DAIRY DIGESTER RESEARCH AND DEVELOPMENT PROGRAM

REPORT OF FUNDED PROJECTS (2015-2017)

February 2018

cdfa

Contents

Executive Summary

The California Department of Food and Agriculture's (CDFA) Dairy Digester Research and Development Program (DDRDP) awards competitive grants to implement dairy digesters that result in long-term methane emission reductions on California dairies and minimize or mitigate adverse environmental impacts.

The Budget Act of 2017-18 (Item 8570-101-3228) required CDFA to provide ongoing updates on the Department's DDRDP projects in January of each year beginning in 2018 and continuing through 2027. The department is required to provide status updates on the implementation of each dairy digester project that was awarded funding in 2014-15 through 2016-17. This legislative mandate is designed to evaluate the efficiency and cost-effectiveness of strategies to reduced emission of short-lived climate pollutants including methane greenhouse gas from dairy operations. The Budget Act of 2017-18 also required an additional report, which will include details on CDFA's recent funding awards to Alternative Manure Management Program projects. That report is due no later than July 1, 2018.

CDFA was appropriated $12 million in the Budget Act of 2014 to fund dairy digesters, of which $11.1 was awarded to fund six projects in 2015 through the DDRDP competitive grant process. CDFA received an additional $50 million from the Greenhouse Gas Reduction Fund (GGRF), authorized by the Budget Act of 2016, to fund dairy digesters as well as non-digester practices for methane reduction on California's dairy and livestock operations. $35.3 million of this allocation was awarded to dairy digester projects in 2017. The remaining funds were used for the Alternative Manure Management Program (AMMP). AMMP provides dairy and livestock operations financial assistance for the implementation of non-digester manure management practices in California. The Budget Act of 2017 allocated another $99 million to CDFA to support dairy and livestock methane reduction projects.

CDFA has funded a total of $46.4 million for dairy digester projects. These projects, collectively, have an estimated greenhouse gas (GHG) reduction of 5.7 million metric tonnes of carbon dioxide equivalents ($MTCO_2e$) over ten years. All funded projects in 2015 are currently operational. All funded projects in 2017 are in progress and currently under construction.

I. Program Background and Award Selection Process

Methane is a potent greenhouse gas that has a global warming potential 25 times that of carbon dioxide. It is also a Short-lived Climate Pollutant; climate gases that remain in the atmosphere for a much shorter period of time than longer lived climate pollutants such as carbon dioxide. In California agriculture, methane is primarily emitted from manure lagoons on dairy operations. CDFA's DDRDP provides financial assistance for the installation of dairy digesters in California to reduce quantifiable greenhouse gas emissions including methane.

CDFA was appropriated $12 million in the Budget Act of 2014 to fund dairy digesters, of which $11.1 were awarded to fund six projects in 2015 through the DDRDP competitive grant process. CDFA received $50 million from the Greenhouse Gas Reduction Fund (GGRF), authorized by the Budget Act of 2016, to fund dairy digesters as well as non-digester practices for methane reduction on California's dairy and livestock operations. $35.3 million of this allocation was awarded to dairy digester projects in 2017. The Budget Act of 2017 allocated $99 million to CDFA to support dairy and livestock methane reduction projects. A summary of funds allocated to the DDRDP are provided in Table 1.

Table 1. Summary of CDFA DDRDP funding to date

Year	Dollar Allocation (millions)	DDRDP Grant Funds Awarded (millions)			Administrative Cost (millions)
		Dairy Digesters	Dairy Digester Research	Non-digester Practices (Alternative Manure Management Program)	
2014-15	$12	$11.09	$0.2	Not applicable	$0.68
2016-17	$50	$35.25	Not applicable	$9.64	$5
2017-18	$99	$61-75*	Not applicable	$19-33**	$4.9
*Currently accepting applications.					
**Request for Grant Applications release anticipated March 2018					

CDFA has funded a total of $46.4 million to dairy digester projects, with $107.7 million provided in matching funds by grant awardees. These projects collectively have an estimated greenhouse gas (GHG) reduction of 5.7 million metric tonnes of carbon dioxide equivalents ($MTCO_2e$) over ten years. Agriculture accounts for 8 percent of total California GHG emissions. These projects together result in an annual 1.7 percent reduction. Specifically from manure management emissions, which constitute 2.7 percent of California's total GHG emissions, this represents a 5 percent share (Figure 1).

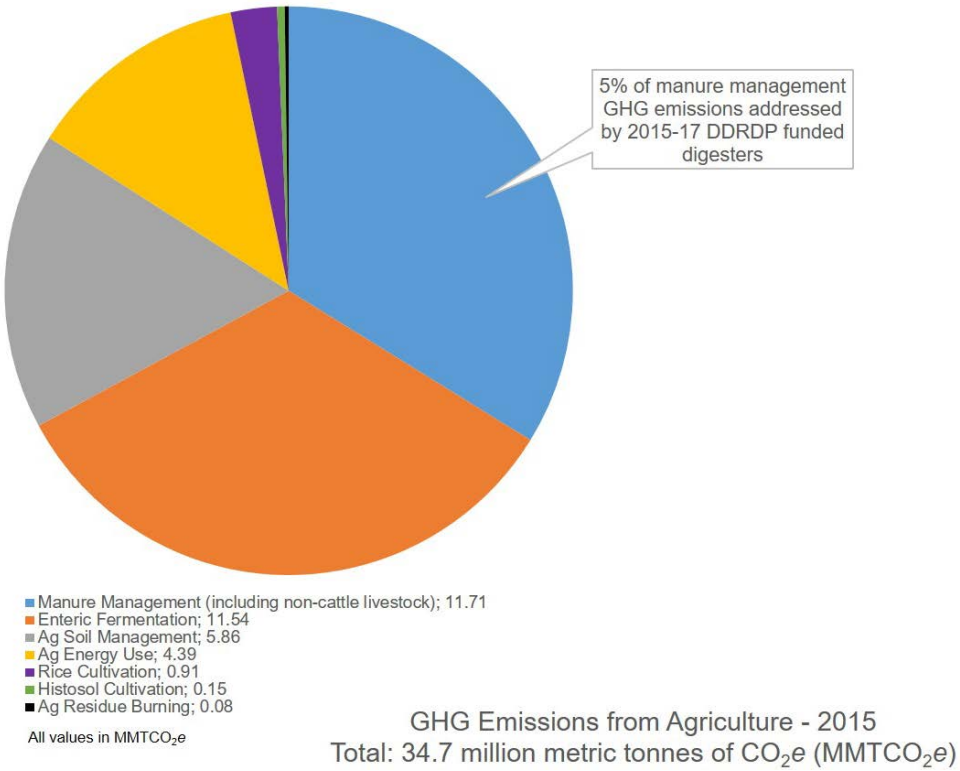

Figure 1. GHG emissions from Manure Management as a proportion of total Agriculture Sector GHG emissions inventory (8 percent or 34.7 $MMTCO_2e$) in California in 2015.

