CALIFORNIA BIOENERGY

Plugging dairies into a renewable future

RNG Projects in the Ag Sector
March 27, 2019 EPA webinar presentation

Dairy Digesters in California –
the Kern Cluster and Other Examples

5 Topics for Discussion

1. Background on Dairies, Digesters and CalBio
2. Hub and Scope Model
3. Lagoon Digesters Projects
4. Economics
5. Environmental Impacts

5 Topics for Discussion

(1) Background on California Climate Reductions, Dairy Industry, and CalBio

Helping California reach its greenhouse gas reduction requirements

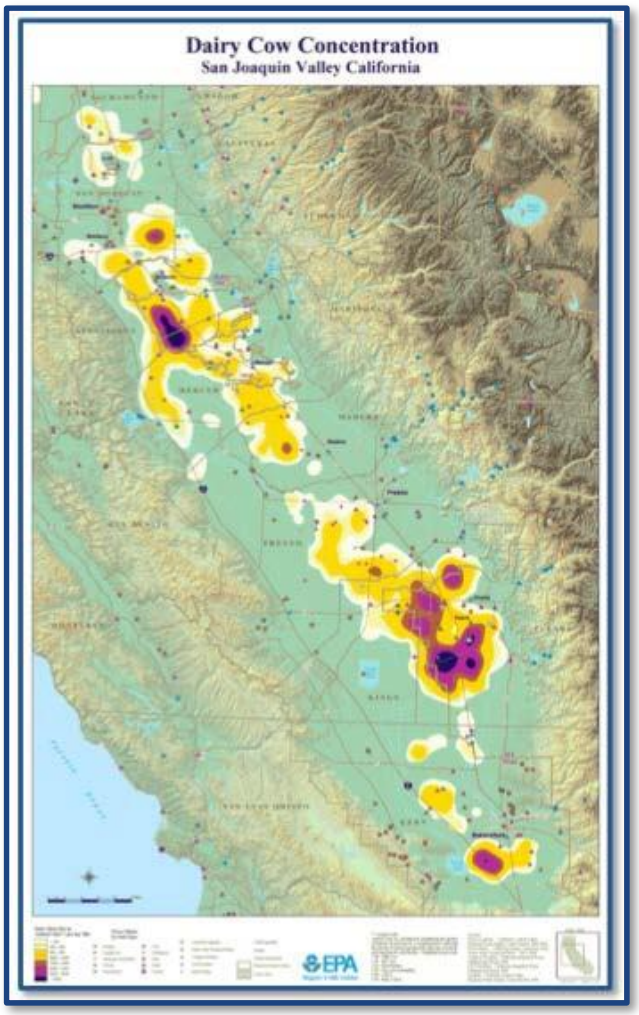
while benefiting the dairy and community

Dairies: One Key to CA's GHG Reductions

- California is a world leader in climate policy and program development
- CA to reduce GHGs* by 40% by 2030
  - All GHGs by 40% versus 1990 baseline
  - **Dairy CH4 by 40% versus 2013 baseline**
- Methane is a significant GHG source
  - 9% of total: 100 year GWP*
  - 22.4% of total: 20 year GWP
- Dairies: a primary source of CA CH4
  - 55% of CA methane emissions
  - **26% of CA total from manure lagoon**

Source: CARB. *GHG: Greenhouse Gases.
GWP: Global Warming Potential

California Dairy Industry



- Dairy is California's #1 ag product
  - **Largest dairy industry in the US. 20% of the nation's milk**
  - $7+ billion per year in farm sales. $98B of economic value.
  - **1.74 million milk cows**
  - 1,300 dairies, family owned
- San Joaquin Valley – center of California's dairying
- Dairy productivity
  - 63 lbs of milk/cow/day; 23,000 lbs/yr
  - **120 pounds of manure/cow/day**
  - Over 100 DGEs/cow/year

California Milk Production

CDFA Report - Jan-Dec 2017		
County	Milk Production (Pounds)	% of Total
#1 Tulare	10,898,199,708	27.4%
#2 Merced	6,118,632,016	15.4%
#3 Kings	4,118,692,949	10.3%
#4 Stanislaus	3,931,744,192	9.9%
#5 Kern	3,718,554,133	9.3%
#6 Fresno	2,756,349,010	6.9%
#7 San Joaquin	2,330,365,468	5.9%
#8 Madera	1,858,949,176	4.7%
#9 San Bernardino	978,098,347	2.5%
#10 Riverside	948,433,111	2.4%
Other (approximate)	2,141,981,890	5.4%
Total (approximate)	39,800,000,000	100.0%

About California Bioenergy LLC ("CalBio")

- Founded 2006. Focus on dairy biogas in California.
- Team + partners: dairy, digester, and oil and gas expertise
- Operate 5 projects, developing 40+: 7 clusters
- Supported by grants, lenders & investors
- Work with regulatory & state agencies
- Partner with the dairy farmer
- Goals

