Impact Area 1-Verification of Methane Reduction Strategies

*The 2022 CLIM³ATE-RP application information was extracted from the online application system as submitted by the applicants, therefore, CDFA cannot guarantee accuracy of the information.

Primary Applicant Organization:	Ira Leifer/Bubbleology Research International
Project Title:	EVAluating the NEw Smart, ClimatE-friendly CAlifornia dairy: Measuring the climate and environmental air emissions footprint of improved manure management practices (EVANESCE-CA)
Amount Requested	$1,599,918.00
Project Overview:	To achieve California's important climate goals (SB1383), Impact Area 1, reductions in agricultural methane, CH4, and other greenhouse gases, GHGs, must be based on smart agriculture. Our study creates a dairy baseline emissions and air quality dataset of GHGs and criteria pollutant emissions from new data collected by a unique mobile air quality lab, "SISTER," airborne remote sensing, and data mining the team's extensive data archives. The dataset is supported by wastewater, manure, solids, soil, and farm operations characterizations to provide a basis to assess the CARB Benefits and co-Benefits Calculator Tool. The assessment is based on a statistically significant number of (anonymized and aggregated) dairies, with and without AMMP and DDRDP improvements covering California's diverse dairies' climates and seasons for a range of CDFA-promoted dairy waste management practices at large and small dairies.

Impact Area 2- Alternative Methane Reduction Strategies

Primary Applicant Organization:	Kevin Monk/Global Clean Energy Holdings
Project Title:	Reducing Enteric Emissions with Camelina
Amount Requested	$498,154
Project Overview:	Global Clean Energy Holdings (GCEH), through its subsidiary, Sustainable Oils, Inc. in partnership with Hess Labs, proposes to conduct an in-depth study that will measure and validate the climate-smart, methane-reduction advantages of adding Camelina sativa (L.) meal to feed rations in livestock. This project will pilot this climate-smart agricultural practice and evaluate the claims made by previous studies to validate the actual reduction of enteric methane production using in vitro studies. The Hess Lab at UC Davis will analyze camelina meal and other byproducts from Camelina sativa harvested and provided by GCEH for their biochemical composition and nutritional value. In vitro rumen assays will be performed with the different camelina derived byproducts at different inclusion rates to identify the most efficient byproducts and feed formulations to reduce the overall carbon footprint, by identifying treatments that are most efficient in inhibiting enteric methanogenesis.

Primary Applicant Organization:	Joan Salwen/Blue Ocean Barns
Project Title:	Bending the Curve of Enteric Methane
Amount Requested	$498,154
Project Overview:	Bending the Curve of Enteric Methane builds and deploys tools—education, software, policy, a reliable inclusion rate algorithm and the Blue Ocean Barns business model to facilitate rapid and widespread adoption of the digestive aid Brominata in dairy farms to increase speed toward public and private goals. The project will pioneer the serialization of Voluntary Emission Reductions (VERs) in a whole-herd deployment of Asparagopsis, using an enteric emission reduction factor established through a meta-analysis design rather than through direct measurement of methane emissions.

Primary Applicant/ Organization:	Pramod Pandey/ University of California, Davis
Project Title:	Low Energy Novel System (LENS) for Dairy Lagoon Treatment for Alternative Methane Reductions
Amount Requested	$321,183
Project Overview:	The proposed project will support the mission of the CLIM3ATE research program by addressing alternative methane reductions from dairy lagoons. The work includes research on dairy lagoon treatment to decrease manure methane emissions from lagoons by decreasing the volatile solids in the lagoons. In this research, we will work on designing a Low Energy Novel System (LENS), developed in University of California Davis, for dairy lagoons which will easily and continuously capture volatile compounds (i.e., compounds that are easily degradable) from lagoon water. This will reduce greenhouse gas (GHG) and ammonia emissions from anaerobic lagoons, odors, nitrogen oxides, and particulate matter. The crucial part of LENS technology is that continuous capturing of fine manure particulates (>20 µm) does not require electrical energy to perform, and separation is done by gravitation power, and will provide clean water with substantially less particles. Separation of fine particles is impossible to achieve in currently popular mechanical liquid-solid separator, electric power-driven technologies used in California. The LENS technology uses reusable geotextile with pore size 15 – 20 µm, which separate volatile solids and other fine particles from liquid manure. In contrast, the current popular mechanical liquid solid separators are based on screen size 1.5 mm (1500 µm), which cannot separate fine particles (<1500 µm) responsible for GHG emissions, and problems such as clogging, high maintenance, and high electric consumptions are few of many inherent challenges of the current mechanical liquid-solid separator technologies. The proposed LENS technology will reduce electric consumption, cost of manure solid separation, and will provide a system, which can be installed in a dairy farm within hours in contrast to the current mechanical separators, which are fixed (immovable) and generally needs 6 - 12 months to install in a dairy farm.