All funded projects since 2016-17 must comply with SB 859 (2016) which requires the Department, prior to awarding grant funds from moneys from the Greenhouse Gas Reduction Fund, to review the applicant's analysis identifying potential adverse impacts of a proposed project. The requirements specified in the bill prohibits a project from receiving funding from the department unless the applicant has conducted outreach in areas that will potentially be adversely impacted by the project, determined potential adverse impacts of the projects, and committed to measures to mitigate impacts. The bill requires the department to prioritize projects based on the criteria pollutant emission benefits achieved by the project.

A. Eligibility and Application Process

Under the DDRDP, CDFA funds up to 50 percent of the total project cost with a maximum grant award up to $3 million per project. Funded projects are required to be completed within 2 years of the execution of the grant agreement. To be eligible for funding, the project site must be located on a commercial California dairy operation. A group of dairy operations can submit one grant application to develop centralized dairy digesters and

gas clean up facilities, known as a “cluster” or “hub and spoke” project. Defunct digesters that were constructed in the past and have become entirely non-functional for a minimum of 12 months due to technical or other issues are also considered eligible for funding through the DDRDP. However, CDFA does not fund upgrades to existing functional dairy digesters to boost emission reductions and energy production. Additionally, projects that propose to switch existing management practices on the dairy operation to those that increase baseline greenhouse gas (GHG) emissions are not eligible for DDRDP funding.

Applicants are required to use the quantification methodology and its associated calculator tool developed by the California Air Resources Board (CARB) for the DDRDP to calculate estimated GHG reductions achievable from projects. The quantification methodology and calculator are available on CARB’s website at www.arb.ca.gov/cci-quantification. Any project benefits provided to disadvantaged and/or low-income communities are determined using the methodology developed by the CARB as provided in the Funding Guidelines for Administering Agencies.

Funded projects must demonstrate protection of water and air quality. The design and construction of digester vessels (*i.e.*, ponds and tanks) under this program must be demonstrated to be protective of surface and ground water quality. To meet the DDRDP water quality requirements, one of the following is required: double–lined ponds consistent with the Tier 1 specification of the Dairy General Order (R52013-0122) of the Central Valley Regional Water Quality Control Board, above-ground concrete tank, or below-grade concrete lined tank. The digester system design, construction, and operation must minimize emission of air pollutants. For power production projects, the total NOx (mono-nitrogen oxides) emissions must be no greater than 0.50 lb/MW-hr. These represent the most stringent water and air quality protection standards across the State, and must be met by a project regardless of its location in California. Funded projects must use commercially-available technologies to produce or capture methane for energy production or transportation fuel.

CDFA utilizes the State Water Resources Control Board’s electronic application system, the Financial Assistance Application Submittal Tool (FAAST) for the DDRDP application process

B. Review Process

CDFA conducts three levels of review during the grant submission and review process. The first is an administrative review to determine if all grant application requirements are met. The second is a comprehensive financial review to evaluate the merits of the grant applications based on the scoring criteria. The third is a technical review by subject matter experts and the Technical Advisory Committee (TAC). The TAC is a sub-committee of the California-Federal Dairy Digester Working Group. The Scoring Criteria for the review process is listed in Table 2. The TAC is further assisted in the review process through the following:

(i) The evaluation of the GHG emission reductions calculations and technical soundness of project by academic experts associated with California

universities (University of California and California State University systems), and,

(ii) The review of financial information submitted with the grant application by CDFA's Audit Office.

Table 2. CDFA DDRDP Scoring Criteria for Project Selection.

Criteria	Points
Digester Project Plan and Long-term Viability	20
Budget Work Sheet and Financials	10
Estimated Greenhouse Gas Emissions Reduction	35
Project Readiness	10
Environmental Performance	15
Community Impact	10
Total	**100**

II. CDFA Public Outreach for DDRDP

The development of the DDRDP framework and grant solicitation (Request for Grant Applications) involves a stakeholder and public engagement process. Additionally, during the application period, CDFA provides application assistance workshops as well as assistance to conduct community outreach about their projects. Community outreach assistance is provided through a collaboration with University of California, Davis Extension, Collaboration Center. A summary of these workshops is provided in Table 3.

Table 3. Summary of CDFA DDRDP Outreach.

Program Development Outreach Public Meetings			
Meeting	**Date**	**Location**	**Number of Attendees**
2015 Digester Grant Development - Stakeholder input	11/6/2014	Modesto	12
2015 Digester Grant Development - Stakeholder input	11/10/2014	Tulare	7
2015 Digester Grant Development - Stakeholder input	11/13/2014	Sacramento	14
2015 Digester Research Development - Stakeholder input	3/4/2015	Sacramento	0
2016 Environmental Justice Listening Session	11/9/2016	Tulare	9
2017 Digester Grant Development - Stakeholder Input	11/17/2016	Clovis	23
2017 Digester Grant Development - Stakeholder Input	11/21/2016	Sacramento	13
2017 Digester Grant Development - Stakeholder Input	11/22/2016	Modesto	10
2017 Digester Grant Development - Stakeholder Input	11/30/2016	Webinar	40
2017 Digester Grant Development - Stakeholder Input on Draft Solicitation	2/6/2017	Webinar	42
Application Assistance Outreach Public Meetings			
Meeting	**Date**	**Location**	**Number of Attendees**
2015 Digester Grant - Application workshop	1/21/2015	Tulare	13
2015 Digester Grant - Application workshop	1/27/2015	Webinar	26

