DAIRY DIGESTER RESEARCH AND DEVELOPMENT PROGRAM


February 2018
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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 $46.4 million for dairy digester projects. These projects, collectively, have an estimated greenhouse gas (GHG) reduction of 5.7 million metric tonnes of carbon dioxide equivalents (MTCO$_2$e) 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

<table>
<thead>
<tr>
<th>Year</th>
<th>Dollar Allocation (millions)</th>
<th>DDRDP Grant Funds Awarded (millions)</th>
<th>Administrative Cost (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-15</td>
<td>$12</td>
<td>$11.09</td>
<td>$0.2</td>
</tr>
<tr>
<td>2016-17</td>
<td>$50</td>
<td>$35.25</td>
<td>Not applicable</td>
</tr>
<tr>
<td>2017-18</td>
<td>$99</td>
<td>$61-75*</td>
<td>Not applicable</td>
</tr>
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</table>

*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 $107.7 million provided in matching funds by grant awardees. These projects collectively have an estimated greenhouse gas (GHG) reduction of 5.7 million metric tonnes of carbon dioxide equivalents (MTCO$_2$e) 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).
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/ccl-quantification](http://www.arb.ca.gov/ccl-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>
<thead>
<tr>
<th>Table 2. CDFA DDRDP Scoring Criteria for Project Selection.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Criteria</strong></td>
</tr>
<tr>
<td>Digester Project Plan and Long-term Viability</td>
</tr>
<tr>
<td>Budget Work Sheet and Financials</td>
</tr>
<tr>
<td>Estimated Greenhouse Gas Emissions Reduction</td>
</tr>
<tr>
<td>Project Readiness</td>
</tr>
<tr>
<td>Environmental Performance</td>
</tr>
<tr>
<td>Community Impact</td>
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<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

**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>
<thead>
<tr>
<th>Table 3. Summary of CDFA DDRDP Outreach.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program Development Outreach Public Meetings</strong></td>
</tr>
<tr>
<td><strong>Meeting</strong></td>
</tr>
<tr>
<td>2015 Digester Grant Development - Stakeholder input</td>
</tr>
<tr>
<td>2015 Digester Grant Development - Stakeholder input</td>
</tr>
<tr>
<td>2015 Digester Grant Development - Stakeholder input</td>
</tr>
<tr>
<td>2015 Digester Research Development - Stakeholder input</td>
</tr>
<tr>
<td>2016 Environmental Justice Listening Session</td>
</tr>
<tr>
<td>2017 Digester Grant Development - Stakeholder Input</td>
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<tr>
<td>2017 Digester Grant Development - Stakeholder Input</td>
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<tr>
<td>2017 Digester Grant Development - Stakeholder Input</td>
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<tr>
<td>2017 Digester Grant Development - Stakeholder Input</td>
</tr>
<tr>
<td>2017 Digester Grant Development - Stakeholder Input on Draft Solicitation</td>
</tr>
</tbody>
</table>

**Application Assistance Outreach Public Meetings**

<table>
<thead>
<tr>
<th><strong>Meeting</strong></th>
<th><strong>Date</strong></th>
<th><strong>Location</strong></th>
<th><strong>Number of Attendees</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 Digester Grant - Application workshop</td>
<td>1/21/2015</td>
<td>Tulare</td>
<td>13</td>
</tr>
<tr>
<td>2015 Digester Grant - Application workshop</td>
<td>1/27/2015</td>
<td>Webinar</td>
<td>26</td>
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</table>
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 MTCO₂e over 10 years, and the approximate cost to achieve one MTCO₂e (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.

