G. Linking Potential Biomethane Production with Possible Off-Farm Markets in California's Central Valley: Geographic Case Studies

The following analysis focuses on compressed biomethane (CBM) as a substitute for compressed natural gas (CNG) in the transportation fuel market.

The analysis relies on the use of various data and geographic information system (GIS) maps to match areas with potentially high and sustainable biomethane production to local points of distribution for CNG as a transportation fuel. Additionally, the analysis includes three case studies of sites that may prove to be optimal for further research into siting a pilot/demonstration project. These case studies include the criteria and characteristics that identify them as potential locations for future projects or further studies.

The case studies examine only those areas with high production potential. They are not intended as comprehensive feasibility studies. Specifically, these case-studies do not explore the following:

- Financial costs to implement a pilot project
- Actual market demand for biomethane
- Opportunity costs for CNG users
- Transaction costs associated with the necessary plant and product permitting, product liability, establishing "rights of way," and determining market price points
- Political potential for support of renewable methane production from dairies at the local, state, and federal level

Selection Criteria for Regional Focus

Three broad criteria were used to select a geographic region for further analysis:

- High concentration of dairies
- Regional demand for CNG as a transportation fuel
- Potential impact on local environmental quality

As discussed below, the San Joaquin Valley fit all three criteria.

Concentration of Dairies

According to 2002 California Department of Food and Agriculture data (CDFA, 2004a), farmers in the state of California produced 35,065 million pounds of milk. Within California, 8 of the top 10 milk producing counties are located in the San Joaquin Valle (Table G-1). The other two counties are San Bernardino and Riverside, both in the Inland Empire.

Table G-1 Top Ten California Milk-Producing Counties

County	Thousands of Pounds of Milk Produced in 2002		
	Grade A	Grade B	Total
Tulare	8,928,146	27,204	8,955,350
Merced	4,729,013	55,209	4,784,222
Stanislaus	3,544,088	47,203	3,591,291
San Bernardino	3,319,084	9,547	3,328,631
Kings	2,819,534	6,607	2,826,141
San Joaquin	2,141,645	8,348	2,149,993
Riverside	2,047,366	1,835	2,049,201
Fresno	1,842,574	2,200	1,844,774
Kern	1,754,901	2,261	1,757,162
Madera	1,007,308	7,807	1,015,115
All other California counties	2,381,394	164,386	2,545,780
Total	34,515,053	332,607	34,847,660

Because the concentration of dairies plays a critical role in the analysis and case-studies, a calculation was made of dairy milk production as a function of the size of each of the top 10 milk-producing counties (Table G-2).

Table G-2 Amount of Milk Produced per Square Mile in California's Top Ten Milk-Producing Counties

County	Grade A	Grade B	Total	Square Miles	Pounds Milk / Square Mile
Tulare	8,928,146	27,204	8,955,350	4,884	1,834
Merced	4,729,013	55,209	4,784,222	2,008	2,383
Stanislaus	3,544,088	47,203	3,591,291	1,521	2,361
San Bernardino	3,319,084	9,547	3,328,631	20,164	165
Kings	2,819,534	6,607	2,826,141	1,436	1,968
San Joaquin	2,141,645	8,348	2,149,993	1,436	1,497
Riverside	2,047,366	1,835	2,049,201	7,243	283
Fresno	1,842,574	2,200	1,844,774	5,998	308
Kern	1,754,901	2,261	1,757,162	8,170	215
Madera	1,007,308	7,807	1,015,115	2,147	473
All other California counties	2,381,394	164,386	2,545,780	---	**---**
Total	34,515,053	332,607	34,847,660	---	---

While instructive, the numbers in Table G-2 can be deceptive. Milk production is highly concentrated in both San Bernardino and Riverside counties. However, the concentration of dairies per square mile is lower because these are two of the largest counties in the United States.

When viewed as a group, the top seven counties (in terms pounds of milk produced per square mile) form a contiguous area much larger than the two Inland Empire counties combined, despite their size.

As shown in Table G-2, the seven counties with the highest concentration of milk production per square mile are:

1. Tulare
2. Merced
3. Stanislaus
4. Kings
5. San Joaquin
6. Fresno
7. Madera

These seven counties in the San Joaquin Valley provide 72% of all the milk production in California. Together, they represent the densest concentration of milk production anywhere in the USA, and possibly, in the world. The characteristics of the dairies in some parts of the San Joaquin Valley would appear to support concentrating on the region. Also, the dairy industry is still growing in the Central Valley, while it is a mature industry and reportedly on the decline in both San Bernardino and Riverside County (CDFA, 2004b).

Because future pilot projects may rely on multiple variables (e.g., access to active landfills, wastewater treatment facilities, etc.) for selection of a project site, the ability to focus on one large, contiguous area that included several different county governments, with different levels of infrastructure investment, appeared to be beneficial.

Regional Demand for Compressed Natural Gas as a Transportation Fuel

According the San Joaquin Air Pollution Control District (District), the region is home to over 1,200 CNG vehicles. That total is equally divided between light-duty and heavy-duty vehicles, at roughly 600 vehicles each. However, we believe these numbers to be low, as the data only reflects the vehicles within the membership of the San Joaquin Clean City Coalition as of the end of 2003. The District also believes that there are 61 public and private CNG fueling stations within the region. However, the source of this data could not be produced when requested of the San Joaquin Valley Clean City Coalition. Regardless, accurate data from both the U.S. Department of Energy and WestStart-CALSTART was found on the number of known stations located within the San Joaquin Valley.

According to data compiled from the WestStart-CALSTART web site <http://www.weststart.org>, the San Joaquin Valley Clean Cities web site <http://www.valleycleancities.org/>, and the US DOE Alternative Fuels Data Center, the San Joaquin Valley has 23 verifiable CNG stations as opposed to 20 CNG stations in the Inland Empire counties.

Although Riverside County has 14 CNG fueling stations, which is the greatest concentration of CNG fueling stations of any 10 top milk producing counties in the state, on a regional basis there are a greater number of stations in the San Joaquin Valley. In terms of conducting a geographic analysis, the San Joaquin Valley appeared to provide more options both in terms of linking demand with supply, and in linking potential production facilities both with the dairies and with the market for CNG as transportation fuel.

Summary of Reasons for Selecting San Joaquin Valley as Geographic Focus

Seven of the eight San Joaquin Valley counties (Tulare, Merced, Stanislaus, Kings, San Joaquin, Fresno, and Madera Counties) were selected to be the focus of this GIS analysis for three complementary reasons:

- High concentration of dairies
- Substantive and dispersed demand for CNG as a transportation fuel
- Dairy's relative impact on local environmental quality

Data Sources

To conduct this initial analysis, we attempted to gather data on four different variables:

- Dairies
- CNG demand
- Landfills (both active and collecting methane) and wastewater treatment plants (collecting methane)
- Local businesses with high CNG demand

Dairies

The data we wanted to acquire about the dairies in the seven counties of the San Joaquin Valley included geographic location and herd size. This data was obtained from three sources. The data for Fresno, Kings, Madera, and Tulare Counties was obtained from Kerry Elliot of the Regional Water Quality Control Board Region 5, Fresno office. The data for Merced and Stanislaus counties was obtained from Polly Lowry from the Regional Water Quality Control Board Region 5, Rancho Cordova office. Data for San Joaquin County and some additional data for Merced County were obtained from Jess Sitre of the Merced County Dairy Program, in Merced. (Jess Sitre provided a file with dairy locations in Merced County, but the file did not contain the number of cows per farm.)

Except for Merced County, the data seemed to be complete in terms of location and estimates of herd size. For the latter, we used the number of milking cows at each dairy. Many dairy farms also have other non-milking producing cattle on-site, but these animals are generally not fed in the "feed lanes" that are flushed to remove manure. As a result, their waste product (manure) is generally unavailable for CNG production. See Annex G1 for additional information regarding the characteristics of the dairy industry in the San Joaquin Valley.

Demand for Compressed Natural Gas

Demand for CNG as a transportation fuel is rising in California. The California Energy Commission (CEC) projects that California's annual demand for CNG as a transportation fuel will rise 46 million to 150 million therms by 2020 (CEC, 2001). In terms of gasoline gallon equivalents, it was estimated that in 2002, California used between 59 million to 67 million "gallons" of CNG (CEC, 2003). Most of this CNG (70% to 80%) was consumed by medium- to heavy-duty vehicles of which there are 4,350 in the state (CEC, 2003). An estimated 607 such vehicles are operating in the San Joaquin Valley (Urata, 2003). This amounts to 14% of the state's medium- to heavy-duty CNG vehicle population. As a relative comparison, the population of the region is just under 12% of California total population.

Regional data concerning the demand for CNG as a transportation fuel and its location within the Central Valley could not be found. As a proxy for establishing total demand and its location, we selected known CNG fueling stations. This data was obtained from three sources:

- A report on alternative fuel vehicles by Linda Urata of the San Joaquin Valley Clean Cities Coalition (prepared for the San Joaquin Valley Pollution Control District in 2003)
- WestStart-CALSTART Clean Car Maps (2004)
- DOE "Clean Cities" web site (2004)

The last two sources are both interactive databases found on the web. The Clean Car Maps database from WestStart-CALSTART was browsed for all seven counties of interest. The Alternative Fuels Center database was browsed using a 35-mile radius for all major metropolitan centers in the seven counties. Most CNG stations were identified in all three sources. The Urata report claimed upwards of 60 CNG fueling stations in the region. However, detailed locations of only 21 of the stations were provided. Upon further investigation it was determined that most of the CNG sites that could not be located were simply private holding facilities for small fleets that were serviced by CNG deliveries via truck.

