



**Title of Proposed Initiative** (Short and concise): *Bio-energy Storage System*

**Investment Areas** (Check one or more) – *For definitions, see First Triennial Investment Plan, page 12:*

- Technology Demonstration and Deployment  
 Market Facilitation

**Electricity System Value Chain (Check only one):** *See CPUC Decision 12-05-037, Ordering Paragraph 12.a. [http://docs.cpuc.ca.gov/PublishedDocs/WORD\\_PDF/FINAL\\_DECISION/167664.PDF](http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF).*

- Grid operations/market design

### Issues and Barriers:

*Renewable energy is predominantly intermittent and not baseload. Bioenergy has the potential to be more reliable. Biogas can be stored and dispatched on-demand much like a battery. California Bioenergy LLC (“CalBio”) has invested in biogas systems that can store a “charge” of bio-energy such that it could be guaranteed available and converted and delivered as a battery like resource. Excess biogas production from our biogas plant not required for recharging would be flared or used to run a standard baseload generator. If a base load generator is co-located it may be turned off as needed (for example during the night) so as to recharge the bio-energy storage. This action mimicks the demand side of an electrochemical battery taking energy off the grid to re-charge.*

*CalBio seeks to commission a 2MWx5 hour bio-energy storage device on an existing biogas facility. CalBio partners, Caterpillar and Quinn Power Systems would assist in the engineering of the synchronous system such that it would power on/off as rapidly as is required to provide grid stability and communicate as needed with utility and CAISO resources. Current synchronous generators do supply diesel backup power that can cycle on (for example in the case of a hospital backup power system) extremely rapidly but no one has yet integrated this knowhow with biogas fuel and biogas storage to provide a robust, reliable, warranted and cost effective solution that meets the service levels specified and required by the PUC, utilities and CAISO.*

*PG&E commented on the feasibility of this solution in their response to Senate Bill (SB) 1122, on 1-16-2014 by stating: “Based on the definition of energy storage in AB 2514, PG&E believes that dairy bioenergy with the capability to store energy for use at a later time could meet the definition of energy storage ... if dairy bioenergy is able to provide operational flexibility and meet the CPUC’s goals for energy storage, it should be counted towards PG&E’s energy storage targets.”*

### Initiative Description and Purpose:

*Purpose is to provide a reliable, multi MW, multi-hour, distributed bio-energy storage system located at or close to utility substations, on the 12kV distribution circuit side.*

*For a shovel ready TD&D project CalBio will provide, quantify and characterize the bio-energy storage system it has built at the Old River dairy biogas plant (shown below) capable of storing at least 10MW-hr energy and will couple it with 2MW of Quinn Power Systems/Caterpillar Synchronous generators engineered for utility back up and support. This system will be controlled by a PLC with interfaces to CAISO/IOU/operators and others as needed. Guaranteed energy storage, levels of service, uptime, availability and other features and contracting models will be developed and explored.*

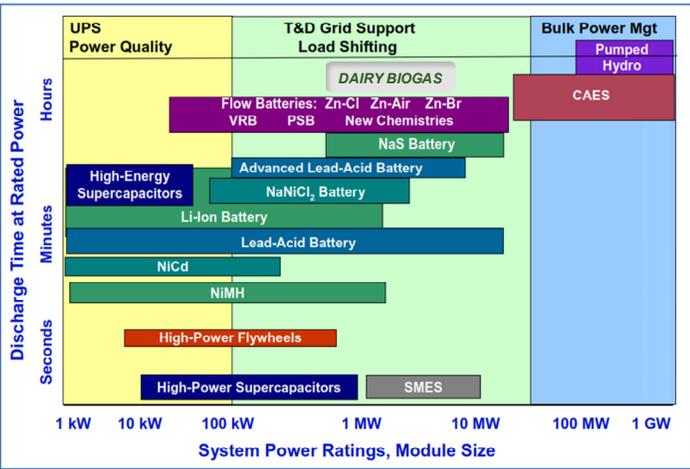
### Storage: Old River 2MW storage proposal

*California Bioenergy: Example Biogas Storage System (Over Charged – Excess Gen Possible)*

- Excess gas for 2MW of base generation & for scheduled delivery
- Stored gas for 'battery gen' 2MW reserved 'Energy Storage'

*California Bioenergy: Example of Biogas Storage System (Base Energy Storage)*

- Excess gas depleted = 0MW base generation
- Reserved capacity of gas for 'battery gen' 'Energy Storage'



2MW x 5 hours would position this renewable energy storage system as shown below. This project is expected to require approximately \$5 – 7 MM to TD&D plus a per kWh fee for re-charge and maintenance.

