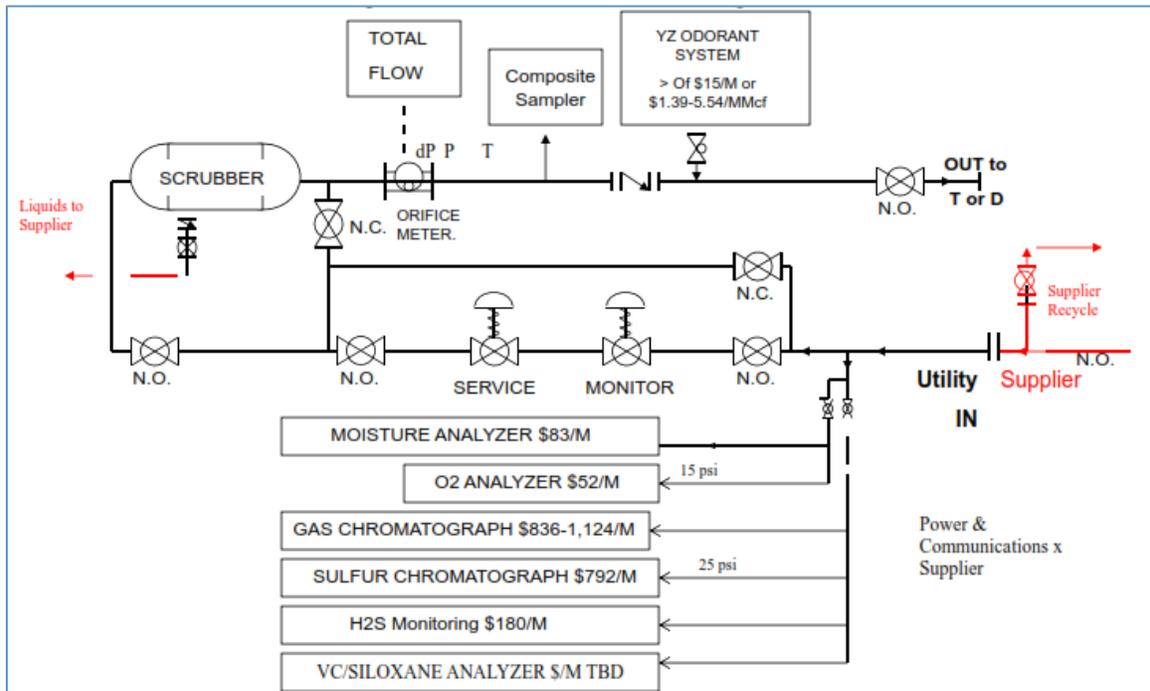


Figure 4: Typical Biomethane Pipeline Injection Interconnect Process Flow (AB1900)

#### 4. Fueling Station

CalBio will run a competitive bidding process with multiple CNG fueling station providers. To date CalBio has worked both with Clean Energy, which has perhaps the largest presence in California, and amp CNG, which has dairy biogas experience in the Midwest. Both are fast-fill operators, which will be needed for commercial vehicles that cannot afford downtime and often operate 24-hours a day.

The construction of the fueling station also plays a valuable role in expanding the state's CNG station infrastructure. The Project's station will serve the needs of the local feed and milk truckers. In addition, there is a shortage of fueling stations on the I-5 corridor. Per the map below, currently there are no CNG fueling stations between Santa Clarita and Los Banos, an approximate 240-mile distance. The Project, located 70 miles from Santa Clarita and 170 miles from Los Banos, will provide a CNG refueling location to address this deficiency.