For future efforts that attempt to further assess the feasibility of biomethane projects, we recommend a more comprehensive survey of CNG fueling stations be conducted. There are two reasons for this. First, the data from web sources does not appear to be updated often enough to be comprehensive. Additionally, each web-based database contained a different number of total

stations. Also, the data from Clean Cities Coalition needs to be more detailed in terms of both location and the annual equivalent (in millions of gallons) of CNG dispensed by each station.

Landfills and Wastewater Treatment Facilities

To build a system capable of economically converting dairy methane biogas into transportation fuel, other research indicated the necessity of using large waste-handling facilities as aggregators and/or processors of the fuel. To satisfy this requirement, data was collected on landfills and wastewater treatment facilities in the seven-county area that currently collect and/or process methane as a by-product of their operations. This data was obtained from the California Energy Commission's "List of Waste to Energy Power Plants in California" (<http://www.energy.ca.gov/development/biomass/index.html>).

Local Businesses with High Demand for Compressed Natural Gas

Prior to the research team's trip to Europe (see main report), data was collected on the natural gas demand of local businesses within the San Joaquin Valley from Dun & Bradstreet (<http://www.zapdata.com>). To determine natural gas usage, the Dun &Bradstreet industry information was cross-referenced by SIC code to the average energy consumption, which was provided by the DOE (Unruh, 2004).

Analysis of the Accuracy of Data Collected

Prior to conducting our analysis, we sought to determine the accuracy of two key variables: the number of cows per dairy and data point location. These data points included not only each dairy but also the CNG stations, wastewater treatment facilities, landfills, and business utilizing CNG. In terms of the number of cows per dairy, the only record of the number of cows per county and the number of dairies per county available from California State government resources was reported data from 1998 and 1999 (CEC, 2004). As mentioned previously, these numbers represent the number of milking cows, not total herd size.

The data is up to five years old and the CDFA (2004b) reports significant changes in the number of dairy farms each year. However, we believe the 1999 data can be used to determine the reasonableness of the data that we collected. The percentage differences between this 1999 data and the data we used are provided in Annex G2.

Annex G2 shows that the number of cows per farm in Madera has significantly increased while the number of dairy farms has remained consistent. Tulare County experienced a small increase in the number of farms and the number of cows. San Joaquin and Stanislaus Counties both experienced a decrease in the number of farms and in the number of cows. The one county where the data we received does not appear to be complete is Merced County. However, we feel we have compensated for this. Refer to Annex G2 for a fuller discussion.

We used several sources to determine the accuracy of the geocoded longitude and latitude location of facilities. Please see Annex G2 for a full description.

Determination of Viable Project Locations

The methodology we used to determine the best locations for biomethane projects in the seven-county area is described below.

Initial Criteria: Nearby Fueling Stations

Research conducted in Europe determined that one of the more ideal off-farm uses of biomethane is as renewable natural gas for transportation uses. Based on this assumption, we sought data on the location of public and private CNG distribution stations in the San Joaquin Valley. An ideal scenario for a biomethane project would be a situation in which locally produced biomethane would be blended with CNG at nearby filling stations and utilized by CNG vehicle drivers.

First, even before we conducted a GIS analysis, we identified an initial 400-square-mile area surrounding each known CNG station location. The 400-square-mile area was centered at the CNG station and extended 10 miles in each direction: to the north, south, east, and west (Figure G-1).

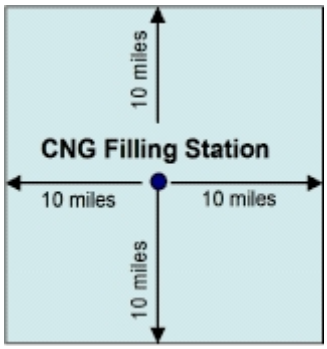


Figure G-1 Identification of 400-Square-Mile Area around CNG Filling Station

All of the dairy farms, wastewater treatment plants, landfills, and other CNG stations located within this initial area were then identified (through an analysis of their geocodes), relative to the main CNG station. The locations were ranked based on the purported number dairy cows nearby.

Initial Site Rankings: Proximity to Dairies

Table G-3 provides a list of the sites ranked according to their proximity to dairies. The table does not include CNG fueling locations that had no cows in the surrounding 400-square-mile area. (A complete list of all CNG stations that were included in this analysis is included in Annex G3).

The initial analysis identified three locations with more than 100,000 nearby cows. Detailed maps were then made of these top three sites (Tulare FleetStar, FleetStar – SoCal Gas, and Kings County Yard/PFC) to enable further study. Additionally, a detailed map was also made of the fourth-ranked site (W.H. Breshear's FleetStar) for two reasons. First, the number of dairies relative to the number of overall cattle could indicate a very concentrated local industry. Second, the local concentration of businesses using a substantial amount of natural gas indicated other potential markets for the CBM outside of the transportation sector. Due to limited resources, we did not further investigate the remaining 14 locations shown in Table G-3. See Annex G4 for site descriptions of the sites ranked 4 through 8.

Table G-3 Initial Ranking of CNG Filling Stations Based on Number of Cows in Surrounding Area

Rank	CNG Location	Cows	Dairies	Wastewater Treatment	Landfill	Other CNG Stations
1	City of Tulare – FleetStar [a]	269,897	235	3	6	0
2	FleetStar - SoCal Gas [a]	132,291	129	3	5	0
3	Kings County Yard/PFC [a]	129,766	150	0	2	1
4	W.H. Breshear's – FleetStar [a]	77,212	160	0	10	0
5	PG&E Merced Service Center [a]	*68,600*	92	0	3	0
6	Lemoore NAS	61,979	92	0	2	1
7	Kings Canyon Unified Sch. Dist.[a]	40,048	30	0	0	0
8	Tesei Petroleum [a]	37,488	30	0	2	0
9	City of Fresno Service Center	17,924	27	1	4	4
10	Visa Petroleum	14,424	23	1	7	4
11	Pinnacle CNG/UPS	12,324	21	1	7	4
12	San Joaquin County	10,895	29	3	9	1
13	PG&E Stockton Service Center	9,395	17	3	10	1
14	CSU Fresno	7,273	11	1	7	4
15	E.F. Kludt and Sons	7,245	12	0	1	0
16	Clovis Unified School District	4,840	6	0	5	4
17	Gibbs Auto Fuel Station	4,475	7	0	1	1
18	City of Delano	2,050	2	0	2	0

[a] These CNG stations are described in detail in this study.

GIS Analysis: More In-depth Rankings

The initial analysis helped guide our selection of CNG sites for further analysis using GIS, a method that can provide more complete results. Our initial analysis examined only the total numbers of cows and potential facilities where biogas might be collected and upgraded; the GIS analysis would provide the additional detail needed for this study.

The upgrading of dairy biogas into a transportation fuel (biomethane) is capital intensive. In most cases, installation of an upgrading plant would be too expensive and complex for a single dairy —or even a group of dairies—to install and operate. Through GIS analysis, the location of

existing wastewater treatment facilities and landfills that were already processing methane could be identified and cross-checked against areas with high concentrations of dairy cows.

We began the GIS analysis by working backwards from the "point of demand" (i.e., the CNG station). First, we sought to determine first the number of cows and infrastructure within a 9-mile radius of the CNG station. Next, we sought to determine the number of cows within an approximate 3-mile radius of any identified infrastructure.

Table G-4 Ranking of Wastewater Treatment Facilities and Landfills in Proximity to Dairies

Rank	Facility Name (Wastewater Treatment Plant or Landfill)	Number and Potential Production of Wastewater Treatment Facilities, Landfills, and Nearby Dairies (9-mile radius)			
		Infrastructure	Dairies	Cows	Annual Biomethane Potential a (million ft^3)
City of Tulare		5	98	124,209	1,360
1	New Era #2		25	41,867	458
2	New Era #1		33	38,670	423
3	Soil Food		30	37,566	411
4	Woodville Disposal		21	29,971	328
8	Tulare County		18	12,685	139
SoCal Gas, Visalia		5	42	41,446	454
5	Wood Industries		21	23,715	260
6	Tulare County		29	16, 835	184
7	Visalia Disposal		9	13,681	150
	Other 2 are two small				0
Kings County Yard/PFC		2	73	59,930	656
9	KWRA Materials & Composting		17	11,299	124
10	Hanford City Wastewater Treatment		11	7,329	80
W.H. Breshear's of Modesto (Incorporates 4 other facilities)		5	77	35,565	389
11	Central Valley		14	4,870	53
12	Bonzi		13	4,305	47
13	City of Modesto		7	3,930	43

[a] Biomethane potential assumes 30 ft^3 biomethane per cow per day

While the selection of the 9-mile radius was relatively arbitrary—an attempt on our part to simply hold down the transportation and delivery costs of the refined and potentially compressed biomethane—the 3-mile radius around the infrastructure was not. It was selected because of the high variable costs of moving manure to a centralized point and/or the high capital costs of

permitting and installing piping to carry the raw biogas from on-farm anaerobic digesters to an aggregating facility.

Using only the top four CNG sites identified in the initial analysis, we then ranked the surrounding infrastructure within the nine mile radius based on their potential annual biomethane production from dairies within three miles of them. The table below organizes these sites around the CNG stations they would serve and supplies each one with a corresponding rank. Each of the four filling stations shows the potential volume of biomethane within a 9-mile radius; landfills and wastewater treatment plants within the 9-mile radius of the filling station are listed below each filling station. Next to each landfill or treatment plan is the potential volume of biomethane within a 3-mile radius of that facility. If the facility is on the edge of the original 9-mile radius, then its 3-mile radius may incorporate a dairy that is outside the filling station's 9-mile radius.