<table>
<thead>
<tr>
<th>Year Awarded</th>
<th>Applicant Organization</th>
<th>Project Title</th>
<th>Submitting Organization</th>
<th>Project Location</th>
<th>Cluster</th>
<th>Project Type</th>
<th>Biogas End-Use</th>
<th>Estimated 10 year GHG reductions (MTCO₂e)*</th>
<th>Grant Funds</th>
<th>Matching Funds</th>
<th>Total Project Cost</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
<td>2015</td>
<td>Philip Verwey Farms</td>
<td>Verwey-Hanford Dairy Digester</td>
<td>Maas Energy Works</td>
<td>Hanford, Kings Co.</td>
<td>NA</td>
<td>New covered lagoon digester</td>
<td>Electrical power generation</td>
<td>535,770</td>
<td>$3,000,000</td>
<td>$3,179,861</td>
<td>Completed</td>
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<tr>
<td>2015</td>
<td>Philip Verwey Farms</td>
<td>Verwey-Madera Dairy Digester</td>
<td>Maas Energy Works</td>
<td>Madera, Madera Co.</td>
<td>NA</td>
<td>New covered lagoon digester</td>
<td>Electrical power generation</td>
<td>240,000</td>
<td>$2,281,091</td>
<td>$2,282,754</td>
<td>Completed</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>ABEC #2 LLC, dba West-Star North Dairy Biogas</td>
<td>West-Star North Dairy Digester</td>
<td>California Bioenergy, LLC</td>
<td>Buttonwillow, Kern Co.</td>
<td>NA</td>
<td>New covered lagoon digester</td>
<td>Electrical power generation</td>
<td>158,700</td>
<td>$1,837,005</td>
<td>$7,165,995</td>
<td>Completed</td>
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<tr>
<td>2015</td>
<td>ABEC #3 LLC, dba Lakeview Farms Dairy Biogas</td>
<td>Lakeview Dairy Biogas Digester</td>
<td>California Bioenergy LLC</td>
<td>Bakersfield, Kern Co.</td>
<td>NA</td>
<td>New covered lagoon digester</td>
<td>Electrical power generation and RCNG</td>
<td>144,090</td>
<td>$2,000,000</td>
<td>$6,500,000</td>
<td>Completed</td>
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<tr>
<td>2015</td>
<td>ABEC #4 LLC, dba Carlos Echeverria &amp; Sons Dairy Biogas</td>
<td>Carlos Echeverria &amp; Sons Dairy Biogas Project</td>
<td>California Bioenergy LLC</td>
<td>Bakersfield, Kern Co.</td>
<td>NA</td>
<td>New covered lagoon digester</td>
<td>Combined heat and electrical power generation</td>
<td>201,200</td>
<td>$1,000,000</td>
<td>$7,969,700</td>
<td>Completed</td>
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<td>2017</td>
<td>Wreden Ranch Dairy Biogas</td>
<td>Wreden Ranch Dairy Biogas</td>
<td>California Bioenergy, LLC</td>
<td>Hanford, Kings Co.</td>
<td>Hanford Cluster</td>
<td>New covered lagoon digester</td>
<td>RCNG**</td>
<td>393,915</td>
<td>$3,000,000</td>
<td>$4,735,860</td>
<td>$7,735,860</td>
<td>In Progress</td>
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<td>2017</td>
<td>Cloverdale Dairy Biogas</td>
<td>Cloverdale Dairy Biogas</td>
<td>California Bioenergy, LLC</td>
<td>Hanford, Kings Co.</td>
<td>Hanford Cluster</td>
<td>New covered lagoon digester</td>
<td>RCNG</td>
<td>360,851</td>
<td>$3,000,000</td>
<td>$4,836,793</td>
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<td>Year</td>
<td>Project Name</td>
<td>Company 1</td>
<td>Company 2</td>
<td>Company 3</td>
<td>County</td>
<td>Cluster</td>
<td>System Type</td>
<td>Cost Breakdown</td>
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<td>2017</td>
<td>Aligned Digester Cooperative LLC</td>
<td>Red Top Madera Dairy Digester Project</td>
<td>Aligned Digester Cooperative LLC</td>
<td>Chowchilla, Madera Co.</td>
<td>NA</td>
<td>New covered lagoon digester</td>
<td>RCNG</td>
<td>282,475</td>
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<td>2017</td>
<td>Calgren Dairy Fuels LLC</td>
<td>Williams Family Dairy Digester Fuel Pipeline Project</td>
<td>Maas Energy Works Inc</td>
<td>Pixley, Tulare Co.</td>
<td>Calgren cluster</td>
<td>New covered lagoon digester</td>
<td>Combustion in Cogeneration Turbines (ethanol); potential RCNG in future.</td>
<td>201,208</td>
<td>$1,500,000 $2,524,659 $4,024,659</td>
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<td>Calgren Dairy Fuels LLC</td>
<td>K&amp;M Visser Dairy Digester Fuel Pipeline Project</td>
<td>Maas Energy Works Inc</td>
<td>Pixley, Tulare Co.</td>
<td>Calgren cluster</td>
<td>New covered lagoon digester</td>