**Stakeholders:**

California Bioenergy LLC, Quinn Power Systems, Caterpillar, (Utility and CAISO as needed)

**Background and the State-of-the-Art:**

- What research development and demonstration has been done or is currently being done to advance this technology or strategy (cite past research as applicable)?

California Bioenergy LLC has demonstrated bio-energy production, capture and cleanup for and can make available a platform including site location. Quinn Power Systems and Caterpillar have demonstrated synchronous generator system capable of rapid start and grid level performance. The parties have together coupled these two technologies for base load generation. Development of on/off, rapid start, controls and the business model for storage is required. Ultra low NOx has been demonstrated.

Quinn Power Systems provides new and used CAT® machines throughout Central and Southern California. Quinn Power Systems provides procurement, engineering, factory support, and application and installation (A&I) expertise for all types of engine systems, power generation equipment and power quality solutions and value added services such as design and construction, exhaust after treatment and fuel conditioning systems. Quinn Power System's current projects include CalBio's Old River dairy project, which utilizes two newly designed G3516A++ biogas fueled engine generators, housing and an exhaust after treatment. This package was especially selected and engineered for CalBio's current and future biogas fuel sources to produce electric power and usable heat and includes ongoing service and maintenance similar to what Quinn provides at a number of renewable energy sites in California.

- Describe any public and/or private successes and failures the technology or strategy has encountered in its path through the energy innovation pipeline: lab-scale testing, pilot-scale testing, pre-commercial demonstration, commercial scale deployment, market research, workforce development.

California Bioenergy LLC has significant biogas experience in California as shown below. Quinn Power System's current projects include CalBio's Old River dairy

### Calbio Experience and CA Projects

CalBio Dairy Project	ABEC Stockdale	ABEC New Hope	ABEC Old River
Location	Bakersfield, CA	Galt, CA	Bakersfield, CA
Dairy (Milk Cows)	Bidart dairy (1,200)	New Hope Dairy (1,400)	Bidart dairy (8,500)
Type of Digester	Covered Lagoon (Psychrophilic)	Continuous Stirred Tank Reactor (Mesophilic)	Covered Lagoon (Psychrophilic)
Biogas Production	60,000 SCF/day	50,000 SCF/day	600,000 SCF/day
Engine Size	600 kW	450 kW	2 x 1,000 kW
Utility Connection	PG&E interconnect	SMUD interconnect	PG&E interconnect
H2S Reduction	In-situ oxidizer system & iron sponge polishing	Treatment using iron chloride & carbon filter	In-situ oxidizer system & iron sponge polishing

*project, which utilizes two newly designed G3516A++ biogas fueled engine generators, housing and an exhaust after treatment. This package was especially selected and engineered for CalBio's current and future biogas fuel sources to produce electric power and usable heat and includes ongoing service and maintenance similar to what Quinn provides at a number of renewable energy sites in California. A storage system would leverage this know how.*

- Identify other related programs and initiatives that deal with the proposed technology or strategy, such as state and federal programs or funding initiatives (DOE, ARPA-E, etc.).  
*None.*

**Justification:**

Describe how this technology or strategy will provide California IOU electric ratepayer benefits and provide any estimates of quantified annual savings/benefits in California, including:

- Name of sector and estimated size and energy use.  
*Renewable energy storage for utility t&d grid support and load shifting at the 12kV distribution level. An affordable multi MW x multi hour storage system would save utilities significant amounts of money meeting AB 2514 procurement goals. The reduced round trip cycle (no need to generate first then store and regenerate a second time) would lead to a much lower operating cost as well.*
- Quantifiable performance improvements for the proposed technology/strategy.  
*2MW x 5 hours plus demonstrating adequate ramping and on/off performance as needed without having to couple as a hybrid system with some electrochemical battery for bridging start up.*
- Maximum market potential, if successful.  
*Calbio has identified 350MW of base loaded dairy biogas that could be redirected to energy storage.*
- Number of direct jobs created in California.  
*Several hundred in construction and ongoing operations (100% located in California).*
- Why this research is appropriate for public funding.  
*Significant environmental benefits in trapping fugitive methane from dairies coupled with cost effective renewable storage delivers substantial rate payer and citizen benefits.*

**Ratepayer Benefits** (Check one or more):

- Promote greater reliability
- Potential energy and cost savings
- GHG emissions mitigation/adaptation in the electricity sector at the lowest possible cost
- Waste reduction
- Economic development

Describe specific benefits (qualitative and quantitative) of the proposed initiative. Please describe how this technology or strategy addresses the principles articulated in California Public Utilities Code Sections 740.1 and 8360. *See details above regarding storable and renewable energy.*

**Submitted by:**

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