2015 Digester Grant - Application workshop	1/28/2015	Sacramento	12
2015 Digester Research - Application Workshop	4/23/2015	Webinar	8
2017 Digester Grant - Application Workshop	5/12/2017	Sacramento	15
2017 Digester Grant - Application Workshop	5/15/2017	Tulare	20
2017 Digester Grant - Application Workshop	5/16/2017	Webinar	22
2017 Digester Grant – Community Outreach Assistance through UC Davis	May 2017	One-on-one Assistance and Consultation	9

III. Projects Funded by the CDFA DDRDP

A summary of the 24 projects funded to date by the CDFA DDRDP is provided in Table 4. The collective GHG reductions estimated from the 24 projects is 5.7 million $MTCO_2e$ over 10 years, and the approximate cost to achieve one $MTCO_2e$ (10-year) reduction is $27.12. Of this cost, the share of the GGRF monies (i.e., the CDFA grant) is approximately $8.16 or 30 percent, and the remainder is achieved through matching funds provided by the grant recipient. A map showing the locations of the funded projects can be found in Image 1. As evident from Image 1, funded projects are primarily located in the Central Valley which is home to a large number of dairy operations in the state. The Cost Effectiveness Summary of the DDRDP is presented in Table 5.

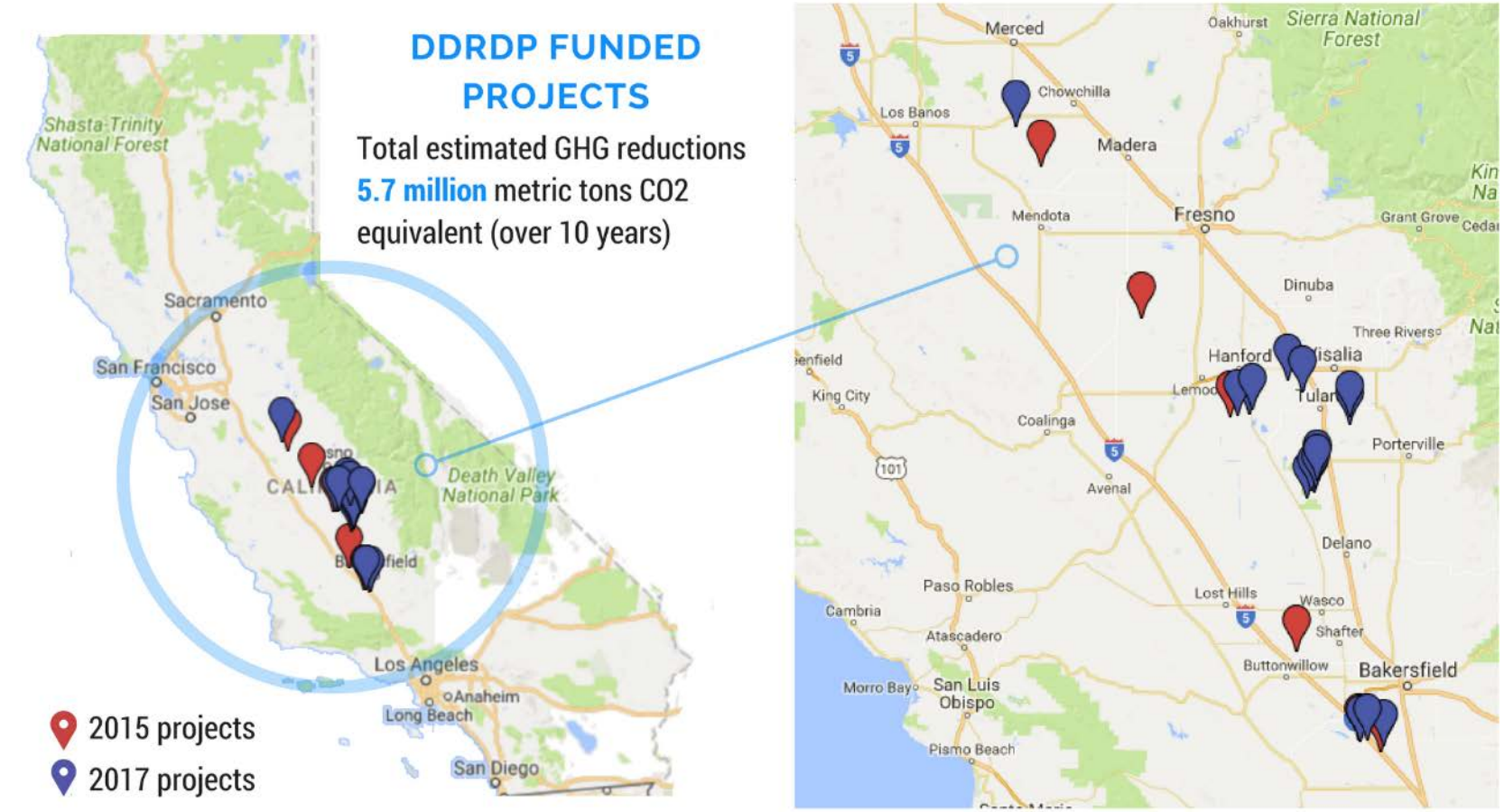

Image 1: Geographical Distribution of CDFA funded Dairy Digesters in California.

Table 4. Summary of Dairy Digester Projects Funded by CDFA.