  (1) Protect global & local environment

  (2) Create a new revenue for dairy

  (3) Enhance dairy operations

  (4) Support the community

Dairy Digesters are Cost Effective*

Program	Cost Per Ton[a]
Organics and recycling loans	$4
Forest health	4
Dairy digester research and development program	8
Organics composting/digestion grants	9
Forest legacy	10
Recycling manufacturing	15
Delta and coastal wetlands restoration	30
State water and efficiency and enhancement program	33
Clean vehicle rebates	46
Sustainable agricultural lands conservation	59
Mountain meadow ecosystems restoration	113
Urban and community forestry	116
Water-energy grant program	141
Affordable housing and sustainable communities	191
Single-family solar photovoltaics[b]	209
Transit and intercity rail capital	259
Single-family energy efficiency and solar water heating[b]	282
Large multifamily energy efficiency and renewables[b]	343
Enhanced fleet modernization program "plus-up"	414
Truck and bus voucher incentives	452
Incentives for public fleets pilot project for DACs	725
Overall Average	**$57**

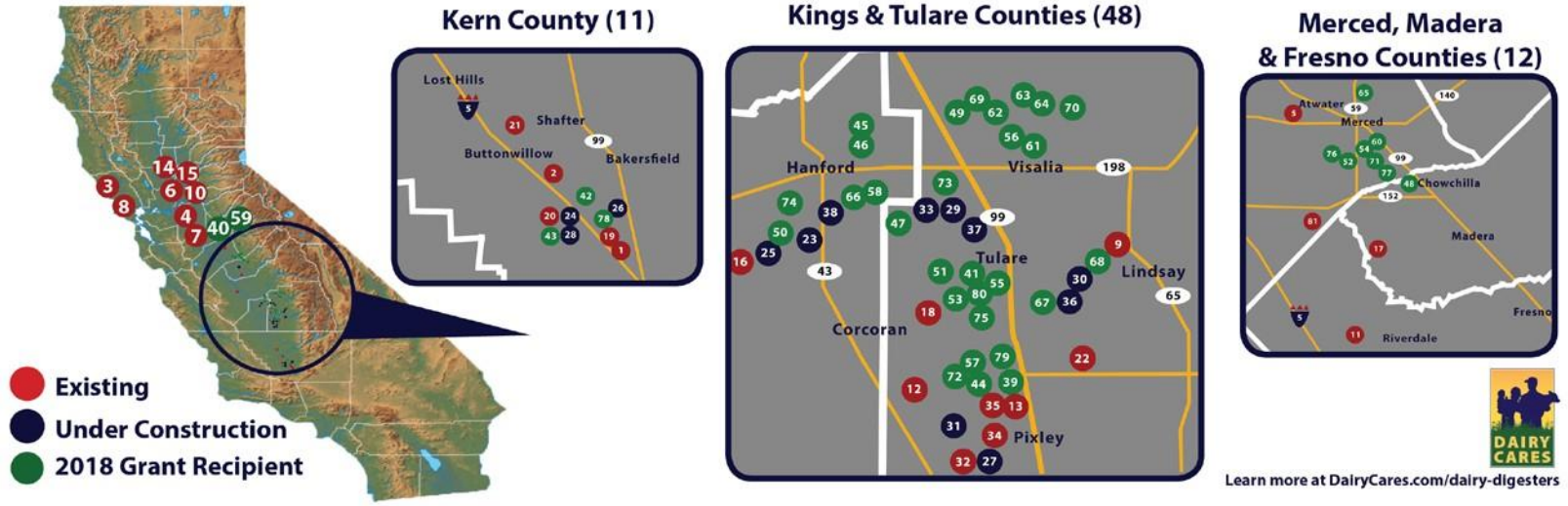
LAO
LEGISLATIVE ANALYST'S OFFICE

April 2016 Report

* Based on 100 yr GWP

CA Digesters: from DairyCares.com

California Dairy Digester Development



1. Bidart- Old River
2. Bidart- Stockdale
3. Blakes Landing Farms/ Straus Family Creamery
4. Castelanelli Brothers Dairy
5. Cottonwood Dairy/ Joseph Gallo Farms
6. Denier Dairy*
7. Fiscalini Farms
8. Giacomini Dairy
9. Hilarides Dairy
10. New Hope Dairy*
11. Open Sky Ranch
12. Pacific Rim Dairy
13. Pixley Biogas
14. Van Steyn Dairy
15. Van Warmerdam Dairy
16. Verwey Dairy– Hanford
17. Verwey Dairy– Madera
18. GJ TeVelde Ranch
19. Carlos Echeverria & Sons
20. Lakeview Dairy
21. West Star Dairy
22. Van Beek Dairy
23. Wreden Ranch
24. Trilogy Dairy
25. Cloverdale Dairy
26. T & W Farms
27. K & M Visser
28. Maple Dairy
29. S & S Dairy
30. Rancho Teresita Dairy
31. Pixley Dairy
32. Legacy Ranch
33. Moonlight Dairy
34. Robert Vander Eyk Dairy
35. Circle A Dairy
36. Bos Farms
37. Hamstra Dairy
38. Hollandia Farms
39. 4k Dairy
40. Ackerman Dairy
41. Aukeman Farms
42. Belonave Dairy
43. BV Dairy
44. Cornerstone Dairy
45. De Groot Dairy (North)
46. De Groot Dairy (South)
47. Decade Centralized Dairy
48. DJ South Dairy
49. Double J Dairy
50. Double L Dairy
51. Dykstra Dairy
52. 5H Dairy
53. FM Jerseys Dairy
54. Hoogendam Dairy
55. Horizon Jersey Dairy
56. Jacobus De Groot #2 Dairy
57. Little Rock Centralized Dairy
58. Lone Oak #1 Dairy
59. Double D Dairy
60. Meirinho Dairy
61. Mellema Dairy
62. Milky Way Dairy
63. Mineral King Dairy
64. Rancho Sierra Vista Dairy
65. Red Rock Dairy
66. River Ranch Dairy
67. Riverbend Dairy
68. Riverview Dairy
69. Rob Van Grouw Dairy
70. Rocking Horse Dairy
71. Rockshar Dairy
72. Sousa & Sousa Dairy
73. Udder Dairy
74. Valadao Dairy
75. Vander Poel Dairy
76. Vander Woude Dairy
77. Vista Verde Dairy
78. Western Sky Dairy
79. El Monte Dairy
80. Scheenstra Dairy
81. Antonio Brasil Dairy