<td>Combustion in Cogeneration Turbines (ethanol); potential RCNG in future.</td>
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<td>2017</td>
<td>Maple Dairy Biogas</td>
<td>Maple Dairy Biogas</td>
<td>California Bioenergy, LLC</td>
<td>Bakersfield, Kern Co.</td>
<td>Kern Dairy Cluster</td>
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<td>2017</td>
<td>S&amp;S Dairy Biogas</td>
<td>S&amp;S Dairy Biogas</td>
<td>California Bioenergy, LLC</td>
<td>Visalia, Tulare Co.</td>
<td>West Visalia Cluster</td>
<td>New covered lagoon digester</td>
<td>RCNG</td>
<td>167,417</td>
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<td>2017</td>
<td>Calgren Dairy Fuels LLC</td>
<td>Pixley Dairy Digester Fuel Pipeline Project</td>
<td>Maas Energy Works Inc</td>
<td>Pixley, Tulare Co.</td>
<td>Calgren cluster</td>
<td>New covered lagoon digester</td>
<td>Combustion in Cogeneration Turbines (ethanol); potential RCNG in future.</td>
<td>212,622</td>
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<td>Calgren Dairy Fuels LLC</td>
<td>Legacy Dairy Digester Fuel Pipeline Project</td>
<td>Maas Energy Works Inc</td>
<td>Pixley, Tulare Co.</td>
<td>Calgren cluster</td>
<td>New covered lagoon digester</td>
<td>Combustion in Cogeneration Turbines (ethanol); potential RCNG in future.</td>
<td>207,209</td>
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<td>2017</td>
<td>Moonlight Dairy Biogas</td>
<td>Moonlight Dairy Biogas</td>
<td>California Bioenergy, LLC</td>
<td>Visalia, Tulare Co.</td>
<td>West Visalia Cluster</td>
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<td>RCNG</td>
<td>154,834</td>
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<td>2017</td>
<td>Calgren Dairy Fuels LLC</td>
<td>R Vander Eyk Dairy Digester Fuel Pipeline Project</td>
<td>Maas Energy Works Inc</td>
<td>Pixley, Tulare Co.</td>
<td>Calgren cluster</td>
<td>New covered lagoon digester</td>
<td>Combustion in Cogeneration Turbines (ethanol); potential RCNG in future.</td>
<td>132,586</td>
<td>$1,000,000 $1,498,381 $2,498,381</td>
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<tr>
<td>Year</td>
<td>Project Name</td>
<td>Owner</td>
<td>Fuel Company</td>
<td>Location</td>
<td>Type of Lagoon Digester</td>
<td>Technology</td>
<td>Cost</td>
<td>Estimated Reductions</td>
<td>Status</td>
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<tr>
<td>2017</td>
<td>Calgren Dairy Fuels LLC Circle A Dairy Digester Fuel Pipeline Project</td>
<td>Calgren Dairy Fuels LLC</td>
<td>Circle A Dairy Digester Fuel Pipeline Project</td>
<td>Pixley, Tulare Co.</td>
<td>New covered lagoon digester</td>
<td>Combustion in Cogeneration Turbines (ethanol); potential RCNG in future.</td>
<td>$1,050,000</td>
<td>$1,301,228</td>
<td>$2,351,228</td>
<td>In Progress</td>
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<td>2017</td>
<td>Bos Farms Dairy Biogas Bos Farms Dairy Biogas</td>
<td>California Bioenergy</td>
<td>Tulare, Tulare Co.</td>
<td>East Tulare Cluster</td>
<td>New covered lagoon digester</td>
<td>RCNG</td>
<td>$1,500,000</td>
<td>$11,334,030</td>
<td>$12,834,030</td>
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<td>2017</td>
<td>Hamstra Dairy Biogas Hamstra Dairy Biogas</td>
<td>California Bioenergy</td>
<td>Tulare, Tulare Co.</td>
<td>West Visalia Cluster</td>
<td>New covered lagoon digester</td>
<td>RCNG</td>
<td>$2,000,000</td>
<td>$4,580,840</td>
<td>$6,580,840</td>
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<td>2017</td>
<td>Hollandia Farms Dairy Biogas Hollandia Farms Dairy Biogas</td>
<td>California Bioenergy</td>
<td>Hanford, Kings Co.</td>
<td>Hanford Cluster</td>
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<td>RCNG</td>
<td>$1,500,000</td>
<td>$5,816,291</td>
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<td>2017</td>
<td>Rancho Teresita Dairy Biogas Rancho Teresita Dairy Biogas</td>
<td>California Bioenergy</td>
<td>Tulare, Tulare Co.</td>
<td>East Tulare Cluster</td>
<td>New covered lagoon digester</td>
<td>RCNG</td>
<td>$2,100,000</td>
<td>$10,400,558</td>
<td>$12,500,558</td>
<td>In Progress</td>
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**Totals**