Year Awarded	Applicant Organization	Project Title	Submitting Organization	Project Location	Cluster	Project Type	Biogas End-Use	Estimated 10 year GHG reductions ($MTCO_2e$)*	Grant Funds	Matching Funds	Total Project Cost	Status
2015	Philip Verwey Farms	Verwey-Hanford Dairy Digester	Maas Energy Works	Hanford, Kings Co.	NA	New covered lagoon digester	Electrical power generation	535,770	$3,000,000	$3,179,861	$6,179,861	Completed
2015	Open Sky Ranch Inc.	Open Sky Ranch Dairy Digester	Maas Energy Works	Riverdale, Fresno Co.	NA	Retrofit covered lagoon digester	Electrical power generation	258,911	$973,430	$973,434	$1,946,864	Completed
2015	Philip Verwey Farms	Verwey-Madera Dairy Digester	Maas Energy Works	Madera, Madera Co.	NA	New covered lagoon digester	Electrical power generation	240,000	$2,281,091	$2,282,754	$4,563,845	Completed
2015	ABEC #2 LLC dba West-Star North Dairy Biogas	West-Star North Dairy Digester	California Bioenergy, LLC	Buttonwillow, Kern Co.	NA	New covered lagoon digester	Electrical power generation	158,700	$1,837,005	$7,165,995	$9,000,000	Completed
2015	ABEC #3 LLC, dba Lakeview Farms Dairy Biogas	Lakeview Dairy Biogas Digester	California Bioenergy LLC	Bakersfield, Kern Co.	NA	New covered lagoon digester	Electrical power generation and RCNG	144,090	$2,000,000	$6,500,000	$8,500,000	Completed
2015	ABEC #4 LLC, dba Carlos Echeverria & Sons Dairy Biogas	Carlos Echeverria & Sons Dairy Biogas Project	California Bioenergy, LLC	Bakersfield, Kern Co.	NA	New covered lagoon digester	Combined heat and electrical power generation	201,200	$1,000,000	$7,969,700	$8,969,700	Completed
2017	Wreden Ranch Dairy Biogas	Wreden Ranch Dairy Biogas	California Bioenergy, LLC	Hanford, Kings Co.	Hanford Cluster	New covered lagoon digester	RCNG**	393,915	$3,000,000	$4,735,860	$7,735,860	In Progress
2017	Trilogy Dairy Biogas	Trilogy Dairy Biogas	California Bioenergy, LLC	Bakersfield, Kern Co.	Kern Dairy Cluster	New covered lagoon digester	RCNG	254,577	$2,250,000	$4,200,840	$6,450,840	In Progress
2017	Cloverdale Dairy Biogas	Cloverdale Dairy Biogas	California Bioenergy, LLC	Hanford, Kings Co.	Hanford Cluster	New covered lagoon digester	RCNG	360,851	$3,000,000	$4,836,793	$7,836,793	In Progress
2017	T & W Dairy Biogas	T & W Dairy Biogas	California Bioenergy, LLC	Bakersfield, Kern Co.	Kern Dairy Cluster	New covered lagoon digester	RCNG	294,982	$ 2,600,000	$ 4,695,759	$7,295,759	In Progress

2017	Aligned Digester Cooperative LLC	Red Top Madera Dairy Digester Project	Aligned Digester Cooperative LLC	Chowchilla, Madera Co.	NA	New covered lagoon digester	RCNG	282,475	$3,000,000	$3,046,875	$6,046,875	In Progress
2017	Calgren Dairy Fuels LLC	Williams Family Dairy Digester Fuel Pipeline	Maas Energy Works Inc	Pixley, Tulare Co.	Calgren cluster	New covered lagoon digester	Combustion in Cogeneration Turbines (ethanol); potential RCNG in future.	201,208	$1,500,000	$2,524,659	$4,024,659	In Progress
2017	Calgren Dairy Fuels LLC	K&M Visser Dairy Digester Fuel Pipeline Project	Maas Energy Works Inc	Pixley, Tulare Co.	Calgren cluster	New covered lagoon digester	Combustion in Cogeneration Turbines (ethanol); potential RCNG in future.	203,416	$1,500,000	$1,793,975	$3,293,975	In Progress
2017	Maple Dairy Biogas	Maple Dairy Biogas	California Bioenergy, LLC	Bakersfield, Kern Co.	Kern Dairy Cluster	New covered lagoon digester	RCNG	348,171	$3,000,000	$5,331,773	$8,331,773	In Progress
2017	S&S Dairy Biogas	S&S Dairy Biogas	California Bioenergy, LLC	Visalia, Tulare Co.	West Visalia Cluster	New covered lagoon digester	RCNG	167,417	$1,600,000	$5,087,926	$6,687,926	In Progress
2017	Calgren Dairy Fuels LLC	Pixley Dairy Digester Fuel Pipeline Project	Maas Energy Works Inc	Pixley, Tulare Co.	Calgren cluster	New covered lagoon digester	Combustion in Cogeneration Turbines (ethanol); potential RCNG in future.	212,622	$1,600,000	$1,847,237	$3,447,237	In Progress
2017	Calgren Dairy Fuels LLC	Legacy Dairy Digester Fuel Pipeline	Maas Energy Works Inc	Pixley, Tulare Co.	Calgren cluster	New covered lagoon digester	Combustion in Cogeneration Turbines (ethanol); potential RCNG in future.	207,209	$1,550,000	$1,731,327	$3,281,327	In Progress
2017	Moonlight Dairy Biogas	Moonlight Dairy Biogas	California Bioenergy, LLC	Visalia, Tulare Co.	West Visalia Cluster	New covered lagoon digester	RCNG	154,834	$1,500,000	$4,855,146	$6,355,146	In Progress
2017	Calgren Dairy Fuels LLC	R Vander Eyk Dairy Digester Fuel Pipeline Project	Maas Energy Works Inc	Pixley, Tulare Co.	Calgren cluster	New covered lagoon digester	Combustion in Cogeneration Turbines (ethanol); potential RCNG in future.	132,586	$1,000,000	$1,498,381	$2,498,381	In Progress

2017	Calgren Dairy Fuels LLC	Circle A Dairy Digester Fuel Pipeline Project	Maas Energy Works Inc	Pixley, Tulare Co.	Calgren cluster	New covered lagoon digester	Combustion in Cogeneration Turbines (ethanol); potential RCNG in future.	138,745	$1,050,000	$1,301,228	$2,351,228	In Progress
2017	Bos Farms Dairy Biogas	Bos Farms Dairy Biogas	California Bioenergy	Tulare, Tulare Co.	East Tulare Cluster	New covered lagoon digester	RCNG	168,398	$1,500,000	$11,334,030	$12,834,030	In Progress
2017	Hamstra Dairy Biogas	Hamstra Dairy Biogas	California Bioenergy	Tulare, Tulare Co.	West Visalia Cluster	New covered lagoon digester	RCNG	205,115	$2,000,000	$4,580,840	$6,580,840	In Progress
2017	Hollandia Farms Dairy Biogas	Hollandia Farms Dairy Biogas	California Bioenergy	Hanford, Kings Co.	Hanford Cluster	New covered lagoon digester	RCNG	178,426	$1,500,000	$5,816,291	$7,316,291	In Progress
2017	Rancho Teresita Dairy Biogas	Rancho Teresita Dairy Biogas	California Bioenergy	Tulare, Tulare Co.	East Tulare Cluster	New covered lagoon digester	RCNG	236,251	$2,100,000	$10,400,558	$12,500,558	In Progress
Totals									**$46,341,526**	**$107,688,242**	**$154,029,768**	

*Estimated reductions calculated using the CARB Quantification Methodology and calculator tool. $MTCO_2e$: Metric tonnes of carbon dioxide equivalent.