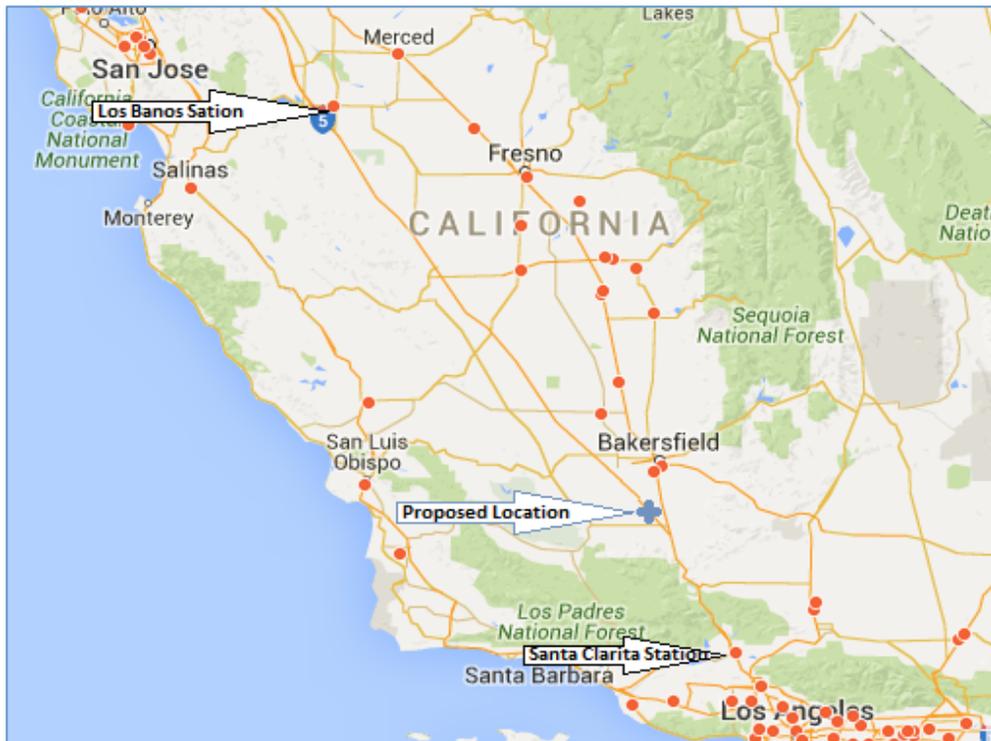


Figure 5: Current CNG Stations (Source DoE)

The Pilot design includes both a fueling station and pipeline injection. We believe both capacities are key to the success of the Pilot Project. Each offers separate and critical learning opportunities – about the servicing of local fleets as well as the ability to interconnect and distribute the R-CNG to remote buyers. Redundancy is also valuable, providing two paths for fleet utilization.

## 5. Truck Technology

The California Air Resources Board recently certified the natural gas-fueled 8.9-liter ISL G engine by Cummins Westport for “near zero emission” of nitrogen oxides. At 0.02 grams per brake-horsepower, it is 90% cleaner than the existing diesel NOx standard of 0.2 grams in effect since 2010.

The Pilot Project will deploy its R-CNG into freight haulers who utilize the advanced, NZE CNG engine technology. CALSTART, Caltrans, ARB, and the Air District, will be important partners to CalBio and the fleets in evaluating, selecting and funding engine models to utilize the R-CNG.

Initially trucks using the certified 8.7L NZE engine can be deployed for moving feed to the dairies and other freight needs. Subsequently, the emerging 12-liter engine (and potentially a 15-liter engine) will play an important role, and its market-entry should correspond to the build out of the digesters in the Cluster. These larger trucks will be available for use by milk and other freight haulers, utilizing the Project’s station or receiving the R-CNG through the pipeline.

### Truck Fleets

CalBio and CALSTART bring important truck fleet relationships to the Pilot Project. CalBio has been working directly with California Dairies Inc. (CDI), the dairy farmers, milk fleets and feed truck fleet operators. CDI, the state’s largest dairy co-op, manages milk hauling for its member dairies. (Please see Attachment 3, letter from CDI.)

Separately, to expand the mix of users of the Pilot R-CNG and to develop interest in subsequent, dairy R-CNG projects, CALSTART is engaging with multiple freight haulers as prospective fuel users. Since there is no price premium on R-CNG relative to CNG to the truck fleets, yet added environmental and marketing benefits, significant interest is anticipated.

Grants for the truck fleets will be an important component in making the Pilot Project successful. It is anticipated that the truck fleets will be eligible for programs administered by the California Energy Commission and by the Air District with CCI funding.

## 6. Future Vehicle Technologies

The Kern Cluster is being developed as a research, experimentation, deployment, and commercial development hub, providing ongoing learning and demonstration for the state. There are two additional fuel-based areas for testing emerging technologies:

**Farm Equipment.** Farm equipment is currently diesel based and adds large quantities of particulate and NOx emissions in the San Joaquin Valley. CNG farm equipment is at an

early stage of development but it will be a goal of the Kern Dairy Cluster, working to test new equipment in coordination with CDFA, (on technology identification), the Air District (for funding), and ARB (on an extension of the GREET pathway).