What we found was that the most promising pilot/demonstration project sites would almost all be centered on the CNG station in the City of Tulare. Table G-5 compares the results of the initial to those of the GIS survey, with the given parameters.

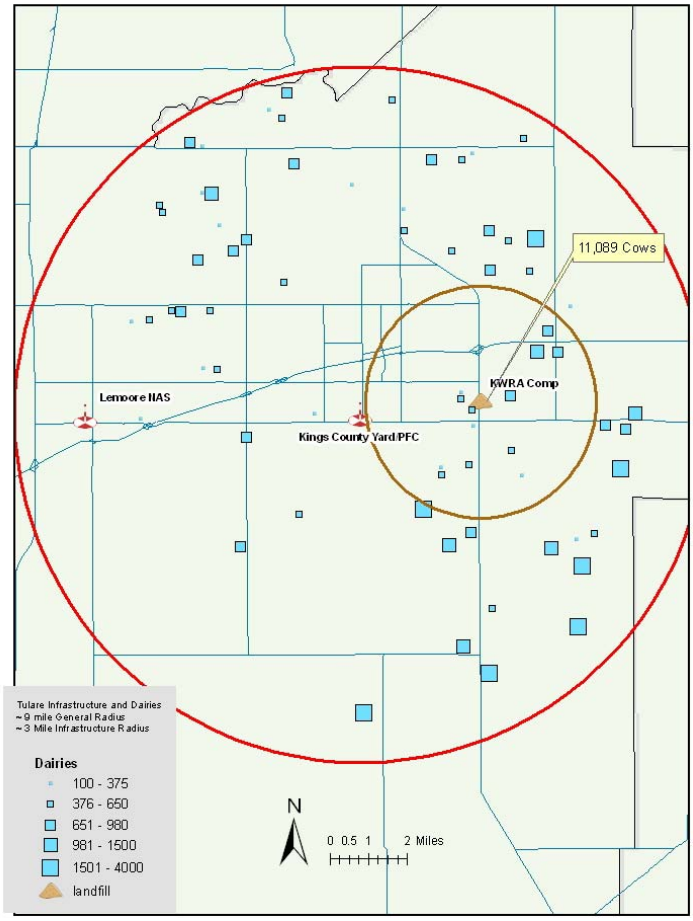
Table G-5 Comparison of Sites Based on Initial and GIS Rankings

	City of Tulare		**SoCalGas, Visalia**		**Kings County Yard**		**W.H. Breshear of Modesto**	
	400 mi^2	**9-mi radius**	**400 mi^2**	**9-mi radius**	**400 mi^2**	**9-mi radius**	**400 mi^2**	**9-mi radius**
Cows	269,897	124,209	132,291	41,446	129,766	59,930	77,212	35,565
Dairies	235	98	129	42	150	73	160	77
Annual Biomethane Potential (million ft3)	2,945	1,360	1,448	453	1,421	656	845	389
Infrastructure and other CNG Facilities	9	5	8	5	3	2	10	5

What seemed like promising sites after the initial analysis looked less promising on the basis of the GIS analysis. For example, the Kings County Yard CNG Station initially seemed appealing as its overlap with the Lemoore NAS indicated that these two stations might be able to somehow work in conjunction (e.g., sharing costs for biomethane aggregation and processing equipment). Additionally, under EPAct, the federal facility is under a mandate to use alternative fuels for up to 20% of their fleet vehicles. Based on the GIS analysis, however, this promising location would most likely not make a good spot for a pilot/demonstration project due to the low concentration of nearby dairies around local infrastructure (see Map 1).

Map 1

Proximity Analysis of Dairies to Infrastructure
- Kings County Yard, Hanford -



Additional Data

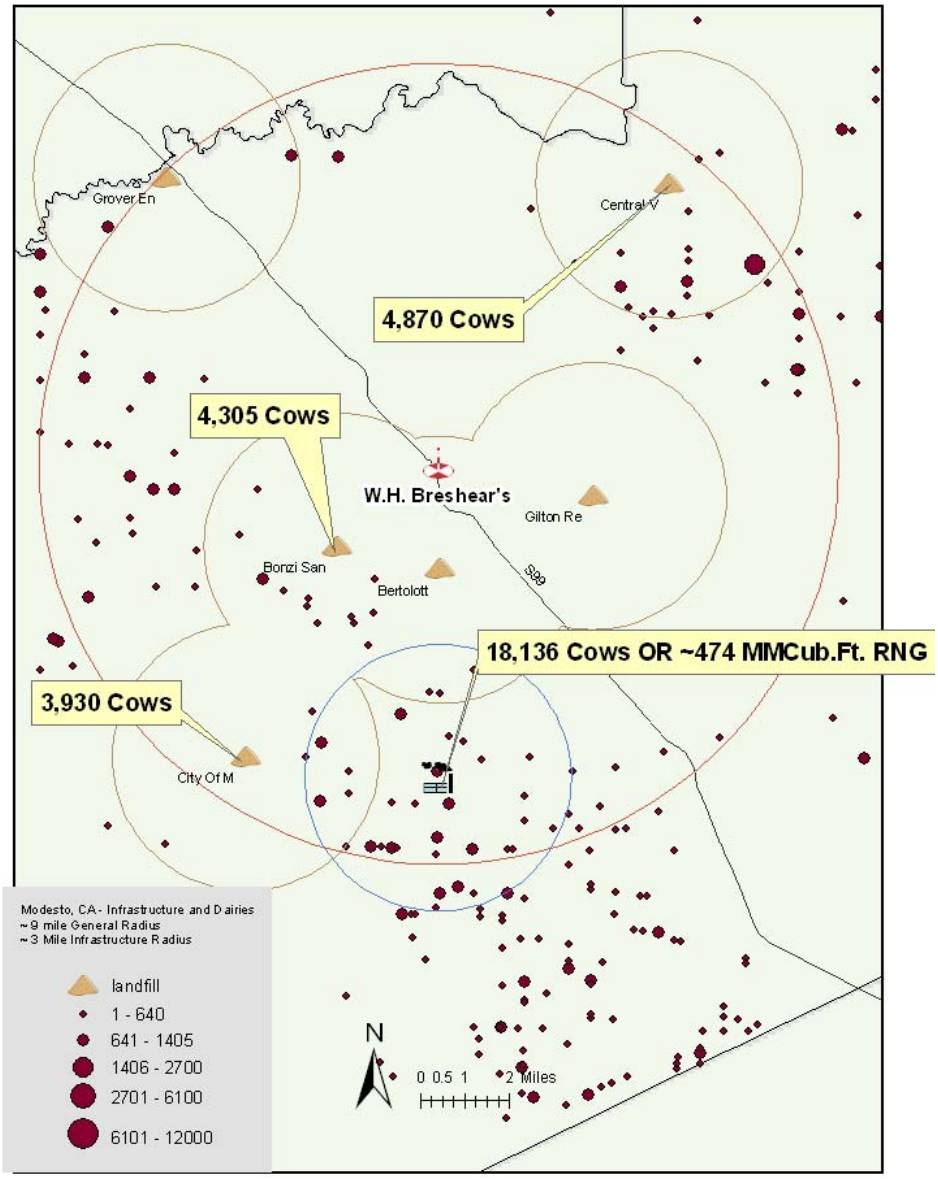
In addition to the data collected on dairies, CNG facilities, wastewater treatment plants, and landfills, data was also collected on local businesses with high natural gas usage. This data was gathered initially as it was unknown as to what type of final biomethane "end-use" would be selected from the research done in Europe. We hoped that understanding the locations and demands of businesses with high demand for natural gas a potential might provide an insight into potential markets for dairy biomethane production.

Ultimately, it was determined that biomethane as a transportation fuel made the most economic sense for future pilot projects. Consequently, the number of potential biomethane end-use industries was not used to rank the locations. However, this information was included in the discussion of the sites because such buyers could provide an alternate market for excess biomethane.

It is interesting to note that in the analysis of Site #4, W.H. Breshear's of Modesto, the most compelling case for using biomethane involves a business with a large CNG demand. In fact this business is surrounded by more dairies than any landfill or wastewater treatment facility combined (see Map 2 below).

Map 2

Proximity Analysis of Dairies to Infrastructure
- CNG Using Industry Near Modesto, CA -



Description of Sites

The following four case studies of the highest ranked sites (see Table 3) use raw GIS data to conduct cursory analyses of the potential for future research pilot/demonstration projects using biomethane as a transportation fuel. With the exception of Site #4, we chose 100,000 dairy cows as an arbitrary "cut-off" point for in-depth GIS analysis. For information on other top-ranked sites, please refer to Annex G4, which contains much of the same ranking information without accompanying maps.

Site #1: City of Tulare, FleetStar

The number 1 ranked location is the City of Tulare FleetStar station. The exact location is:

3989 S K Street
Tulare, CA 93274

This CNG station allows public access with restrictions. In 2003, the station sold 84,000 gasoline gallon equivalents of CNG (Al Miller, City of Tulare, personal communication).