**RCNG: Renewable Compressed Natural Gas

Table 5. Cost Effectiveness Summary of Dairy Digester Projects Funded by CDFA.

Year Awarded	Project Title	Total cost of 1 $MTCO_2e$ GHG reduction ($)	GGRF cost of 1 $MTCO_2e$ GHG reduction ($)	percent of 1 $MTCO_2e$ GHG reduction cost supported cost by GGRF
2015	Verwey-Hanford Dairy Digester	11.53	5.60	49
2015	Open Sky Ranch Dairy Digester	7.52	3.76	50
2015	Verwey-Madera Dairy Digester	19.02	9.50	50
2015	West-Star North Dairy Digester	56.71	11.58	20
2015	Lakeview Dairy Biogas Digester	58.99	13.88	24
2015	Carlos Echeverria & Sons Dairy Biogas Project	44.58	4.97	11
2017	Wreden Ranch Dairy Biogas	19.64	7.62	39
2017	Trilogy Dairy Biogas	25.34	8.84	35
2017	Cloverdale Dairy Biogas	21.72	8.31	38
2017	T & W Dairy Biogas	24.73	8.81	36
2017	Red Top Madera Dairy Digester Project	21.41	10.62	50
2017	Williams Family Dairy Digester Fuel Pipeline	20.00	7.45	37
2017	K&M Visser Dairy Digester Fuel Pipeline Project	16.19	7.37	46
2017	Maple Dairy Biogas	23.93	8.62	36
2017	S&S Dairy Biogas	39.95	9.56	24
2017	Pixley Dairy Digester Fuel Pipeline Project	16.21	7.53	46
2017	Legacy Dairy Digester Fuel Pipeline	15.84	7.48	47
2017	Moonlight Dairy Biogas	41.04	9.69	24
2017	R Vander Eyk Dairy Digester Fuel Pipeline Project	18.84	7.54	40
2017	Circle A Dairy Digester Fuel Pipeline Project	16.95	7.57	45
2017	Bos Farms Dairy Biogas	76.21	8.91	12
2017	Hamstra Dairy Biogas	32.08	9.75	30
2017	Hollandia Farms Dairy Biogas	41.00	8.41	21
2017	Rancho Teresita Dairy Biogas	52.91	8.89	17

IV. Individual Project Information

Information on individual projects funded through the CDFA DDRDP from 2014-2017.

Verwey-Hanford Dairy Digester
Funded: 2015
Completed: 2017
Status: Operational

The Verwey-Hanford Dairy Digester project is a new covered lagoon digester at Philip Verwey Farms #2 dairy. The biogas from the digester will be used to produce approximately 7.6 million kWh of renewable electricity per year.

- Location – Hanford, California (Kings County)
- CDFA DDRDP Funding - $3,000,000
- Matching funds - $3,179,861
- Total Project costs - $ 6,179,861
- Estimated 10-year GHG reductions - 535,770 $MTCO_2e$.
- GHG reductions per CDFA grant dollar - 0.18 $MTCO_2e$
- GHG reductions per total project dollars - 0.09 $MTCO_2e$
- Total cost per $MTCO_2e$ - $11.54

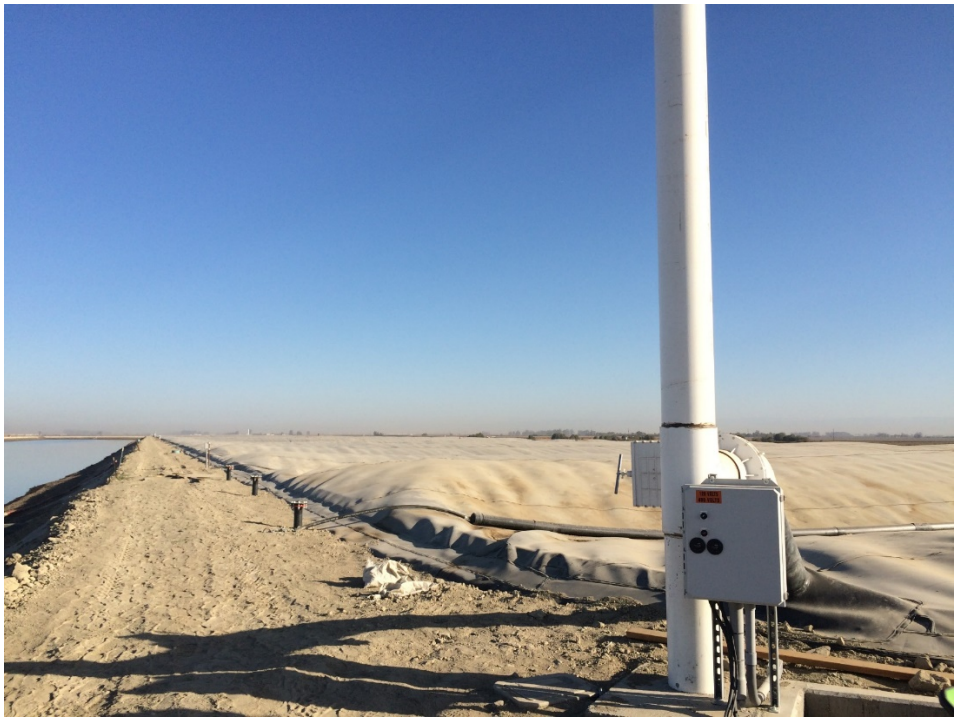

Image: View of the covered lagoon digester at Verwey-Hanford Dairy (Source: CDFA).

Image: Aerial view of the Verwey-Hanford Dairy Digester (Source: CDFA)

Open Sky Ranch Dairy Digester
Funded: 2015
Completed: 2016
Status: Operational

The Open Sky Ranch Dairy Digester project recommissioned a defunct covered lagoon digester at Open Sky Ranch. The biogas from the digester will be used to produce approximately 6.4 million kWh of renewable electricity per year.

- Location – Riverdale, California (Fresno County)
- CDFA DDRDP Funding - $973,430
- Matching funds - $973,434
- Total Projects costs - $1,946,864
- Estimated 10-year GHG reductions - 258,911 $MTCO_2e$
- GHG reductions per CDFA grant dollars – 0.27 $MTCO_2e$
- GHG reductions per total projects dollars 0.13 $MTCO_2e$
- Total cost per $MTCO_2e$ - *$7.52*

Image 2: A view of the Open Sky Ranch Dairy digester.