**Hydrogen Highway.** There is potential use of the renewable methane as source of hydrogen, and this will also be the basis for work with ARB, the Air District and Caltrans. For instance, Nuvera's steam methane reformer uses a catalyst to strip hydrogen out of biomethane in a local onsite facility. This is a promising, longer-term opportunity, providing an additional solution to passenger vehicles.

## **V. Achieving the Other Goals of the Sustainable Freight Action Plan/Strategy**

### **Economic Development**

The Pilot Project and the broader Cluster development will be an engine for economic development. The Cluster will be the source of approximately \$100 million of investment (Section VI). Of this amount over \$13 million has been spent to date. The estimated \$12.5 million for the Pilot fuels program will accelerate and expand capital investment.

The Cluster capital expenditures will create local jobs for digester construction and pipeline development. The local economic development is described by Lorelei Oviatt, Kern County's Director, Planning and Community Development Department, in her November 20 letter: "CalBio now proposes to utilize a portion of the biogas for use as renewable compressed natural gas (R-CNG) for truck freight. It is these type of innovative approaches to renewable energy site that Kern County supports for the future of jobs and new business opportunities in the area."

Besides providing construction-related jobs, dairy bioenergy projects also create long-term operation and maintenance (O&M) positions, which require skill development and are well paid. The economic development at the Cluster will be replicated across the San Joaquin Valley, based on the learning from the Pilot Project and the advancement of the dairy bioenergy industry.

### **Improving Freight Efficiency**

The primary impact on freight efficiency will be the reduction of GHG, NO<sub>x</sub> and particulate matter emissions per mile driven. Additional benefits include the net reduction of NO<sub>x</sub>, from preventing the addition of electricity generating internal combustion engines.

CalBio will work with the local fleets on scheduling refueling to minimize any waiting time. In addition, local biogas fuel production reduces truck traffic and pollution for wholesale diesel hauling to public and private fuel stations.

The Project’s CNG station will increase retail access to CNG encouraging other freight operators along the I-5 corridor. As shown in the map (Figure 5), the Project’s fueling station fills an important need in the Los Angeles to San Francisco/Sacramento corridor. Local agricultural operators, fleets traveling the I-5, as well as car traffic, will be able to access fuel.

**Low, Zero and Negative Emissions**

The Pilot Project works on three independent levels. Truck fleets will be converted to new ultra low NOx and particulate emission CNG technologies. By creating a market for the dairy biogas as R-CNG, its use in electricity generation will be reduced, further curbing NOx emissions. Perhaps the most stunning impact will be the use of a R-CNG source that is anticipated to have the highest negative carbon intensity GREET rating: around or in excess of -100.

**Competitive Advantages**

The Pilot project will have two impacts on competitiveness. If a price differential continues between CNG and diesel, the CNG fleets will have a competitive advantage. As CNG truck prices come down, fleet subsidies may not be required. In addition, within the dairy industry, truck fleets using dairy R-CNG may find themselves in a competitive advantage in securing contracts, by helping advance the dairy industry’s sustainability goals and providing a revenue stream, from their fuel purchases, to their dairy farmer customers.

**VI. Financial Analysis**

*“Estimated cost for implementation and existing funding commitments (include any funding limitations or constraints) by stakeholder and amount.”*

The construction of the full Cluster will cost approximately \$100 million to \$120 million. The initial Pilot Project cost estimates are between \$10 million and \$15 million, making up roughly 10% to 15% of the overall costs.

<b>Cluster Development</b>		
Pilot Project cost	\$10,000,000	\$15,000,000
Digester and Engine	\$80,000,000	\$100,000,000
Incremental costs 100 CNG trucks	\$6,000,000	\$6,000,000
	<b>\$96,000,000</b>	<b>\$121,000,000</b>

The \$80 to \$100 million has been and will be provided by a mix of grant programs and private capital. Historically CalBio has benefited from the US Treasury 1603 program and

CEC EPIC program. The match-level to date has ranged from approximately 50% to over 70%. We are assuming the continuation of GGRF/CDFA program going forward.