- **Cost**: $46,341,526
- **Estimated Reductions**: $107,688,242
- **Total Reductions**: $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.

<table>
<thead>
<tr>
<th>Year Awarded</th>
<th>Project Title</th>
<th>Total cost of 1 MTCO$_2$e GHG reduction ($)</th>
<th>GGRF cost of 1 MTCO$_2$e GHG reduction ($)</th>
<th>percent of 1 MTCO$_2$e GHG reduction cost supported by GGRF</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>Verwey-Hanford Dairy Digester</td>
<td>11.53</td>
<td>5.60</td>
<td>49</td>
</tr>
<tr>
<td>2015</td>
<td>Open Sky Ranch Dairy Digester</td>
<td>7.52</td>
<td>3.76</td>
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<td>2015</td>
<td>Verwey-Madera Dairy Digester</td>
<td>19.02</td>
<td>9.50</td>
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<td>2015</td>
<td>West-Star North Dairy Digester</td>
<td>56.71</td>
<td>11.58</td>
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<td>2015</td>
<td>Lakeview Dairy Biogas Digester</td>
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<td>2015</td>
<td>Carlos Echeverria &amp; Sons Dairy Biogas Project</td>
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<td>Wreden Ranch Dairy Biogas</td>
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<td>Cloverdale Dairy Biogas</td>
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<td>T &amp; W Dairy Biogas</td>
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<td>Red Top Madera Dairy Digester Project</td>
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<td>Williams Family Dairy Digester Fuel Pipeline</td>
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<td>23.93</td>
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<td>S&amp;S Dairy Biogas</td>
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<td>Pixley Dairy Digester Fuel Pipeline Project</td>
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<td>Legacy Dairy Digester Fuel Pipeline</td>
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<td>Moonlight Dairy Biogas</td>
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<td>Bos Farms Dairy Biogas</td>
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<td>Hollandia Farms Dairy Biogas</td>
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<td>8.41</td>
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<td>Rancho Teresita Dairy Biogas</td>
<td>52.91</td>
<td>8.89</td>
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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 - $6,179,861
- Estimated 10-year GHG reductions - 535,770 MTCO$_2$e.
- GHG reductions per CDFA grant dollar - 0.18 MTCO$_2$e
- GHG reductions per total project dollars - 0.09 MTCO$_2$e
- Total cost per MTCO$_2$e - $11.54

Image: View of the covered lagoon digester at Verwey-Hanford Dairy (Source: CDFA).
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 - $1,946,864
- Estimated 10-year GHG reductions - 258,911 MTCO$_2$e
- GHG reductions per CDFA grant dollars – 0.27 MTCO$_2$e
- GHG reductions per total projects dollars 0.13 MTCO$_2$e
- Total cost per MTCO$_2$e - $7.52
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 - $4,563,845
- Estimated 10-year GHG reductions - 240,000 MTCO$_2$e
- GHG reductions per CDFA grant dollar - 0.11 MTCO$_2$e
- GHG reductions per total project dollars - 0.05 MTCO$_2$e
- Total cost per MTCO$_2$e - $19.02

Image 2: A view of the Open Sky Ranch Dairy digester.
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** - $9,000,000
- **Estimated 10-year GHG reductions** - 158,370 MTCO$_2$e
- **GHG reductions per CDFA grant dollar** - 0.09 MTCO$_2$e
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 - $8,500,000
- Estimated 10-year GHG reductions - 144,090 MTCO$_2$e
- GHG reductions per grant dollar - 0.07 MTCO$_2$e
- GHG reductions per total project dollars - 0.02 MTCO$_2$e
- Total cost per MTCO$_2$e - $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 MTCO₂e
- **GHG reductions per CDFA grant dollars** - 0.2 MTCO₂e
- **GHG reductions per total project dollars** - 0.02 MTCO₂e
- **Total cost per MTCO₂e** - $44.58