Verwey-Madera Dairy Digester
Funded: 2015
Completed: 2017
Status: Operational

The Verwey-Madera Dairy Digester project is a new covered lagoon digester to be installed at Philip Verwey Farms #1. The biogas from the digester will be used to produce approximately 4.8 million kWh renewable electricity per year.

- Location – Madera, California (Madera County)
- CDFA DDRDP Funding - $2,281,091
- Matching funds - $2,282,754
- Total Project costs - $4,563,845
- Estimated 10-year GHG reductions - 240,000 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.11 $MTCO_2e$
- GHG reductions per total project dollars - 0.05 $MTCO_2e$
- Total cost per $MTCO_2e$ - $19.02

Image 5. Covered lagoon digester at Verwey-Madera Dairy.

Image 6. Installed electrical genset at Verwey-Madera Dairy.

West-Star North Dairy Digester
Funded: 2015
Completed: January 2018
Status: Operational

The West-Star North Dairy digester is a covered lagoon digester project. This project will capture biogas from two covered lagoons at the dairy. Biogas from the digester will produce 7.6 million kWh renewable electricity per year.

- Location – Buttonwillow, California (Kern County)
- CDFA DDRDP Funding - $1,837,005
- Matching funds - $7,165,995
- Total Project costs - $9,000,000
- Estimated 10-year GHG reductions - 158,370 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.09 $MTCO_2e$

- GHG reductions per total project dollars - 0.02 $MTCO_2e$
- Total cost per $MTCO_2e$ - $56.71

Image 6. Aerial view of West-Star North Dairy Digester

Lakeview Dairy Biogas Digester
Funded: 2015
Completed: January 2018
Status: Operational

Lakeview Dairy Biogas Digester is a covered lagoon digester system. The biogas generated by this project will generate 6.7 million kWh of electricity per day.

- Location – Bakersfield, California (Kern County)
- CDFA DDRDP Funding - $2,000,000
- Matching funds - $6,500,000
- Total Project costs - $8,500,000
- Estimated 10-year GHG reductions - 144,090 $MTCO_2e$
- GHG reductions per grant dollar - 0.07 $MTCO_2e$
- GHG reductions per total project dollars - 0.02 $MTCO_2e$
- Total cost per $MTCO_2e$ - $13.88

Carlos Echeverria & Sons Dairy Biogas Project
Funded: 2015
Completed: January 2018
Status: Operational

ABEC #4 LLC dba Carlos Echeverria & Sons Dairy Biogas is a new covered lagoon dairy digester system and a biogas-fueled combined heat and power (CHP). An estimated of 7.6 million kWh of renewable electricity per year.

- Location – Bakersfield, California (Kern County)
- CDFA DDRDP Funding - $1,000,000
- Matching funds - $7,969,700
- Total Project costs - $8,969,700
- Estimated 10-year GHG reductions - 201,200 $MTCO_2e$
- GHG reductions per CDFA grant dollars - 0.2 $MTCO_2e$
- GHG reductions per total project dollars - 0.02 $MTCO_2e$
- Total cost per $MTCO_2e$ - $44.58

Wreden Ranch Dairy Biogas
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

Wreden Ranch will build a covered lagoon digester with enhanced gas storage, gas pre-treatment and effluent distribution. The project will add sand lane and screens for pre-digester solid separation. Biogas will be conditioned to meet the SoCalGas standards for natural gas fuel, and will be used for vehicle fuel use.

- Location – Hanford, California (Kings County)
- CDFA DDRDP Funding - $3,000,000
- Matching funds – $4,735,860
- Total Project costs - $7,735,860
- Estimated 10-year GHG reductions - 393,915 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.13 $MTCO_2e$
- GHG reductions per total project dollars - 0.05 $MTCO_2e$
- Total cost per $MTCO_2e$ - $19.64

Trilogy Dairy Biogas
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

Trilogy Dairy will build a covered lagoon digester with enhanced gas storage, gas pre-treatment and effluent distribution. Biogas will be conditioned to meet the SoCalGas standards for natural gas fuel and will be used for vehicle fuel use.

- Location – Bakersfield, California (Kern County)
- CDFA DDRDP Funding - $2,250,000
- Matching funds - $4,200,840
- Total Project costs - $6,450,840
- Estimated 10-year GHG reductions - 254,577 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.11 $MTCO_2e$
- GHG reductions per total project dollars - 0.04 $MTCO_2e$
- Total cost per $MTCO_2e$ - $25.34

Cloverdale Dairy Biogas
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

Cloverdale Dairy will build a covered lagoon digester with enhanced gas storage, gas pre-treatment and effluent distribution. The project will add sand lane and screens for pre-digester solid separation. Biogas will be conditioned to meet the SoCalGas standards for natural gas fuel and will be used for vehicle fuel use.

- Location – Hanford, California (Kings County)
- CDFA DDRDP Funding - $3,000,000
- Matching funds - $4,836,793
- Total Project costs - $7,836,793
- Estimated 10-year GHG reductions - 360,851 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.12 $MTCO_2e$
- GHG reductions per total project dollars - 0.05 $MTCO_2e$
- Total cost per $MTCO_2e$ - $21.72

T&W Dairy Biogas
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

T & W Farms will build a covered lagoon digester with enhanced gas storage, gas pre-treatment and effluent distribution. The project will add sand lane and screens for pre-digester solid separation. Biogas will be conditioned to meet the SoCalGas standards for natural gas fuel and will be used for vehicle fuel use.

- Location – Bakersfield, California (Kern County)
- CDFA DDRDP Funding – 2,600,000
- Matching funds - $4,695,759
- Total Project costs - $7,295,759
- Estimated 10-year GHG reductions - 294,892 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.11 $MTCO_2e$
- GHG reductions per total project dollars - 0.04 $MTCO_2e$
- Total cost per $MTCO_2e$ - $24.73

Aligned Digester Cooperative LLC
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

Aligned Digester Co., LLC (dba Aligned Digester Cooperative LLC) has partnered with Red Top Jerseys Dairy to develop a covered lagoon digester that will produce up to 63,000 MMBtu of renewable natural gas (RNG) to expand the market for near-zero emission natural gas vehicles in the San Joaquin Valley. The resulting gas will be further cleaned to produce biomethane for the vehicle fuel market. The RNG will be compressed and sold to compressed natural gas fueling stations for local use.