The high level of match has been possible because of the ability to secure vendor-provided debt based on the PPA with the IOU. By contrast, debt financing will likely be impossible for the Pilot Project, given the absence of predictable revenue streams, as well as absence of vendor financing.

Based on an initial review, the Pilot Project costs breakdown as follows:

<b>Construction Costs</b>	<i>Initial Estimates</i>	
	Low End	High End
Local Pipeline Infrastructure	\$2,000,000	\$3,000,000
Gas Clean-up/Conditioning	\$3,500,000	\$4,000,000
Fueling Station	\$2,800,000	\$4,200,000
Interconnection (net PUC grant)	\$1,700,000	\$3,800,000
<b>Total Pilot Project Cost</b>	<b>\$10,000,000</b>	<b>\$15,000,000</b>

The estimated cost of the Pilot portion of the Cluster is \$10 million to \$15 million. Assuming a \$12.5 million cost, CalBio is requesting \$10 million in grant funding towards the Pilot.

Placed in the larger context, this would correspond to a match in excess of 50% as shown in summary below.

<b>(1) Cluster Costs (digester and engine)</b>		<i>Approximate Costs + Preliminary Estimates</i>			
<u>Completed</u>	<b>Project Cost</b>	<b>Grant Funding (Received-Sought)</b>	<b>Source</b>	<b>Private Capital</b>	<b>Timeline</b>
Old River Dairy	\$13,800,000	\$3,300,000	US Treasury	\$10,500,000	2013
<b>In Development</b>					
Lakeview Farms	\$8,500,000	\$4,000,000	CEC EPIC	\$4,500,000	2016-17
CE&S Dairy	\$8,000,000	\$3,000,000	CEC EPIC	\$5,000,000	2016-17
<b>Planned</b>					
Next 2 projects (Stage 1)	\$16,000,000	\$7,200,000	GGRF/CDFA	\$8,800,000	2017-18
Subsequent 7 projects (Stage 2)	\$53,900,000	\$24,255,000	GGRF/CDFA	\$29,645,000	2018-19
R-CNG only	\$33,800,000	\$15,210,000	GGRF/CDFA	\$18,590,000	2018-19
Subtotal (with engines)	\$100,200,000	\$41,755,000	Various	\$58,445,000	2013-2019
Subtotal (R-CNG only)	\$80,100,000	\$32,710,000	Various	\$47,390,000	2013-2019
<b>(2) Pilot Project Costs (R-CNG)</b>					
R-CNG infrastructure Cluster	\$12,500,000	\$10,000,000	State sources	\$2,500,000	2016-2017
<b>(3) Truck Fleet Upgrade</b>					
Trucks - 100	\$6,000,000	\$3,000,000	CNG Incentives	\$3,000,000	2017-2019
<b>Total (with engines)</b>	<b>\$118,700,000</b>	<b>\$54,755,000</b>	<b>Various</b>	<b>\$63,945,000</b>	
<b>Total (R-CNG only)</b>	<b>\$98,600,000</b>	<b>\$45,710,000</b>		<b>\$52,890,000</b>	
		<b>46%</b>		<b>54%</b>	

## VII. Timeline

A summary of the timeline is as follows:

- 2016: Planning, Design, Permitting and start of local pipeline construction. Contracting fuel sales
- 2017: Construction of biogas upgrading system, fuel station and complete pipeline interconnection. Begin operating two new digesters and start of construction on two more. Initial fleet purchases. End of 2017: initial fuel sales of both R-CNG and CNG
- 2018: Completion of two more digesters. Start construction on three to six more. Expansion of truck fleets. On going sales both via station and via pipeline

A more detailed timeline is in Attachment 4, with the two horizontal sections provided below.