This facility is located at the southern spur of the city of Tulare, Tulare County, in the Southern California Edison service territory (this service area is included as Annex G5). The facility is within a half mile of Highway 99. Of the 235 dairies in the area, 232 are located in Tulare County and 3 are located in Kings County. According to the 2000 US Census data (2002), the City of Tulare has a population of 43, 994. The breakdown on "customers" for this station was 18 heavy-duty CNG vehicles and 42 light-duty CNG vehicles. The station is unique in that it receives LNG and converts it to CNG as needed.

The wastewater treatment plants and landfills located in the area of initial analysis are listed below. The following map (Map 3) details a smaller area that includes 9 miles around the CNG Station; only five wastewater treatment plants and landfills are included in this smaller zone. For more information about these facilities, see annexes G6 and G7.

1. City Of Tulare
   1875 South West Street
   Tulare, CA
2. Royal Farms #1 - #2
   Tulare, CA 93274
3. Tulare County Landfill and Recycling Complex
   26951 Road 140
   Visalia, CA 93292
4. New Era Farm Service #2
   Jim Nance Dairy
   6440 Ave 160
   Tulare, CA

5. New Era Farm Service #1
   Hoffman Dairy Ave 216 & Rd 140
   Tulare, CA

6. Tulare County Compost and Biomass
   24487 Road 140
   Tulare, CA

7. Soil Foods, Inc.
   20002 Road 140
   Tulare, CA

9. Woodville Disposal Site
   Rd 152 At Ave 198
   Tulare, CA

Three of the sites mentioned above—the City of Tulare, Royal Farms, and Tulare County—all currently generate electricity by burning methane produced by animal waste. The City of Tulare's plant is 0.41 MW, the Royal Farm is 0.18 MW and the Tulare County Landfill is 1.9 MW.

There are three businesses within the area of analysis that use large amounts of natural gas. Based on industrial sales and national average industry natural gas usage for these businesses, we estimate that these three locations would use a total of 129,564,000 kBtu/year.

The three businesses are:

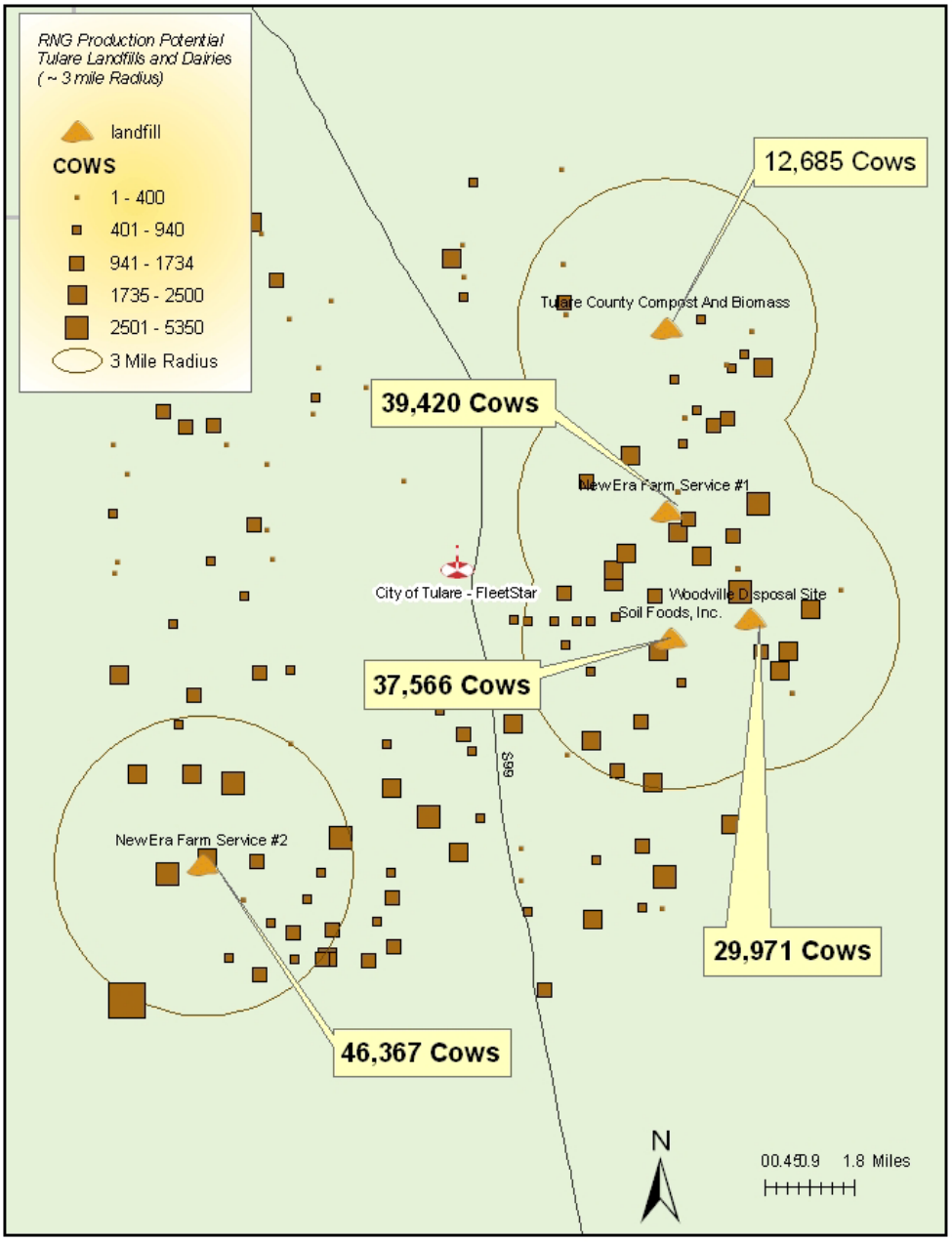
1. JIT Steel Inc
   2000 S O St
   Tulare, CA 93274
   Process sheet metal
   Estimated Natural Gas usage = 33,400,000 kBtu/year

2. Golden Valley Dairy Products
   1025 E Bardsley Ave
   Tulare, CA 93274
   Mfg cheese and whole dairy products
   Estimated Natural Gas usage = 45,124,000 kBtu/year

3. CP International
   800 E Paige Ave
   Tulare, CA 93274
   Mozzarella cheese & whey manufacturing
   Estimated Natural Gas usage = 51,040,000 kBtu/year

Map 3

Proximity Analysis of Dairies to Infrastructure
- City of Tulare CNG Station -



Site #2: Visalia SoCal Gas, FleetStar

The second ranked location is the Visalia's SoCal Gas-FleetStar. The exact location is:

FleetStar-SoCal Gas
320 N Tipton Street
Visalia, CA 93292

This CNG location distributed 63,000 gasoline gallon equivalents of CNG in 2003.

This facility is located on the western end of the city of Visalia, Tulare County, and is approximately 18 miles NNW of Site #1. The 2000 US Census (2002) states that the city of Visalia had a population of 91,565. The CNG facility is within two miles of Highway 198, which provides easy access to Highway 99. The CNG station is in Southern California Edison's service territory (Annex G5).

Of the 129 dairies in the surrounding area, 127 are located in Tulare County and 2 are located in Fresno County. Much of the area surrounding this site and Site #1 overlap, including 72 dairies, 3 of the infrastructure facilities identified previously, and 2 of the 3 major industrial users of CNG identified. Please refer to the accompanying map (Map 4) for more details.

The wastewater treatment plants and landfills located in the area of initial analysis are listed below. The following map details a smaller area of 9 miles around the CNG Station and includes only three of these facilities. For more information about all the facilities, see annexes G6 and G7. Again, the first three landfill locations are identical to locations identified in Site #1 but are not shown on the following map as they are outside of the nine mile radius of analysis.

1. Tulare County Recycling Complex
   26951 Road 140
   Visalia, CA

2. Tulare County Compost and Biomass
   24487 Road 140
   Tulare, CA

3. Woodville Disposal Site
   Rd 152 at Ave 198
   Tulare, CA

4. Sunset Material Recovery Facility
   1707 East Goshen Road
   Visalia, CA

5. Visalia Disposal Site
   Rd 80 at Ave 332
   Visalia, CA

Two of the three businesses listed below were identified previously and are within the initial analysis area of Tulare's SoCal Gas CNG station. Based on the industries' sales and national average industry natural gas usage, it is estimated that these three locations would use a total of 124,924,000 kBtu/year. Please refer to the following map for greater details. The three businesses are:

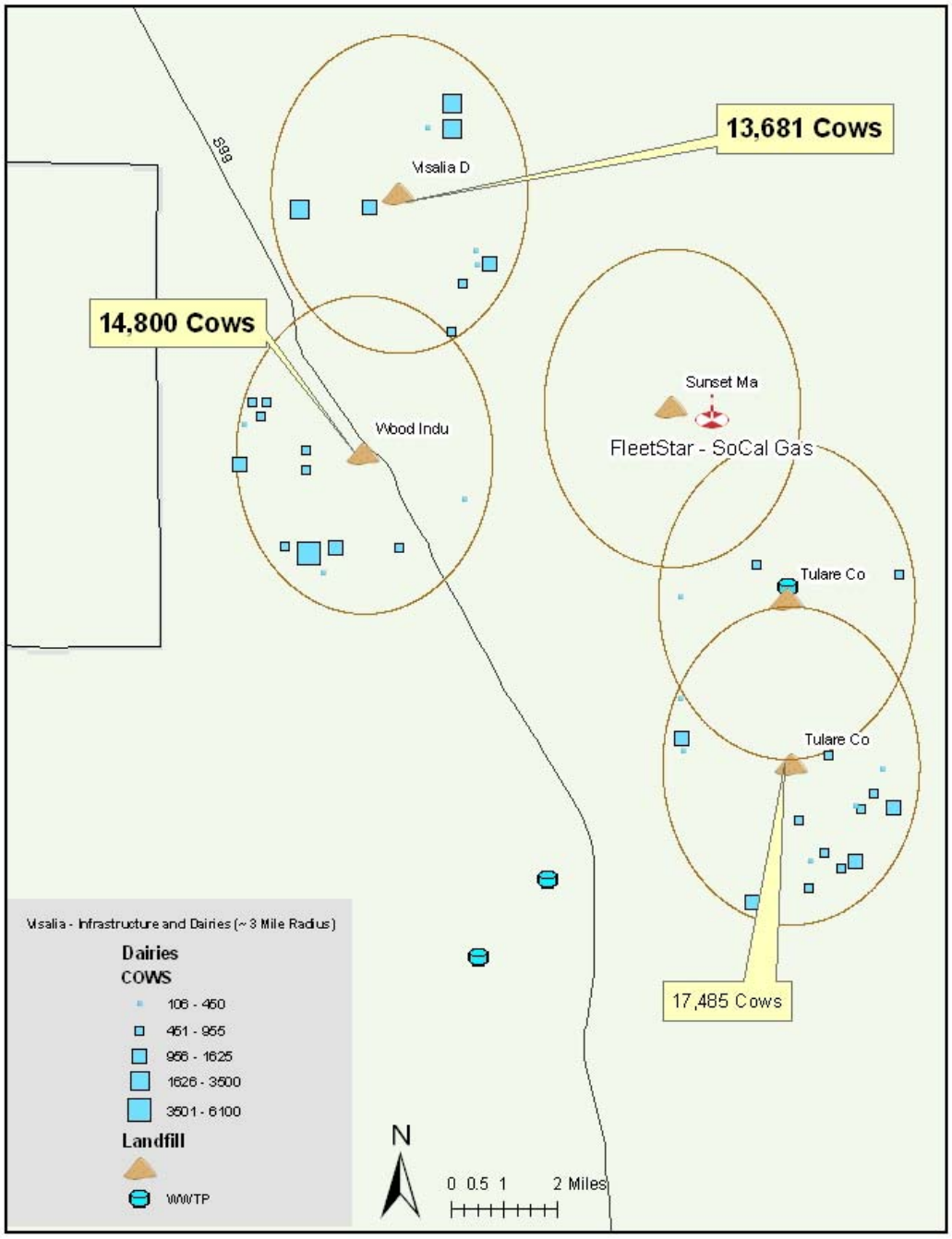
1. JIT Steel Inc
   2000 S O St
   Tulare, CA 93274
   Process sheet metal
   Estimated Natural Gas usage = 33,400,000 kBtu/year

2. Golden Valley Dairy Products
   1025 E Bardsley Ave
   Tulare, CA 93274
   Mfg cheese and whole dairy products
   Estimated Natural Gas usage = 45,124,000 kBtu/year

3. California Pretzel Co Inc
   7607 W Goshen Ave
   Visalia, CA 93278
   Pretzel and cookie production
   Estimated Natural Gas usage = 46,400,000 kBtu/year

Map 4

Proximity Analysis of Dairies to Infrastructure
- SoCalGas CNG Station, Visalia -



Site #3: Kings County Yard/PFC

The third ranked location is the Visalia SoCal Gas-FleetStar. The exact location is:

Kings County Yard/PFC
11827 S 11th Ave
Hanford, CA 93230

This CNG location allows public access with restrictions. In 2003, the station sold 45,000 gasoline gallon equivalents of CNG.

This facility is located in the southern half of the city of Hanford, in Kings County. According to the 2000 US Census (2002) the city of Hanford had a population of 41,685. The CNG station is also within 2 miles of Highway 198, providing easy access to Highway 99. Of the 150 dairies in the surrounding area, 116 are located in Kings County, 23 are located in Tulare County, and 11 are located in Fresno County. The CNG station is also in Southern California Edison's service territory (Annex G5).

Not surprisingly given the concentration of dairies in the region, the initial analysis of this site had a portion of the area surrounding this location overlapping with both Site #1 and Site #2. To be exact, there are 5 dairies that fall within the overlap with Site #1, and 24 dairies with Site #2. However, none the sites showed overlap under the more tightly focused GIS analysis.

Of the 30,000 gallon equivalents distributed by the Kings County CNG station, it was estimated that 33% was used by medium-to-heavy-duty vehicles.

Our analysis only indicated one wastewater treatment facility in the area of initial analysis surrounding this site and one landfill actively collecting and utilizing methane. The locations are:

1. KWRA Material Recovery and Composting Facility
   7803 Hanford-Armona Rd.
   Hanford, CA 93230

2. City of Hanford Waste Water Treatment Plant
   1055 Houston Ave.
   Hanford, CA 93230

As mentioned previously, there is another CNG filling station close by: the CNG station located near the Lemoore Naval Air Station (NAS). The Lemoore station is just 10 miles west of the Kings County CNG station. There are fewer than half the number of cows and dairies near the Lemoore location than there are near the Kings County CNG station. This is because of the significant size of the Lemoore NAS facility. The Lemoore NAS CNG station is a government site and there is no public access, however, federal facilities are under a mandate (EPAct) to use cleaner burning and/or renewable fuels in their fleet vehicles (up to 20%). Further investigation is necessary, but this site may provide an outlet for biomethane aggregated and refined at one of the two nearby infrastructure facilities.

Additionally, there are four businesses near the CNG station. Based on industrial sales and the national average natural gas usage for these industries, it is estimated that these four businesses would use a total of 342,930,000 kBtu/year. The four businesses, which represent a small additional potential demand, include the following:

1. Central Valley Meat Co Inc
   10431 8 3/4 Ave
   Hanford, CA 93230
   Meat Packing Plants
   Estimated Natural Gas usage = 52,896,000 kBtu/year

2. Mineral King Minerals Inc
   10585 Industrial Ave
   Hanford, CA 93230
   Nitrogenous Fertilizers
   Estimated Natural Gas usage = 51,487,500 kBtu/year

3. Moore Agricultural Products Co
   11521 Excelsior Ave
   Hanford, CA 93230
   Nitrogenous fertilizers
   Estimated Natural Gas usage = 188,318,023 kBtu/year

4. SK Foods
   1175 19th Ave
   Lemoore, CA 93245
   Canned Fruits and Specialties
   Estimated Natural Gas usage = 50,228,000 kBtu/year

Site #4

The fourth ranked location is W.H. Breshear's FleetStar, located at 428 7th Street, Modesto, California 95354. This CNG station will be shut down in December of 2004 due to the low volume of sales (personal conversation with FleetStar company representative).

This facility is located in the center of the City of Modesto in Stanislaus County. According to the US Census data for 2000 (2002), the city of Hanford had a population of 188,856. The facility is within a half mile of Highway 99. Of the 160 dairies in the surrounding area, 157 are located in Stanislaus County and 3 are located in San Joaquin County. Modesto has a history of using biomethane to fuel its fleet vehicles. However, the system was destroyed by a flood in the mid-1990s and was never repaired.

The dairies in this area are smaller than in the top three sites and thus it may take more work to coordinate biomethane production. Yet, there is a long history of dairies operating in this area. A combination of factors led us to believe that despite the higher number of dairies and smaller herd size, these dairies may be geographically concentrated that could compensate for such hurdles.

There is only one major wastewater treatment plant in the area. This facility is owned by the City of Modesto and does not currently collect methane for any purposes.

There are 10 landfills listed in the area, but many of them overlap. In all, there are only 5 distinct sites. This still shows a number of potential collaborating partners that could provide biomethane aggregating and processing capabilities for the numerous dairies. The 8 landfills, listed below, are shown on the Map 2. For more information about the landfills see Annex G7.

1. Grover Environmental Products/Salida
   6131 Hammett Road
   Modesto, CA 95358

2. City Of Modesto Co-Compost Project
   7007 Jennings Road
   Modesto, CA 95358

3. Modesto Disposal Svc TS/Res Rec Fac
   2769 West Hatch Road
   Modesto, CA 95358

4. Bonzi Sanitary Landfill
   2650 West Hatch Road
   Modesto, CA 95358

5. Bertolotti Transfer & Recycling Center
   231 Flamingo Drive
   Modesto, CA 95358

6. Valley Wood Disposal
   1800 Reliance Street
   Modesto, CA 95358

7. Gilton Resource Recovery
   800 S. McClure Rd.
   Modesto, CA 95357

8. Central Valley Agricultural Grinding, Inc.
   5707 Langworth Road
   Modesto, CA 95357

Twelve businesses in the area use a substantial amount of natural gas. This Modesto site provides the largest number and volume of alternative uses for biomethane. Accordingly, it minimizes the market risks associated with dependency on a single CNG filling station.