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**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 MTCO₂e
- **GHG reductions per CDFA grant dollar** - 0.13 MTCO₂e
- **GHG reductions per total project dollars** - 0.05 MTCO₂e
- **Total cost per MTCO₂e** - $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 MTCO2e
- GHG reductions per CDFA grant dollar - 0.11 MTCO2e
- GHG reductions per total project dollars - 0.04 MTCO2e
- Total cost per MTCO2e - $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 MTCO2e
- GHG reductions per CDFA grant dollar - 0.12 MTCO2e
- GHG reductions per total project dollars - 0.05 MTCO2e
- Total cost per MTCO2e - $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** - $7,295,759
- **Estimated 10-year GHG reductions** - 294,892 MTCO$_2$e
- **GHG reductions per CDFA grant dollar** - 0.11 MTCO$_2$e
- **GHG reductions per total project dollars** - 0.04 MTCO$_2$e
- **Total cost per MTCO$_2$e - $24.73**

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**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** - $6,046,875
- **Estimated 10-year GHG reductions** - 282,475 MTCO$_2$e
- **GHG reductions per CDFA grant dollar** - 0.09 MTCO$_2$e
- **GHG reductions per total project dollars** - 0.05 MTCO$_2$e
- **Total cost per MTCO$_2$e - $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 MTCO2e
- GHG reductions per CDFA grant dollar - 0.13 MTCO2e
- GHG reductions per total project dollars - 0.05 MTCO2e
- Total cost per MTCO2e - $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 MTCO2e
- GHG reductions per CDFA grant dollar - 0.14 MTCO2e
- GHG reductions per total project dollars - 0.05 MTCO2e
- Total cost per MTCO2e - $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 - $8,331,773
- Estimated 10-year GHG reductions - 348,171 MTCO$_2$e
- GHG reductions per CDFA grant dollar - 0.12 MTCO$_2$e
- GHG reductions per total project dollars - 0.04 MTCO$_2$e
- Total cost per MTCO$_2$e - $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 - $6,687,926
- Estimated 10-year GHG reductions - 167,417 MTCO$_2$e
- GHG reductions per CDFA grant dollar - 0.1 MTCO$_2$e
- GHG reductions per total project dollars - 0.03 MTCO$_2$e
- Total cost per MTCO$_2$e - $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\textsubscript{2}e
- GHG reductions per CDFA grant dollar - 0.13 MTCO\textsubscript{2}e
- GHG reductions per total project dollars - 0.06 MTCO\textsubscript{2}e
- Total cost per MTCO\textsubscript{2}e - $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\textsubscript{2}e
- GHG reductions per CDFA grant dollar - 0.13 MTCO\textsubscript{2}e
- GHG reductions per total project dollars - 0.06 MTCO\textsubscript{2}e
- Total cost per MTCO\textsubscript{2}e - $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 MTCO₂e
- GHG reductions per CDFA grant dollar - 0.1 MTCO₂e
- GHG reductions per total project dollars - 0.02 MTCO₂e
- Total cost per MTCO₂e - $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 MTCO₂e
- GHG reductions per CDFA grant dollar - 0.13 MTCO₂e
- GHG reductions per total project dollars - 0.05 MTCO₂e
- Total cost per MTCO₂e - $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 - $2,351,228
- Estimated 10-year GHG reductions - 138,745 MTCO$_2$e
- GHG reductions per CDFA grant dollar - 0.13 MTCO$_2$e
- GHG reductions per total project dollars - 0.06 MTCO$_2$e
- Total cost per MTCO$_2$e - $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 - $12,834,030
- Estimated 10-year GHG reductions - 168,398 MTCO$_2$e
- GHG reductions per CDFA grant dollar - 0.11 MTCO$_2$e
- GHG reductions per total project dollars - 0.01 MTCO$_2$e
- Total cost per MTCO$_2$e - $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\textsubscript{2e}
- **GHG reductions per CDFA grant dollar** - 0.1 MTCO\textsubscript{2e}
- **GHG reductions per total project dollars** - 0.03 MTCO\textsubscript{2e}
- **Total cost per MTCO\textsubscript{2e}** - $32.08

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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\textsubscript{2e}
- **GHG reductions per CDFA grant dollar** - 0.12 MTCO\textsubscript{2e}
- **GHG reductions per total project dollars** - 0.02 MTCO\textsubscript{2e}
- **Total cost per MTCO\textsubscript{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\textsubscript{2}e
- **GHG reductions per CDFA grant dollar** - 0.11 MTCO\textsubscript{2}e
- **GHG reduction per total project dollars** - 0.02 MTCO\textsubscript{2}e
- **Total cost per MTCO\textsubscript{2}e** - $52.91

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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\textsubscript{2}e 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\textsubscript{2}O, CH\textsubscript{4} and CO\textsubscript{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.