Primary Applicant/ Organization:	Frank Mitloehner/ University of California, Davis
Project Title:	Effects of Nanobubbles on Methane Emissions from Dairy Manure
Amount Requested	$499,546
Project Overview:	This project aims to evaluate nanobubble technology as a new alternative manure management technology. Nanobubbles are spherical gas-filled nano-cavities with diameters of 10–200 nanometers (nm). Compared to aeration and microaeration, nanobubbles have several advantages such as large specific surface areas, and high gas transfer efficiency and interface potential. Nanobubbles have the capability to generate free radicals that make them attractive for applications in wastewater treatment. In comparison with conventional aeration, nanobubbles could save up to 40%-50% of the electricity that is typically required for aeration. For this project, the performance of a laboratory-scale nanobubble system will be evaluated, and operation parameters will be optimized in the laboratory. The best operation parameters determined in the laboratory will be used to evaluate the performance (e.g., removal of volatile solids and chemical oxygen demand, and nitrogen) of a mobile pilot-scale nanobubbles system on a dairy farm. The emissions of methane and other gases from lagoon will be measured before and after the application of the nanobubbles system. The project will also evaluate the impact of the nanobubbles on the quality of the treated manure as a fertilizer.

Primary Applicant/ Organization:	John Gibbons/ Mooteric LLC
Project Title:	Feeding Seaweed to Accelerate Enteric Methane Emissions Reductions in Central Valley Dairies
Amount Requested	$500,000
Project Overview:	Mooteric's project will address Impact Area 2,Alternative Methane Reduction Strategies, through three primary objectives: 1) Conduct rigorous on-farm feeding trials to verify the methane-mitigating qualities of seaweed-based feed additives within the regular feed rations of Central Valley dairy cows; 2) Establish long-term economical supply chain development for seaweed-based products; and 3) Conduct extensive financial modeling for California dairies to foster acceptability and understanding among producers to utilize seaweed-based feed additives.

Impact Area 3 - Manure Recycling and Innovative Products Development

Primary Applicant Organization:	Jason Prapas/FYTO
Project Title:	Aquatic Crop Production as a Nutrient-to-Feed Solution for California Dairies
Amount Requested	$2,000,000
Project Overview:	FYTO will install a commercial-scale, automated aquatic crop farm at Fiscalini Farms in Modesto, CA. When complete, the proposed farm will function as a nutrient management technology that efficiently recycles manure effluents into valuable agricultural inputs. The installation will be partitioned into two separate grow areas independently supplied with dairy lagoon effluent and anaerobic digester effluent as the sole nutrient inputs for aquatic crop cultivation. FYTO and dairy industry partners will jointly validate the environmental impact, economic feasibility, and product efficacy of L. minor (Lemna) grown on both effluent types, as a high-protein dairy feed ingredient.

Primary Applicant Organization:	Frank Mitloehner/ University of California, Davis
Project Title:	Evaluation of Vermifiltration for Reducing the Emissions of Greenhouse Gases and other Pollutants from Dairy Manure and its Digestate
Amount Requested	$1,313,846
Project Overview:	The goal of this project is to evaluate the effectiveness of vermifiltration on reducing GHG and nitrogenous emissions from manure lagoons and anaerobic digester effluents; and assess the economic and environmental benefits of using the vermifiltration technique on California dairies. The project will address: 1) quantifying vermifiltration effects on water quality and emissions of CH4, N2O, and NH3 from dairy anaerobic lagoons and digestate; 2) developing an efficient vermifiltration system to reduce digestate GHG and NH3 emissions from an anaerobic digester digestate, by optimizing the hydraulic organic and nitrogen loading capacity for digestate; and 3) evaluating the economics of using a vermifiltration system on dairies and evaluate the marketability of the technology bio-product (vermicompost).

Primary Applicant/ Organization:	Pramod Pandey/ University of California, Davis
Project Title:	Microwave Assisted Stabilization of Dairy Manure for Controlling Methane and VOC emissions, and Producing Innovative Products
Amount Requested	$620,898
Project Overview:	Waste stabilization and water recovery using microwave is found to be the most promising method for treating solid waste during extended manned space missions. The importance of microwave in our daily life starting from signal transmission to cooking. In this proposed project, microwave power will be used to treat solid dairy manure and convert manure into innovative stabilized organic fertilizer pellets (SOFP) using a recently invented process in UC Davis. What it means that using microwave energy, water present in solid dairy manure will be heated selectively and rapidly, and heat and radiation produced inside the waste will create an environment, which will eliminate harmful bacteria, methane producing bacteria, molds, virus, fungus, volatile organic compounds (VOC), and completely seize the methane emissions from dairy manure. Further, the conversion of stabilized manure into the value-added pellets will lead to high demands of manure, new technology, and new economic opportunities. In addition, water will be recovered from microwave volatilized vapor using inexpensive condensation, and sorbent material filters will trap VOC emission from dairy manure.

Primary Applicant Organization:	Ken Tasaki/Figure 8 Environmental
Project Title:	Producing Bioammonia and Protein Hydrolysate from Dairy Effluent, a Multi-step Zero Waste Manure Management System
Amount Requested	$1,999,953.60
Project Overview:	A significant volume of GHG emissions is generated along the supply chain of dairy production in California, from nitrogen (N) fertilizer production to manure management. If all the components in manure are recycled or recovered for reuse, there should be nothing left behind to generate GHG emissions from manure management. We propose to produce four manure byproducts from manure, leaving very few behind manure. We will perform the techno-economic analysis of each recovery technology. We will also show how agriculture can supply one of its resources for zero-carbon fuels to reduce overall GHG emissions across different sectors.