*Temporarily Offline

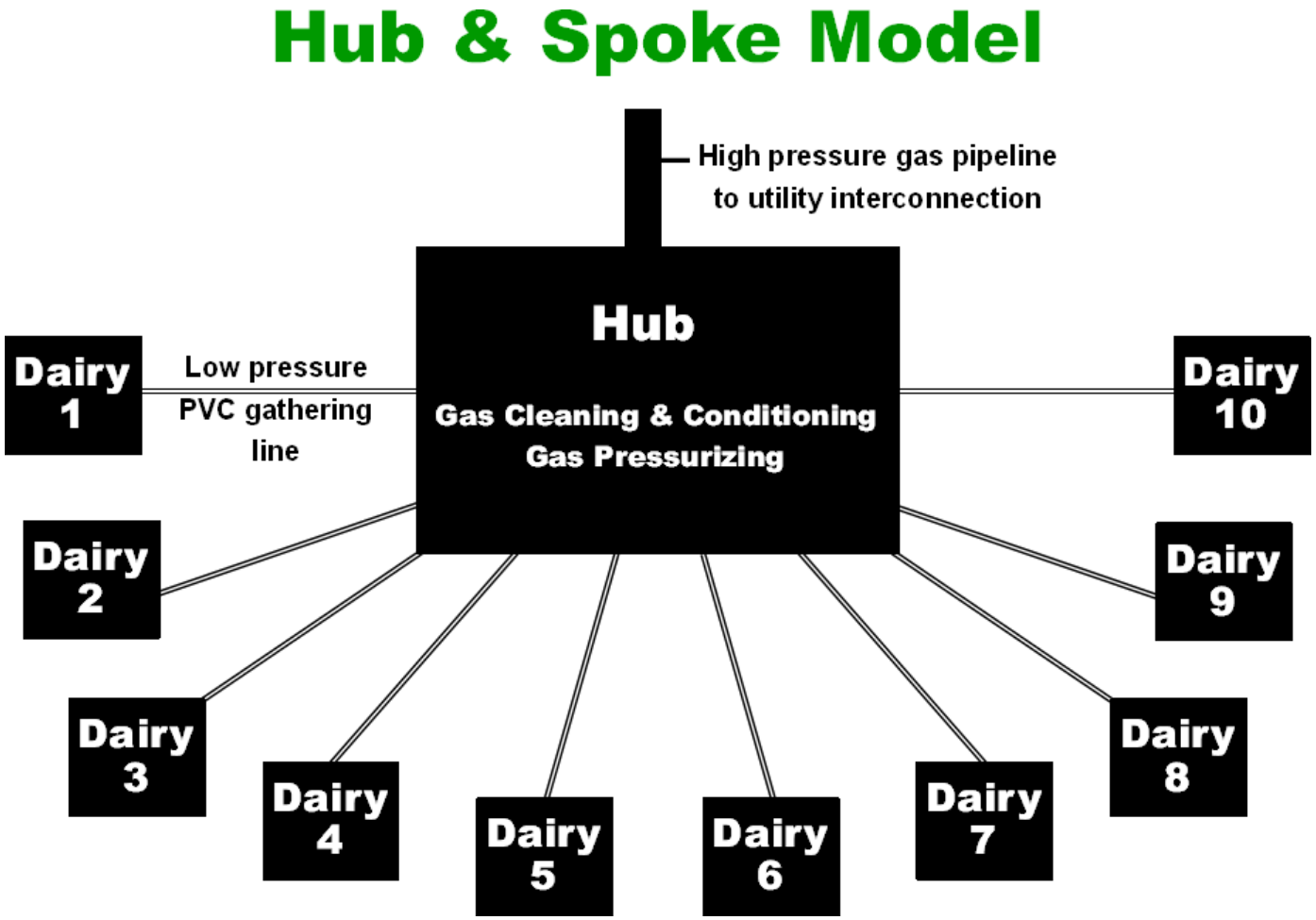
Updated March 2019

5 Topics for Discussion

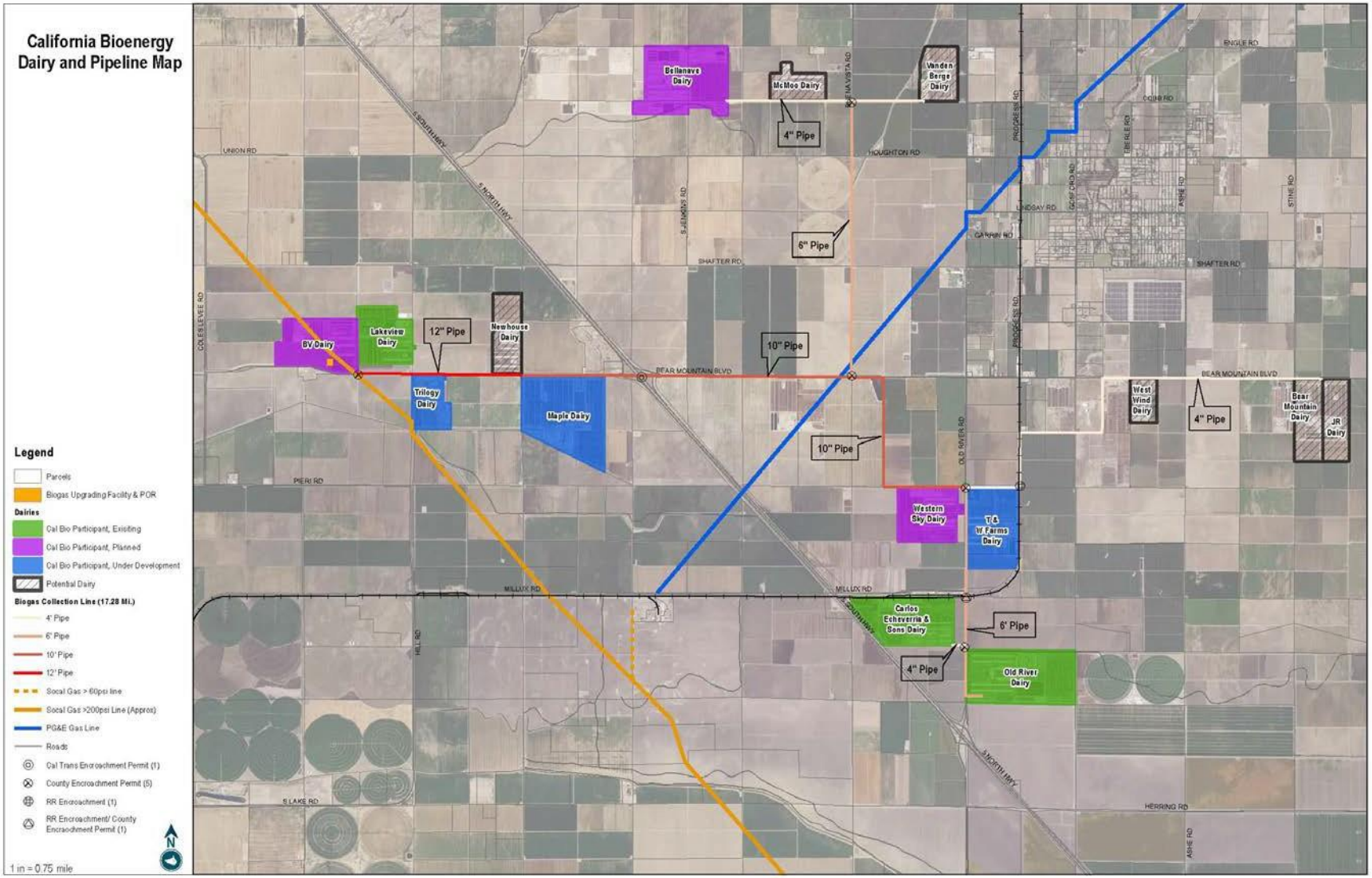
(2) Hub and Spoke Model

- A digester is at the dairy
- H2S is removed locally
- The dairy biogas is moved through a gathering line
- At a central location the biogas is upgraded to nearly pure methane
- The methane is injected into the pipeline