Task	Task Name	Work	Notes/Requirements	Biogas SCFD	R-CNG %	R-CNG SCFD	DGEs
1.0	Construction of New Dairy Digester Projects	Project 1	COD 12/2013 May add codigestion 2016; in Biogas SCFD	680,000			
		Projects 2 + 3	Awarded CEC grants 2015. Awaiting BioMAT PPAs	550,000	25%	170,000	265,000
		Projects 4 + 5	Based on BioMAT PPAs and GGRF/C DFA grants	460,000	25%	137,500	210,000
		Project: 6 to 12 (or more)	Based on GGRF/C DFA digester grants Electricity sales may not be needed	1,110,000	33%	151,800	240,000
					50%	555,000	870,000
2.0	Construction of R-CNG Pilot Project	Lay local Pipeline	<i>Schedule based on grant funding</i> Permitting 2016 Construction Q 1 2017				
		R-CNG upgrading system	Permitting 2016 Construction Q 1 2017				
		CNG station	Permitting 2016 Construction Q 1 2017				
		Pipeline interconnection	Permitting 2016 Construction Q 1 2017				
3.0	Freight Use	Fleet relationships					
		Fuel station sales					
		Pipeline-based sale					
		Fleet upgrades					
		Technology roll out					
		Truck purchases/grants					

Schedule (Initial Draft)			2016		2017		2018		2019
Task	Task Name	Work	Q1-2	Q3-4	Q1-2	Q3-4	Q1-2	Q3-4	Q1-2
1.0	Construction of New Dairy Digester Projects	Project 1	Electricity generation						
		Projects 2 + 3			R-CNG production				
		Projects 4 + 5			Electricity generation				
		Project: 6 to 12 (or more)			R-CNG production				
2.0	Construction of R-CNG Pilot Project	Lay local Pipeline	Permitting						
		R-CNG upgrading system	Permitting	Construction					
		CNG station	Permitting		Construction				
		Pipeline interconnection	Permitting		Construction				
3.0	Freight Use	Fleet relationships							
		Fuel station sales	Build relationships and contract (based on delivery)						
		Pipeline-based sale	Build relationships and contract (based on delivery)						
		Fleet upgrades							
		Technology roll out	8.9L NZE available		11.9L NZE release		15L NZE (uncertain)		
		Truck purchases/grants			Initial purchases following release, contracts, grants				

### VIII. Measuring Progress: Data Collection and Analysis

*“Means for measuring progress toward meeting goals over time.”*

The Pilot Project is an opportunity for significant data collection and mining, measuring performance relative to both the Sustainable Freight Action Plan’s goals and CalBio’s goals. Success in turn will result in expansion to new Clusters and additional digester development in the San Joaquin Valley.

The primary goals are lowering fleet emissions, lowering the Cluster’s NOx footprint , and reducing GHG emissions. CalBio’s goal is proving an economically successful model for digester project construction. Its financial success in turn will spur replication in future Clusters, helping further both the SFAP and SLCP goals. Secondary goals,

embedded within the success of the primary goals, include deploying advanced technologies, improving efficiency and generating local economic development.

An outline of prospective metrics is provided below.

### **1) Impact and Success of Pilot Project**

- A. Volume and use of biogas produced per year
  - Portion of biogas used for electricity and fuel per year
  - kWh and DGE produced
  - Use of kWh: on-site load versus export
  - Use of DGE at the fueling station and through the pipeline. Make up of truck fleets using R-CNG. Portion of the fleets' fuel from R-CNG versus CNG
- B. Efficiency of biogas use
  - Electrical efficiency (and use of waste heat)
  - Biogas upgrade performance efficiency
- C. Successful generation of GHG credits and LCFS credits
  - Relative to targets, per year and per each separate project in the Cluster
- D. Impact of R-CNG on profitability
  - Review profitability, looking at revenue and expense impacts, per year and over time (with growth of Cluster volume and maturity of credit markets), and break down analysis between electricity and fuel

### **2) Environmental Impacts**

- A. NOx and particulate metrics
  - Emissions from electrical generators including NOx reduction from use of biogas for R-CNG
  - NOx and particulate reduction based on truck performance (both from the R-CNG and CNG resulting from the Cluster-based fleet contract)
  - If RNG-based farm equipment is tested, measuring and estimating impacts and potential
- B. GHG metrics
  - CH4 captured and destroyed. Amount of GHG offset credit and LCFS credits generated per year and over time. The GHG credits from the cluster are estimated at 150,000 to 200,000 MT per year at 21 Global Warming Potential (GWP) factor and 200,000 to 265,000 with a 28 GWP factor. The GREET 1.8b LCFS carbon intensity value is being evaluated by ARB.
  - GHG reductions from the displacement of fossil trucking fuels