1. Formulation Technology Inc
   571 Armstrong Way
   Oakdale, CA 95361
   Intravenous solutions
   Estimated Natural Gas usage = 109,153,500 kBtu/year

2. Valley Fresh Inc
   680 D St
   Turlock, CA 95380
   Poultry, processed: canned
   Estimated Natural Gas usage = 162,168,000 kBtu/year

3. Sensient Dehydrated Flavors
   151 S Walnut Rd
   Turlock, CA 95380
   Vegetables, dried or dehydrated (except freeze-dried)
   Estimated Natural Gas usage = 150,800,000 kBtu/year

4. Pacific Southwest Cont LLC
   4530 Leckron Rd
   Modesto, CA 95357
   Boxes, corrugated: made from purchased materials
   Estimated Natural Gas usage = 656,949,000 kBtu/year

5. Boyd Corporation
   600 S McClure Rd
   Modesto, CA 95357
   Hard rubber and molded rubber products
   Estimated Natural Gas usage = 41,750,000 kBtu/year

6. Signature Fruit Company LLC
   2260 Tenaya Dr
   Modesto, CA 95354
   Fruits: packaged in cans, jars, etc
   Estimated Natural Gas usage = 59,160,000 kBtu/year

7. John F. Turner and Company
   1911 Yosemite Blvd
   Modesto, CA 95354
   Stationery products
   Estimated Natural Gas usage = 108,962,500 kBtu/year

8. Triad Waste Management
   204 Kerr Ave
   Modesto, CA 95354
   Fertilizers, mixing only
   Estimated Natural Gas usage = 247,140,000 kBtu/year

9. Gallo Glass Company
   605 S Santa Cruz Ave
   Modesto, CA 95354
   Glass containers
   Estimated Natural Gas usage = 594,909,000 kBtu/year

10. E & J Gallo Winery
    600 Yosemite Blvd
    Modesto, CA 95354
    Wines
    Estimated Natural Gas usage = 497,756,000 kBtu/year

11. Stanislaus Distributing Co
    400 Hosmer Ave
    Modesto, CA 95351
    Carbonated beverages, nonalcoholic: pkged. in cans, bottles
    Estimated Natural Gas usage = 42,920,000 kBtu/year

12. Horizon Ag-Products Inc
    P.O. BOX 1888
    Modesto, CA 95353
    Soil conditioners
    Estimated Natural Gas usage = 67,963,500 kBtu/year

Conclusion and Further Study

Based on industrial sales and the national average natural gas usage for the represented industries, we estimate that the four locations investigated in this report would use more than 2.7 billion kBtu/year.

This GIS-based analysis was meant only to investigate the potential for more focused pilot/demonstration project in the future. The San Joaquin Valley was selected not only because it has a large and growing dairy industry, but also because the region and its inhabitants are disproportionately impacted by the dairy industry's waste by-products. A similar analysis could be conducted for the dairy industry in the Inland Empire (Riverside and San Bernardino counties).

In terms of selecting optimal sites for future pilot/demonstration projects, we suggest the following steps:

1. *Investigate Tulare project site.* Based on all of the available data, the best project site would be near the City of Tulare CNG station. The concentration of dairies near existing infrastructure already collecting methane (in some form) makes the Tulare area a prime location for further analysis into a pilot/demonstration project.

2. *Improve data for future analysis.* Prior to launching a pilot/demonstration project, resources must be invested in generating or collecting better data. While sufficient for the purposes of this study, a more exhaustive survey accounting for the location and size of each dairy farm should be undertaken; this is especially needed for Merced County. Any such survey should also identify the type of dairy manure collection system in place at each of the targeted dairies. Estimated volumes of potential biomethane production rest on several broad assumptions about manure collection and handling; these assumptions should be checked prior to launching a pilot and/or demonstration project.

Additionally, data for both the wastewater treatment plants and landfills reflect only those sites known to be collecting and using methane. No steps were taken to determine if other types of sites not currently collecting and using methane would be willing to accept dairy waste into their operations. Locations of these other sites are known, but a decision was made not to include them in this preliminary analysis. A more comprehensive survey is needed to ascertain the best possible sites for aggregating and processing biomethane for a pilot study.

Also, our estimate of the potential industrial use of natural gas was based solely on sales of the firm and the industry average use of natural gas based on sales. The natural gas usage of an individual business may vary significantly from the industry average. If it is determined that industrial biomethane demand is a viable market, these businesses should be contacted and their actual natural gas usage verified prior to final site selection.

3. *Explore utilization of other waste streams.* Provided that potential aggregating sites are willing to work with multiple feedstocks (other types of waste materials), it would be beneficial to determine if any other potential sources of biogas exist in the area of a future pilot/demonstration project. These sources could include non-dairy concentrated animal feeding operations (CAFO), by-products from local food-processing facilities, cull and surplus produce, yellow grease from restaurant operations, and potentially, waste from slaughterhouses. Combining of these waste streams into a single biomethane operation may create technical and permitting hurdles (especially from a transporting perspective), it can also increase the quantity of biomethane produced and improve a region's ability to sustainably handle its waste.

4. *Refining facility location.* Much of our analysis worked "backward" from the point of final distribution, the CNG station itself. All CNG stations and most aggregating and refining infrastructure are located in or near cities; however, it may be better to locate a biomethane refining facility farther out in the rural areas. A few miles difference in the final site location can have a significant impact on the number of nearby dairies The GIS analysis could be applied to more rural sites to identify locations proximate to larger concentrations of dairies.

   Although it would appear that demand for CNG as a transportation fuel is growing more robustly in the southern part of the San Joaquin Valley, CNG fueling station locations in the region are in a state of flux. During the course of this study, one of the top four potential locations for a pilot project moved and another was closed. This fact stress the importance of conducting a more thorough survey of local CNG vehicle operators and CNG fuel distributors prior choosing any potential pilot project site.

Appendix G References

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Annex G1: Characteristics of Dairy Industry in the San Joaquin Valley

There are 1,159 dairy farms in the seven counties included in this report. Dairy farms that have closed down and no longer have milking cows and dairy farms that are just starting and do not yet have milking cows are not included in the dairy farm count. Additionally, there were ten farms reported that had 6,825 cows between them for which we were not given the longitude and latitude coordinates. These records represent less than 1% of the total dairy farms and less than 1% of the total number of cows. Without the longitude and latitude coordinates the records could not be included in the GIS analysis.

The average number of cows per farm was 821, the median was 550 and the mode was 400. Only milking cows were included in the number of cows on the farm. Non-milking cows are not included in any aspect of this analysis. The smallest number of cows per farm was one and the largest number of cows per farm was 12,000. The following table shows the distribution of dairy farms based on the number of cows per farm for all seven counties.

Distribution of Farms based on the Cows per Farm

Cows per Farm	Number of Farms	Percent
1 - 500	543	46.9%
501 - 1000	341	29.4%
1001 - 2000	190	16.4%
2001 - 4000	70	6.0%
More than 4000	15	1.3%
	1159	100.0%

The variance in the number of milking cows per farm between the seven counties is statistically significant. Stanislaus, Merced and San Joaquin counties all average less than 550 cows per farm. Kings, Tulare, and Madera counties all average more than 1,000 cows per farm. The probability of this variance in size happening by chance is less than 1 in million. The causes for the variances in the average number of cow per farm by county were not investigated because that research is beyond the scope of this report.

Average Cows per Dairy by County

County	Number of Dairy Farms	Total Cows	Average Cows / Farm
Stanislaus	271	130,494	481.5
Merced	161	86,420	536.8
San Joaquin	134	73,153	545.9
Fresno	102	90,220	884.5
Kings	123	124,901	1,015.5
Tulare	317	379,318	1,196.6
Madera	51	69,795	1,368.5
TOTAL	1,159	954,301	823.4

Annex G2: Data Accuracy

Discussion on the accuracy of the data for Merced County

While the California Dairy Information Bulletin reports that Merced County has experienced a steady loss in the number of farms over the last five years, the amount of loss does not account for the 50% discrepancy in data. The data file provided by the Water Quality Control board had 51% the entries with no cow data reported. Jess Sitre of the Merced County Dairy Program provided some additional records dairy records with cow counts for Merced County. The data between the two sources was merged into one file. Based on the merged files we have approximately 60% of the dairy information for all of Merced County and at least 75% of all data for the area of interest surrounding the Merced County CNG filling station.

While the Merced cow data is not completely accurate we were provided the Merced dairy locations from two different sources; Jess Sitre and Polly Lowry. Both sources provided the exact same locations for 331 dairies. Therefore, we believe the dairy farm information provided to be very accurate. The missing cow data only impacted the analysis of the Merced CNG station. In instances where data on the number of cows were missing, we simply employed the county average of cows per farm. While an approximation, we feel confident that the analysis will be within 20% the number of cows in the area surrounding the CNG station.

California Counties: Cows, Dairies, and Cows per Dairy
Number of milk cows and heifers that have calved on farms, number of dairies, and average number of cows per dairy in California by counties and regions, 1998 and 1999

	1998			1999		
County	Number Cows	Number Dairies [2/]	Average Number Cows/Dairy	Number Cows	Number Dairies [2/]	Average Number Cows/Dairy
Fresno	84,172	106	794	84,172	105	802
Kings	109,512	151	725	124,668	146	854
Madera	32,021	49	653	35,507	52	683
Merced	178,241	336	530	185,130	338	548
San Joaquin	88,719	156	569	88,778	154	576
Stanislaus	142,546	319	447	146,285	323	453
Tulare	312,340	296	1,055	337,685	293	1,153
Total	947,551	1,413	671	1,002,225	1,411	710

[2/] Number of dairies source is Milk and Dairy Foods Control.

	OUR DATA			Percent Difference Our Data and 1999 Data	
County	Number Cows	Number Dairies	Average Number Cows/Dairy	Number Cows	Number Dairies
Fresno	90,220	102	885	7%	-3%
Kings	124,901	123	1,016	0%	-16%
Madera	69,795	51	1,369	97%	-2%
Merced	118,959	343 [1]	598	-36%	+2%
San Joaquin	73,153	134	546	-18%	-13%
Stanislaus	130,494	271	482	-11%	-16%
Tulare	379,318	317	1,197	12%	8%
Total	954,301	1,159	823		

1. 164 of the dairy farms reported from Merced did not include the number of cows located at the dairy.