- Location – Chowchilla, California (Madera County)
- CDFA DDRDP Funding – $3,000,000
- Matching funds - $3,046,875
- Total Project costs - $6,046,875
- Estimated 10-year GHG reductions - 282,475 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.09 $MTCO_2e$
- GHG reductions per total project dollars - 0.05 $MTCO_2e$
- Total cost per $MTCO_2e$ - $21.41

Williams Family Dairy Digester Fuel Pipeline
(Calgren Dairy Fuels LLC)
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

The Williams Family Dairy Digester Fuel Pipeline Project is a covered lagoon anaerobic digester. The project is part of the Calgren Dairy Fuels Cluster. The biogas from the digester will be supplied via private pipeline to fuel two 5MW gas turbines that power the Calgren ethanol refinery. The cluster will install a RCNG station and later connect to the utility pipeline to supply more RCNG stations.

- Location – Pixley, California (Tulare County)
- CDFA DDRDP Funding - $1,500,000
- Matching funds - $2,524,659
- Total Project costs - $4,024,659
- Estimated 10-year GHG reductions - 201,208 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.13 $MTCO_2e$
- GHG reductions per total project dollars - 0.05 $MTCO_2e$
- Total cost per $MTCO_2e$ - $20

K&M Visser Dairy (Calgren Dairy Fuels LLC)
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

The K&M Visser Dairy Digester Fuel Pipeline Project is a covered lagoon anaerobic digester. The project is part of the Calgren Dairy Fuels Cluster. The biogas from the digester will be supplied via private pipeline to fuel two 5MW gas turbines that power the Calgren ethanol refinery. The cluster will install a RCNG station and later connect to the utility pipeline to supply more RCNG stations.

- Location – Pixley, California (Tulare County)
- CDFA DDRDP Funding - $1,500,000
- Matching funds - $1,793,975
- Total Project costs - $3,293,975
- Estimated 10-year GHG reductions - 203,416 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.14 $MTCO_2e$
- GHG reductions per total dollars - 0.06 $MTCO_2e$
- Total cost per $MTCO_2e$ - $16.19

Maple Dairy Biogas
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

Maple Dairy will build a covered lagoon digester with enhanced gas storage, gas pre-treatment and effluent distribution. The project will add pre-digester sand lane and screens for solid separation pre-digester. Biogas will be conditioned to meet the SoCalGas standards for natural gas fuel, and will be used for vehicle fuel use. A 1MW generator has been permitted for with an emissions mitigation plan in the event an alternate methane destruction device is required.

- Location – Bakersfield, California (Kern County)
- CDFA DDRDP Funding - $3,000,000
- Matching funds – $5,331,773
- Total Project costs - $8,331,773
- Estimated 10-year GHG reductions - 348,171 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.12 $MTCO_2e$
- GHG reductions per total project dollars - 0.04 $MTCO_2e$
- Total cost per $MTCO_2e$ - $23.93

S&S Dairy Biogas
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

S&S Dairy will build a covered lagoon with enhanced gas storage, gas pre-treatment and effluent distribution. The project will add sand lane and screens for pre-digester solid separation. Biogas will be conditioned to meet the SoCalGas standards for natural gas fuel, and will be used for vehicle fuel use. A 1MW generator has been permitted for with an emissions mitigation plan in the event an alternate methane destruction device is required.

- Location – Visalia, California (Tulare County)
- CDFA DDRDP Funding – $1,600,000
- Matching funds - $5,087,926
- Total Project costs - $6,687,926
- Estimated 10-year GHG reductions - 167,417 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.1 $MTCO_2e$
- GHG reductions per total project dollars - 0.03 $MTCO_2e$
- Total cost per $MTCO_2e$ - $39.94

Pixley Dairy (Calgren Dairy Fuels LLC)
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

The Pixley Dairy Digester Fuel Pipeline Project is a covered lagoon anaerobic digester. The project is part of the Calgren Dairy Fuels Cluster. The biogas from the digester will be supplied via private pipeline to fuel two 5MW gas turbines that power the Calgren ethanol refinery. The cluster will install a RCNG station and later connect to the utility pipeline to supply more RCNG stations.

- Location – Pixley, California (Tulare County)
- CDFA DDRDP Funding - $1,600,000
- Matching funds - $1,847,237
- Total Project costs - $3,447,237
- Estimated 10-year GHG reductions - 212,622 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.13 $MTCO_2e$
- GHG reductions per total project dollars - 0.06 $MTCO_2e$
- Total cost per $MTCO_2e$ - $16.21

Legacy Dairy (Calgren Dairy Fuels LLC)
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

The Legacy Dairy Digester Fuel Pipeline Project is a covered lagoon anaerobic digester. The project is part of the Calgren Dairy Fuels Cluster. The biogas from the digester will be supplied via private pipeline to fuel two 5MW gas turbines that power the Calgren ethanol refinery. The cluster will install a RCNG station and later connect to the utility pipeline to supply more RCNG stations.

- Location – Pixley, California (Tulare County)
- CDFA DDRDP Funding - $1,550,000
- Matching funds - $1,731,327
- Total Project costs - $3,281,327
- Estimated 10-year GHG reductions - 207,209 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.13 $MTCO_2e$
- GHG reductions per total project dollars - 0.06 $MTCO_2e$
- Total cost per $MTCO_2e$ - $15.84

Moonlight Dairy Biogas
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

Moonlight Dairy will build a covered lagoon digester with enhanced gas storage, gas pre-treatment and effluent distribution. The project will add sand lane and screens for pre-digester solid separation. Biogas will be conditioned to meet the SoCalGas standards for natural gas fuel, and will be used for vehicle fuel use. A 1MW generator has been permitted for with an emissions mitigation plan in the event an alternate methane destruction device is required.