### **3) Expansion and Scalability**

- A. Expansion of project per year at the Cluster. Total growth in biogas. Changes in percentages between electricity and fuel
- B. Expansion of R-CNG projects through out the Central Valley
  - Dual use - electricity and R-CNG projects
  - Single use R-CNG projects – clustered and on individual dairies
  - Pipeline connected and fuel station connected projects
  - The role and quantity of grant funding for future projects – for digester construction, electricity and fuel

#### **4) Measurement of Other Goals**

- A. Economic Development
  - Project capital invested by the state and private sources from both Pilot funds and full Cluster development
  - Number of jobs created during construction and long-term, including jobs provided to residents of disadvantaged communities
- B. Evaluation of Advanced Technology
  - Performance relative to expectation
  - Ongoing support infrastructure and impact of economies on costs
- C. Freight efficiency
  - Impacts of R-CNG replacing diesel delivery to current fleet fueling centers
  - Performance of the fueling station on fueling time (internal metrics and evaluations from the local fleets)
- D. Advancement of new technologies such as CNG-fueled farm equipment and potential sourcing for the emerging Hydrogen fueled vehicle initiatives

#### **IX. Roles of Interagency Partners**

*“Description of the potential rolls each of the interagency partners could provide to support the project’s implementation.”*

- A. ARB
  - GGRF for funding of dairy methane reduction, sustainable freight and other programs
  - LCFS mechanisms to support for long-term private capital financing
  - CA-GREET models:
    - Dairy biogas to R-CNG in independent and centralized facilities.
    - GREET adaptation for flush versus vacuum dairies.
    - GREET adaptation for co-digestion.
    - GREET adaptation and LCFS credits for farm equipment and on-site refueling use of R-CNG
- B. Air District
  - Measuring NOx and PM impacts of digester projects – factoring in electricity and R-CNG generation

- Funding truck conversions and fleet replacements
  - Testing emerging farm equipment powered by CNG
- C. CDFA
- In concert with ARB GGRF grant management for dairy biogas projects
  - Identifying emerging CNG powered farm equipment
  - Analysis of secondary opportunities for fertilizer and soil amendment
  - Educating other dairies
- D. CEC
- CEC EPIC Digester Program. Played key role – funding the second and third projects in Cluster
  - Integration with the Alternative and Renewable Fuel and Vehicle Technology Program (AB 118) and related transportation programs
- E. Caltrans
- Measuring station and fleet efficiencies
  - Funding truck conversions and fleet replacements
- F. Governor’s Office of Economic Development
- Permitting. Various needs. One example, laying local pipeline from spokes to hub, based on learning from Pilot Project experience with Kern County PVC share with other Counties
  - Pipeline interconnection – work with CPUC and IOUs to potentially streamline the CPUC’s AB 1900 pipeline specifications for injecting dairy biogas into the pipeline. Ensure grant funding, and economic and rapid pipeline interconnection
  - BioMAT Integration

**X. Additional Information**

**1) Letters of Support**

- Air District
- Kern County, Planning and Community Development Department
- California Dairies Inc. (CDI)

**2) Team Overview**

The Pilot Project team is in development. The following are organizations and companies CalBio is working with. It will grow and change.

- A. Advisory Partner: CALSTART

- B. Dairy industry support – Agricultural Energy Consumers Association, Milk Producers Council, CDI, milk truckers
- C. Environmental group involvement: EDF and others
- D. Academic involvement: information
- E. Bioenergy and fuel industry support: Bioenergy Association of California
- F. Engineering Firms
  - Black and Veatch – help over see technology selection, RFP development and evaluation
  - 4 Creeks – Central Valley firm overseeing permitting, lower-pressure pipeline, and integration with dairies
- G. Technology Companies
  - Biogas upgrade: Greenlane, BioCNG, SoCal tariff and others
  - Fuel Station: Clean Energy, ampCNG, and others
  - The many other companies that work closely with CalBio in building the digesters and supplying and operate low NOx engines
- H. Utilities – SoCal and PG&E

### **3) Other Projects at the Cluster**

The Cluster is center for learning. Additional areas currently or planned for study include:

- Use of waste heat from electrical engines to cool milk
- Impact of digestion on manure water – improved ability to land apply/enter irrigation system
- Increased form of absorbable nitrogen – decrease risk of ground water impacts. Potential soil enhancement and fertilizer products
- NOx impacts and center for testing low NOX systems
- Testing fuel cells and other low-NOx systems for future applications.