Determining Location Accuracy

To determine the accuracy of the GIS information we were provided, a comparison was made of geocodes from multiple sources. We also had geocode information for dairies from Tele Atlas and D&B. Tele Atlas is an internet geocode service at <http://www.geocode.com>. A random sampling of 23 dairies comparing the geocodes between the dairy records from the state and

county and Tele Atlas and the dairy record and D&B revealed the following variance between the sourced. D&B geocodes were not available for 11 of these dairies. Some variance is to be expected because the geocodes are for different locations on the dairy. The Merced County Dairy Program indicated that it takes geocodes from the front door of the barn. Tele Atlas is providing geocodes based on the postal address and it returns a code for a location along the street. The source of D&B geocodes is not known. Assuming that up to 1 mile is an acceptable variance based on the different locations the geocodes were taken from then there is an 87% accuracy rate between the state supplied records and Tele Atlas and there is a 75% accuracy rate between the state supplied records and D&B. Of the three sources of data D&B is assumed to be the least accurate and this data was used only for plotting businesses in high natural gas usage industries.

The accuracy rate between Tele Atlas and the state supplied records can be determined for the total population. Based on the 87% accuracy rate for the 23 records sampled and using a 95% confidence level it can be determined that the total population accuracy rate is between these two sources would be between 73% to 99%.

Inaccuracy between the sources does not mean that the state and county records were inaccurate. The accuracy of the three sources can not be determined without taking new geocode reading. Since the state and county supplied records were based on actual readings and Tele Atlas geocodes are computed using the address of record, we assume that the state supplied geocodes are more accurate than the Tele Atlas geocodes. The geocodes from the state were used in our analysis. Tele Atlas geocodes were used for two dairy records that were supplied without geocodes but with addresses.

Accuracy of Geocodes between the Records Received from the Water Quality Control Board and Tele Atlas and D&B

Mile Variance Comparison to Tele Atlas

Miles Variance	*Frequency*	Percent
0-.49	19	83%
.5-.99	1	4%
1.0-1.49	1	4%
1.5-1.99	0	0%
2 or More	2	9%
	23	100%

Mile Variance Comparison to D&B

Miles Variance	*Frequency*	Percent
0-.49	8	67%
.5-.99	1	8%
1.0-1.49	1	8%
1.5-1.99	0	0%
2 or More	2	17%
	12	100%

We were not provided geocodes for the CNG stations. Geocodes for CNG stations were determined from two different sources and compared. The geocodes from both sources were determined based on the CNG street address. The first source we used to identify CNG geocodes was Tele Atlas, an internet geocode service at <http://www.geocode.com>. The second source of

geodes was the California State University, Fresno Interdisciplinary Spatial Information Systems Center (ISIS). The two CNG stations for which there was a discrepancy of more than one tenth of a mile only occurred when Tele Atlas could not identify an exact location based on the street address and provided an approximate location. All of the other variances were less than 125 feet.

The Waste Treatment Plants file provided to us was not geocoded. We determined geocodes for these locations using Tele Atlas. The landfill location and the business locations were provided with geocodes and these geocodes were not verified. Based on the verification process that we undertook we found the geocodes provided to be highly accurate.

Annex G3: CNG Filling Stations

Name	Phone	Address	City	State	Zip	Type of Access	County
California State University at Fresno	800-723-9398	385 E Barstow Ave	Fresno	CA	93710	Public with restrictions; card key required	Fresno
City of Fresno Service Center	800-684-4648	1900 E St	Fresno	CA	93706	Public with restrictions; card key required	Fresno
Clovis Unified School District	800-723-9398	1450 Herndon Avenue	Clovis	CA	93611	Government Personnel only	Fresno
Gibbs Automated Fuel Station	800-684-4648	3555 S Academy Ave	Sanger	CA	93657	Public with restrictions; card key required	Fresno
Kings Canyon Unified School District	213-244-5215	675 W Manning Avenue	Reedley	CA	93654	Private Station; limited access	Fresno
Pinnacle CNG/UPS	915-686-6487	1601 W McKinley Ave	Fresno	CA	93728	Public with restrictions; card key required	Fresno
Visa Petroleum	800-723-9398	2414 Monterey Street	Fresno	CA	93721	Public with restrictions; card key required	Fresno
Kings County Yard/PFC	888-732-6487	11827 S 11th Ave	Hanford	CA	93230	Public with restrictions; card key required	Kings
Lemoore NAS	213-244-5215	25000 Coalinga Highway - Transportation Division Building 765, NAS Lemoore	Lemoore	CA	93246	Government Personnel only	Kings
Tesei Petroleum	(559) 673-3597	1300 S. Gateway Drive	Madera	CA	93637	Public Access Allowed	Madera
PG&E Merced Service Center	800-684-4648	3185 M St	Merced	CA	95348	Public with restrictions; card key required	Merced
E.F. Kludt and Sons	(209)368-0634	1126 E. Pine Street	Lodi	CA	95241	Public Access Allowed	San Joaquin
PG&E Stockton Service Center	800-684-4648	4040 West Ln	Stockton	CA	95204	Public with restrictions; card key required	San Joaquin
San Joaquin County	209-468-3380	1810 E Hazelton Ave	Stockton	CA	95201	Private Station; limited access	San Joaquin
W.H. Breshear's - FleetStar	800-723-9398	428 7th Street	Modesto	CA	95354	Public with restrictions; card key required	Stanislaus
City of Tulare - FleetStar	800-723-9398 or 800-685-2376	3989 S K Street	Tulare	CA	93274	Public with restrictions; card key required	Tulare
FleetStar - SoCal Gas	800-723-9398	320 N Tipton Street	Visalia	CA	93292	Public with restrictions; card key required	Tulare

Annex G4: Analysis of Sites 5 through 8

Site #5 - PG&E Merced Service Center

The fifth ranked location is the PG&E Merced Service Center

3185 M St
Merced, CA 95348

This CNG location allows public access with restrictions.

Cows	68,600
Dairies	92
Avg. No. of Cows	746
Annual biomethane Production Potential (million ft^3)	751
Landfills	3
Wastewater plants	0

This facility is located in the center of the city of Merced. The city of Merced is located in Merced County. According to the 2000 US Census the city of Merced had a population of 63,893. The facility is within two and a half miles of Highway 99. Of the 92 dairies in the surrounding area, all are located in Merced County.

No wastewater treatment plants are located in the 400-square-mile area surrounding this site.

The landfills located in the 20-square-mile area surrounding this site are listed below. For more information about the landfills see Annex G7. None of the landfills are common to any other site. All three landfill sites have the same address and are located approximately 6 miles south of the CNG station.

1. Highway 59 Compost Facility
   6040 N. Highway 59
   Merced, CA 95340

2. Highway 59 Research Composting Op.
   6040 N. Highway 59
   Merced, CA 95340

3. Highway 59 Disposal Site
   6040 N. Highway 59
   Merced, CA 95340

There are five businesses in the area surrounding this location that represent industries that use large amounts of natural gas. Based on the industries' sales and national average industry natural gas usage it is estimated that these four locations would use a total of 305,975,000 kBtu/year. These five businesses represent a small additional demand. The five businesses are:

1. Oasis Foods Inc
   9341 E Childs Ave
   Planada, CA 95365
   Fruits and fruit products, in cans, jars, etc
   Estimated Natural Gas usage = 33,640,000 kBtu/year

2. Pacific-Sierra Publishing Inc
   3032 G St
   Merced, CA 95340
   Newspapers, publishing and printing
   Estimated Natural Gas usage = 33,400,000 kBtu/year

3. CHEFS PRIDE
   2751 N Santa Fe Dr
   Merced, CA 95348
   Meat packing plants
   Estimated Natural Gas usage = 38,397,000 kBtu/year

4. Teasdale Quality Foods
   901 Packers St
   Atwater, CA 95301
   Tomato products, packaged in cans, jars, etc.
   Estimated Natural Gas usage = 53,940,000 kBtu/year

5. J R Wood Inc
   7916 Bellevue Rd
   Atwater, CA 95301
   Fruits, quick frozen and cold pack (frozen)
   Estimated Natural Gas usage = 146,598,000 kBtu/year

The three landfills in the area provide a poor potential number of collaborating partners that could help provide a steady flow of methane for refining and/or help build markets for biomethane. The five businesses in the area that are in high natural gas industries represent a small potential for additional demand of biomethane.

Site #6 – Lemoore NAS

The sixth site is located near the Lemoore Naval Air Station. All of the characteristics of this site are shared with Site #3. For further information about this location see Site #3.

Site #7 - Kings Canyon Unified School District

The seventh ranked location is Kings Canyon Unified School District. The address is:

675 W Manning Avenue
Reedley, CA 93654

This CNG location is a private station with limited access.

Cows	40,048
Dairies	30
Avg. No. of Cows	1,335
Annual biomethane Production Potential (Million ft^3)	438
Landfills	0
Wastewater Plants	0

This facility is located in the center of the City of Reedley. Reedley is located in Fresno County. According to the 2000 US Census (2002), Reedley had a population of 20,756. The facility is 11 miles from Highway 99. Of the 30 dairies in the surrounding area, 5 are in Fresno County, 3 are in Kings County and 22 are in Tulare County. The largest dairy in the valley, the Boertje Dairy, with 12,000 cows is located in the surrounding area and skews the average number of cows per dairy. The data did not show any active landfills or wastewater plants in the area currently utilizing methane.