From Independent to Hub & Spoke



Kern Cluster: 15 dairies, 14 planned digesters



5 Topics for Discussion

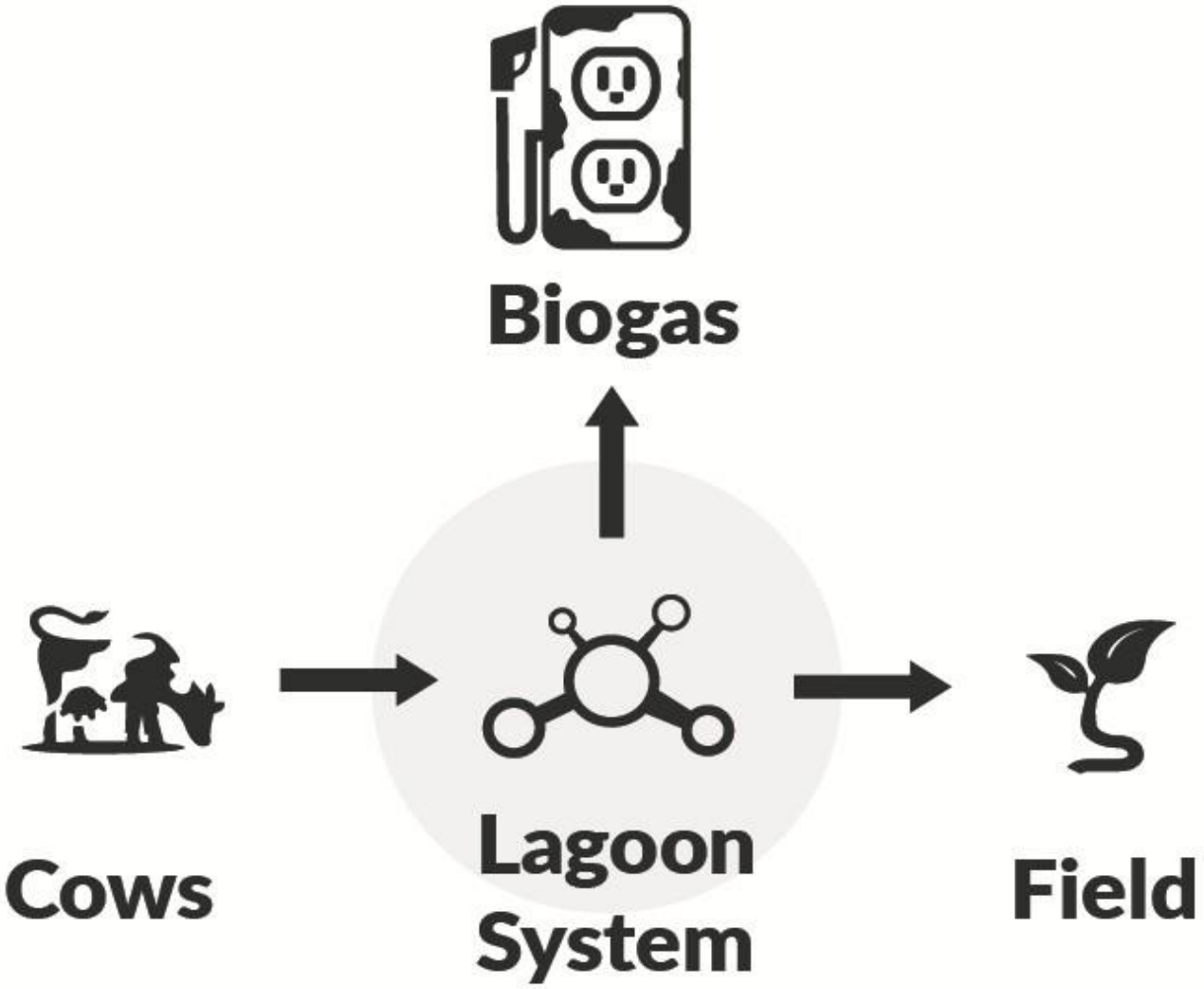
(3) How a Lagoon Digester Project Works

- In California manure is flushed with water into a lagoon system, where ambient temperature bacteria breakdown the manure releasing methane.

- The project integrates a covered lagoon digester into the flush manure management system.

- The covered lagoon captures the biogas composed of CH4, CO2, H2S and other gases.