- Location – Visalia, California (Tulare County)
- CDFA DDRDP Funding - $1,500,000
- Matching funds - $4,855,146
- Total Projects costs - $6,355,146
- Estimated 10-year GHG reductions - 154,834 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.1 $MTCO_2e$
- GHG reductions per total project dollars - 0.02 $MTCO_2e$
- Total cost per $MTCO_2e$ - $41.05

R Vander Eyk Dairy (Calgren Dairy Fuels LLC)
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

The Robert Vander Eyk Dairy Digester Fuel Pipeline Project is a covered lagoon anaerobic digester. The project is part of the Calgren Dairy Fuels Cluster. The biogas from the digester will be supplied via private pipeline to fuel two 5MW gas turbines that power the Calgren ethanol refinery. The cluster will install a RCNG station and later connect to the utility pipeline to supply more RCNG stations.

- Location – Pixley, California (Tulare County)
- CDFA DDRDP Funding - $1,000,000
- Matching funds - $1,498,381
- Total Projects costs - $2,498,381
- Estimated 10-year GHG reductions - 132,586 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.13 $MTCO_2e$
- GHG reductions per total project dollars - 0.05 $MTCO_2e$
- Total cost per $MTCO_2e$ - $18.84

Circle A Dairy (Calgren Dairy Fuels LLC)
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

The Circle A Dairy Digester Fuel Pipeline Project is a covered lagoon anaerobic digester. The project is part of the Calgren Dairy Fuels Cluster. The biogas from the digester will be supplied via private pipeline to fuel two 5MW gas turbines that power the Calgren ethanol refinery. The cluster will install a RCNG station and later connect to the utility pipeline to supply more RCNG stations.

- Location – Pixley, California (Tulare County)
- CDFA DDRDP Funding - $1,050,000
- Matching funds - $1,301,228
- Total Project costs - $2,351,228
- Estimated 10-year GHG reductions - 138,745 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.13 $MTCO_2e$
- GHG reductions per total project dollars - 0.06 $MTCO_2e$
- Total cost per $MTCO_2e$ - $16.95

Bos Farms Dairy Biogas
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

Bos Farms is a covered lagoon digester project with enhanced gas storage, gas pre-treatment and effluent distribution. The project will add sand lane and screens for pre-digester solid separation. Biogas will be conditioned to meet the SoCalGas standards for natural gas fuel, and will be used for vehicle fuel use. A 1MW generator has been permitted for with an emissions mitigation plan in the event an alternate methane destruction device is required.

- Location – Tulare, California (Tulare County)
- CDFA DDRDP Funding - $1,500,000
- Matching funds - $11,334,030
- Total Project costs - $12,834,030
- Estimated 10-year GHG reductions - 168,398 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.11 $MTCO_2e$
- GHG reductions per total project dollars - 0.01 $MTCO_2e$
- Total cost per $MTCO_2e$ - $76.21

Hamstra Dairy Biogas
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

Hamstra Dairy will build a covered lagoon digester with enhanced gas storage, gas pre-treatment and effluent distribution. The project will add sand lane and screens for pre-digester solid separation. Biogas will be conditioned to meet the SoCalGas standards for natural gas fuel, and will be used for vehicle fuel use. A 1MW generator has been permitted for with an emissions mitigation plan in the event an alternate methane destruction device is required.

- Location – Tulare, California (Tulare County)
- CDFA DDRDP Funding – $2,000,000
- Matching funds - $4,580,840
- Total Project costs - $6,580,840
- Estimated 10-year GHG reductions 205,115 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.1 $MTCO_2e$
- GHG reductions per total project dollars - 0.03 $MTCO_2e$
- Total cost per $MTCO_2e$ - $32.08

Hollandia Farms Dairy Biogas
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

Hollandia Farms will build a covered lagoon digester with enhanced gas storage, gas pre-treatment and effluent distribution. The project will add sand lane and screens for pre-digester solid separation. Biogas will be conditioned to meet the SoCalGas standards for natural gas fuel, and will be used for vehicle fuel use. A 1MW generator has been permitted for with an emissions mitigation plan in the event an alternate methane destruction device is required.

- Location – Hanford, California (Kings County)
- CDFA DDRDP Funding - $1,500,000
- Matching funds - $5,816,291
- Total Project costs - $7,316,291
- Estimated 10-year GHG reductions - 178,426 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.12 $MTCO_2e$
- GHG reductions per total project dollars - 0.02 $MTCO_2e$
- Total cost per $MTCO_2e$ - $41

Rancho Teresita Dairy Biogas
Funded: 2018
Status: In Progress
Expected Completion Date: September, 2019

Rancho Teresita Dairy will build a covered lagoon digester with enhanced gas storage, gas pre-treatment and effluent distribution. The project will add sand lane and screens for pre-digester solid separation. Biogas will be conditioned to meet the SoCalGas standards for natural gas fuel, and will be used for vehicle fuel use. A 1MW generator has been permitted with an emissions mitigation plan in the event an alternate methane destruction device is required.

- Location – Tulare, California (Tulare County)
- CDFA DDRDP Funding - $2,100,000
- Matching funds - $10,400,558
- Total Projects costs - $12,500,558
- Estimated 10-year GHG reductions - 236,251 $MTCO_2e$
- GHG reductions per CDFA grant dollar - 0.11 $MTCO_2e$
- GHG reduction per total project dollars - 0.02 $MTCO_2e$
- Total cost per $MTCO_2e$ - $52.91

Research Project: Converting Manure to Reduce Greenhouse Gas Emissions, Minimize Environmental Impacts, and Enhance the Economic Feasibility of Dairy Operations
Prof. William Horwath, University of California Davis
Funded: 2016 Status: In Progress, expected completion February, 2018

The UC Davis Manure Conversion Research Project was funded with $225,909 through the 2014-15 DDRDP. The Project Leaders will evaluate a new method capable of converting large amounts of manure and/or urine from dairy operations into a more stable sterile soil amendment with a predictable nitrogen mineralization response that reduces greenhouse gas (GHG) emissions. This project targets a 25 percent GHG reduction in overall CO_2e emission rates from manure and subsequent amended soils, which can be scaled to intensive livestock operations throughout the state of California and beyond.

The objectives of the lab and field research are to measure the effects of 'converted' manure on N_2O, CH_4 and CO_2 emissions, as well as the effects of the converted manure on crop productivity, compared to conventionally handled manure and cropland fertility management. The 'conversion' process for manure involves the hydrodynamic cavitation of homogenized solid or liquid livestock waste slurry, which is pumped through attenuating tubules that suddenly open. The over-arching goal of this research is to provide an alternative to business as

usual waste management in dairy operations that will reduce GHGs while maximizing economic and environmental benefits.