How a digester works to produce biogas



Digester in Construction

1. Manure water is flushed

2. It goes over a separator and sand lane

3. Flows into a Covered Lagoon - Digester

3a. The Lagoon Digester is Double-Lined

3b. The Lagoon Digester Has Baffle Walls

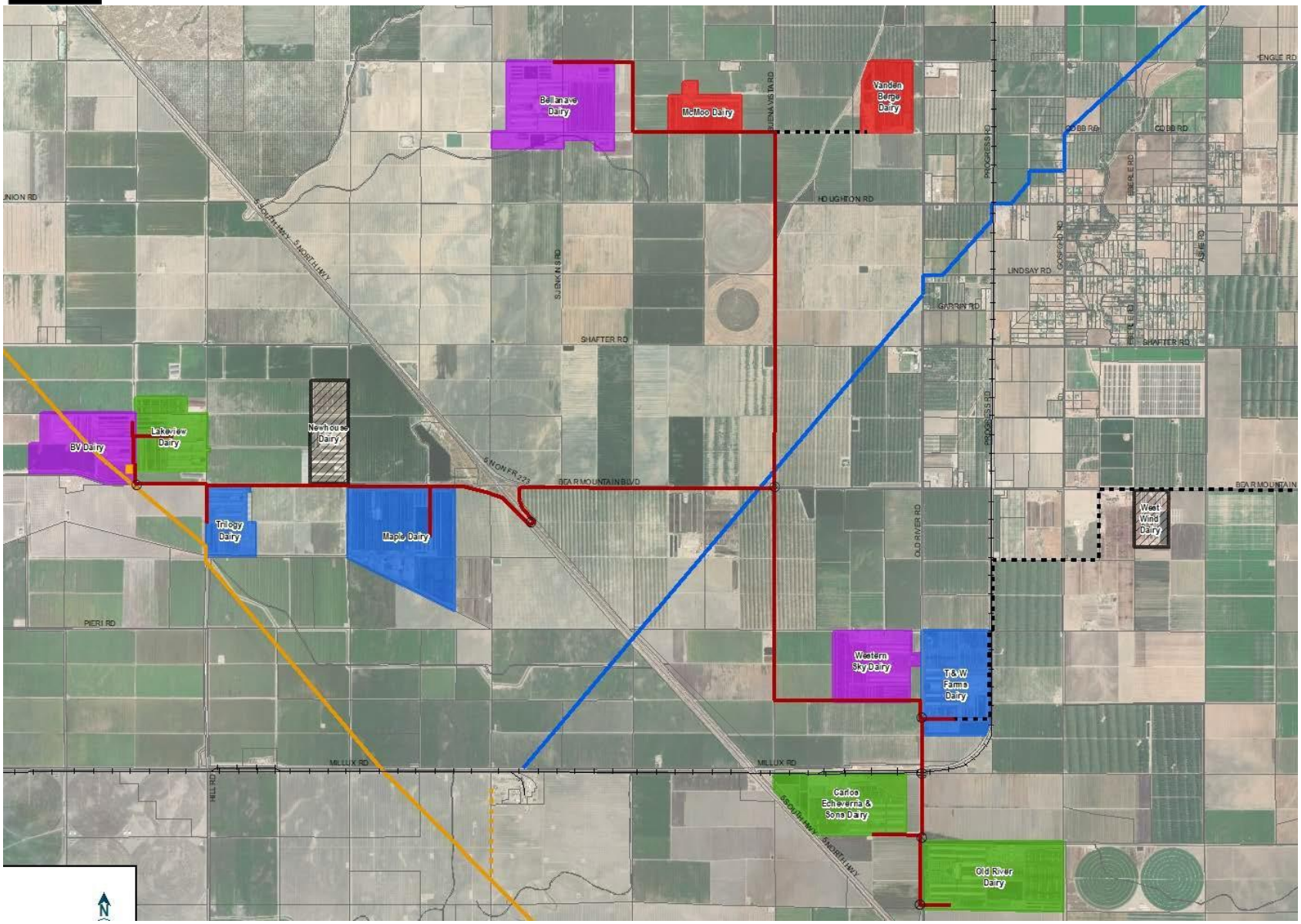
3c. The Lagoon Cover is Strong & Expands

4. H2S Removal

- H_2S
  - High, dangerous concentrations: 2000 to 5000 PPM
  - Risk to people. Corrosive to equipment
  - So vital to remove in pre-treatment
  - Gives dairies rotten egg smell, greatly reduced after cleanup
- Removal systems
  - Air injection under the cover
  - Iron sponge

4. H2S Gas Equipment

5. Gathering Line Connects the Dairies (in red)



6. Upgrading to CNG, Air Liquide System

- SoCalGas has high standards for quality of gas to be accepted
  - Greater than 97% methane at very high pressures
  - Nearly non-existent levels of H_2S, H_2O, and $CO2_2$
  - If requirements are not met, gas is rejected and vented into the atmosphere
- A very precise membrane that only allows CH_4 to flow

5 Topics for Discussion

(4) Economics

The value comes from the generation of "credits" from California's program and the U.S. EPA program

Fuel (CNG) versus Electricity

Fuel (R-CNG)

1. Price: $50-$95/MMBTU
   - CA's Low Carbon Fuel Standard
   - US EPA's RPS RINs (D-3)
   - Plus natural gas value
2. Bank history – risk adverse
   - Market based volatile pricing
3. Significant environ. benefits:

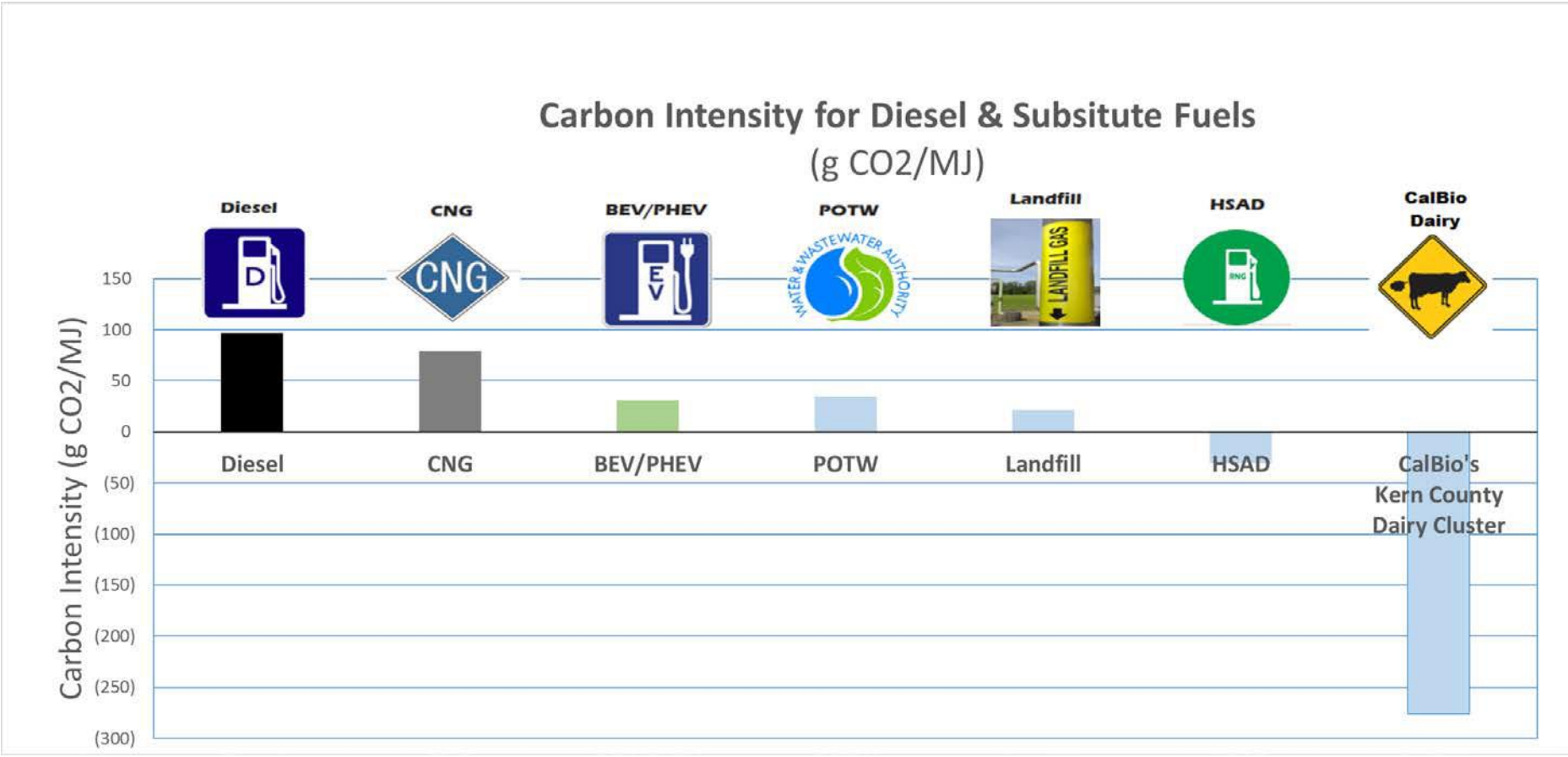
   NOx-pollution reductions

Electricity (options changing)

1. Price: $24/MMBTU or higher
   - Was electricity + GHG credits
   - Increasing with LCFS value
   - Potential future eRIN
2. Bank financeable with PPAs
   - Bank financing issues with LCFS
3. NOx emissions:

   Impact changing

The LCFS Values Relative Carbon Intensity



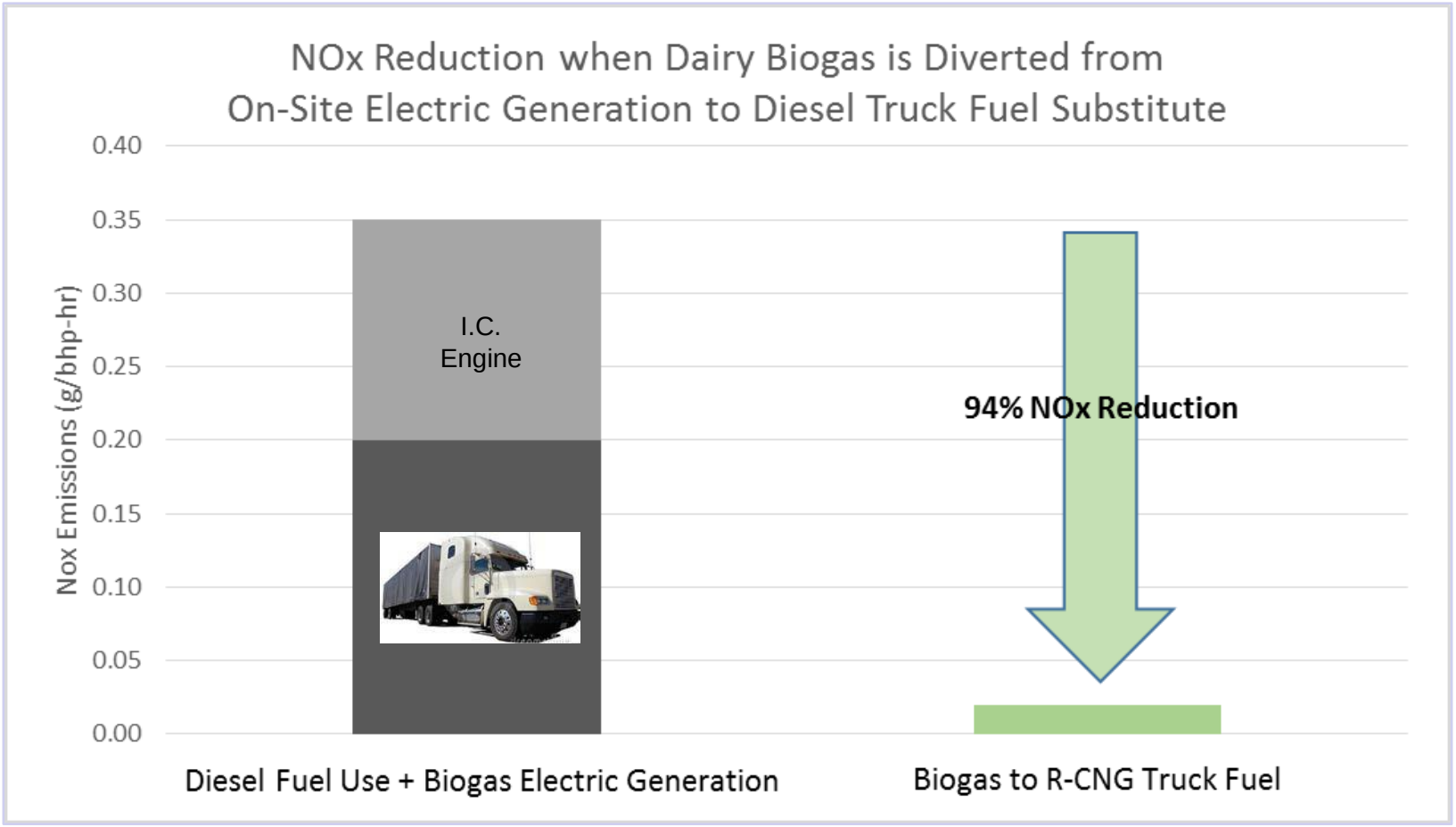
* California Bioenergy LLC: California Dairy Digester Biogas to CNG GREET 2.0, LCFS FP: CNG056, CI: -276.24

5 Topics for Discussion

(5) Other Environmental Benefits

- A lagoon digester collects the fugitive biogas
  - The methane is used as vehicle fuel.
- Natural gas trucks are significantly cleaner than diesel trucks

Dairy Biomethane for Fuel Reduces NOx



* Heavy-duty diesel engine at 0.2 g/bhp-hr NOx. Heavy-duty "NZ" NG engine at 0.02 g/bhp-hr Nox. Electric gen. at 0.15 g/bhp-hr BACT

San Joaquin Valley Air Quality Improvements

- One digester at a dairy of approximately 3000 cows reduces NOx emissions equivalent to taking 89 cars off the road. The displacement of diesel by CNG trucking fleets further reduces NOx by the equivalent of 5,971 cars
- A cluster of digesters (of approximately 24,000 cows) reduces NOx emissions equivalent to taking 40,837 cars off the road

CalBio Contact Information

Neil Black (President)

nblack@calbioenergy.com

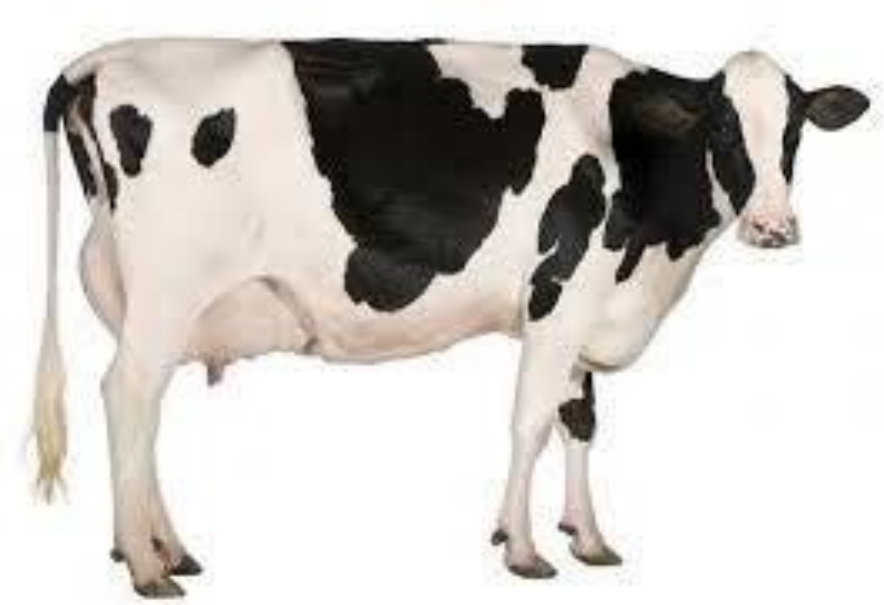
Any Questions?

Please contact us via email or at 559-667-9560

California Bioenergy

324 S. Santa Fe St., Suite B

Visalia, CA 93292



www.calbioenergy.com