One other CNG Filling Station is located within the surrounding area. The Gibbs Automated Fueling Station is located in Sanger to the northwest of this location. The Gibbs Automated Fueling Station is a public station with restricted access.

There are five businesses in the area surrounding this location that are in high natural gas using industries. Based on the industries' sales and national average industry natural gas usage it is estimated that these four locations would use a total of 678,420,000 kBtu/year. These five businesses represent a good additional demand for biomethane, the largest potential demand of all Sites that are highlighted. The five businesses are:

1. Kaweah Container Inc
   13291 Avenue 404
   Cutler, CA 93615
   Corrugated and solid fiber boxes
   Estimated Natural Gas usage = 91,907,500 kBtu/year

2. Nutrient Technologies Inc
   1092 E Kamm Ave
   Dinuba, CA 93618
   Fertilizers: natural (organic), except compost
   Estimated Natural Gas usage = 73,602,000 kBtu/year

3. Ruiz Food Products Inc
   501 S Alta Ave
   Dinuba, CA 93618
   Ethnic foods, nec, frozen
   Estimated Natural Gas usage = 229,745,000 kBtu/year

4. Sanger Wrks Fctry Holdings
   1949 E Manning Ave
   Reedley, CA 93654
   Packaging machinery
   Estimated Natural Gas usage = 32,648,500 kBtu/year

5. Sun-Maid Growers California
   13525 S Bethel Ave
   Kingsburg, CA 93631
   Raisins
   Estimated Natural Gas usage = 250,517,000 kBtu/year

The lack of landfills and wastewater treatment plants in the surrounding area means that there are no potential collaborating partners to provide alternative sources of methane or to help market biomethane. The five businesses in the area that are in high natural gas industries represent a good potential for additional demand of biomethane.

Site #8 – Tesei Petroleum

The eighth ranked location is Tesei Petroleum in Madera. The address is:

1300 S. Gateway Drive
Madera, CA 93637

This CNG location allows public access.

Cows	30,488
Dairies	30
Avg. No. of Cows	1,016
Annual biomethane Production Potential (Million ft^3.)	338
Landfills	2
Wastewater plants	0

This facility is located on the southern half of the city of Madera. The city of Madera is located in Madera County. According to the 2000 US Census (2002) the city of Madera had a population of 43,207. The facility is less than one tenth of a mile from Highway 99. Of the 48 dairies in the surrounding area, 45 are located in Madera County and 3 are located in Fresno County. The surrounding area does not overlap with any other highlighted sites.

No wastewater treatment plants are located in the area surrounding this site. The two landfills located in the area surrounding this site are listed below. For more information about the landfills see Annex G7.

1. Mammoth Recycling Facility
   21739 Road 19
   Chowchilla, CA 93610

2. Fairmead Solid Waste Disposal Site
   Avenue 22 At Road 19
   Chowchilla, CA 93610

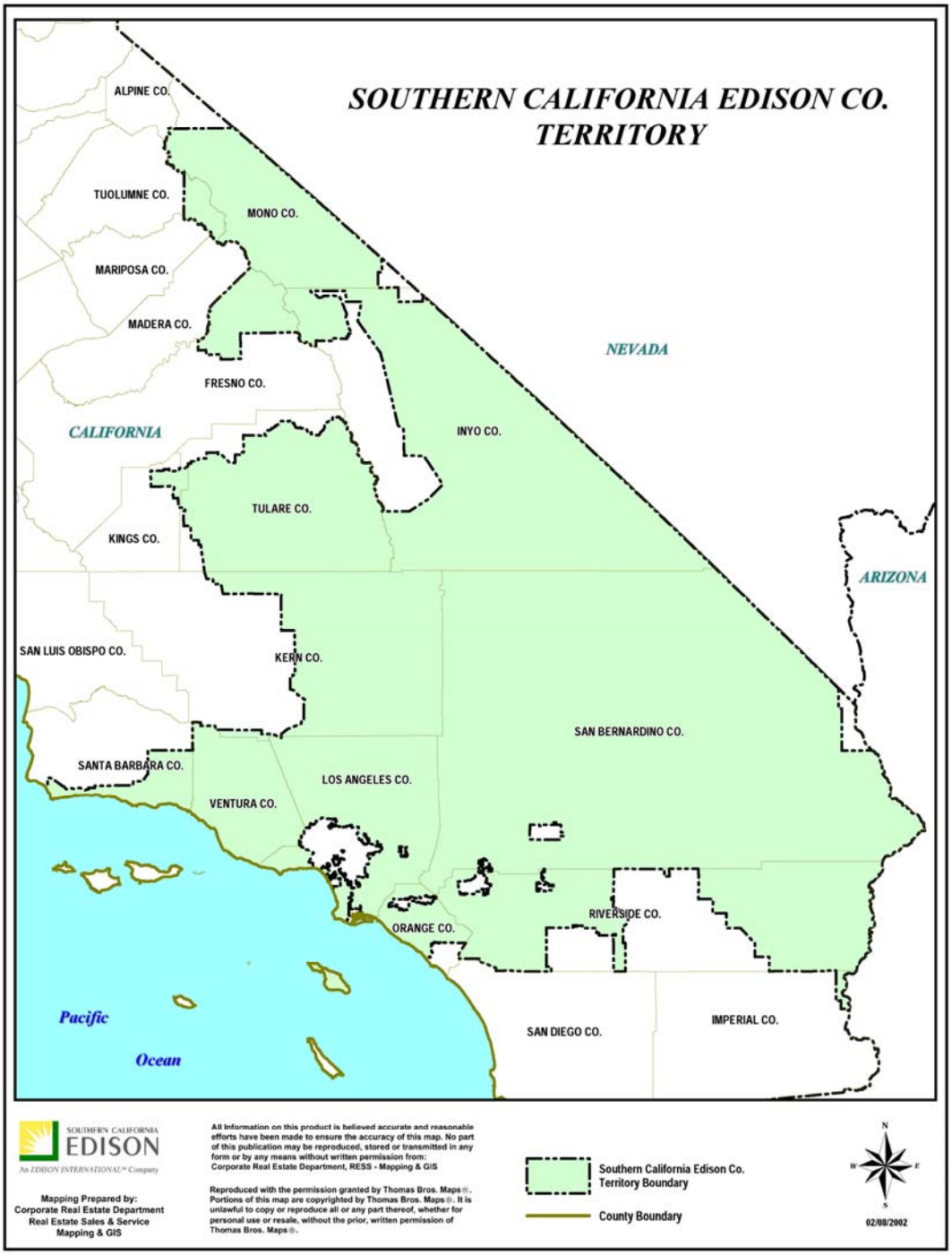
No other CNG Filling stations are located within the surrounding area.

There is 1 business in the 400 square mile area surrounding this location that is in high natural gas using industries. Based on the industries' sales and national average industry natural gas usage it is estimated that these five locations would use a total of 62,524,000 kBtu/year. This business represents a very small additional demand. The business is:

Canandaigua Wine Company Cal
12667 Road 24
Madera, CA 93637-9020
Wines, brandy, and brandy spirits
Estimated Natural Gas usage = 62,524,000 kBtu/year

The two landfills in the area provide a poor potential number of collaborating partners that could help provide a steady flow of methane for refining and/or help build markets for biomethane. The one business in this area represents a very poor potential for an alternative demand for biomethane Site #7 represents the smallest potential alternative use of biomethane of all the sites highlighted.

Annex G5 – Southern California Edison Service Territory



(Source: Southern California Edison, no date)

Annex G6: Wastewater Treatment Plants

Biomass

Plant Name (Alias)	Facility	Fuel Source (Cogen)	Technology	Online <MW)< B>	Service Area	County	Plant Address	Plant Phone	Operator / Owner (if different)	Operator-Contact / Owner-Contact	Operator-Phone# / Owner Phone#	Operator-Address / Owner Address
Auberry Energy	WTE	Biomass - Ag. & Woodwaste (Cogen)		7.5	PG&E	Fresno	32180 Auberry Road New Auberry 93602	209-855-4001	Auberry Energy Inc	Doug Thompson	209-855-4001	32180 Auberry Rd, Auberry Ca 93602
Delano Energy I-Ii	WTE	Biomass - Ag. & Woodwaste		49.9	SCE	Kern	31500 Pond Road Delano 93215	805-792-3062	Delano Power Co Thermo Ecotek	Dale Hale Or Tony Collins Tony Collins Or Jimmy Hakimiam	805-792-3067 805-792-3067	31500 Pond Rd, Po 1461, Delano Ca 93215
Mendota Biomass Power	WTE	Biomass - Ag. & Woodwaste (Cogen)	Fluidized Boiler	25	PG&E	Fresno	400 Guillen Parkway Mendota 93640	209-655-4921	Mendota Biomass Power Thermo Ecotek	Glen Sizemore Or Bob Notoheis	209-655-4921	400, Guillen Pkwy, Po Box 99, Mendota Ca 93640
Tracy Biomass	WTE	Biomass - Ag. & Woodwaste		21	PG&E	San Joaquin	14800 W. Schultz Road Tracy 95376	209-835-6914	Tracy Operators Community Energy Alternatives Inc (Cea)	Larry K. Lien Art Nislick	209-835-6914 201-652-2772	Po Box 1211, Tracy Ca 95378-1211 1200 E. Ridgewood Ave, Ridgewood Nj 07450
Diamond Walnut Growers	WTE	Biomass - Ag. Waste - Walnut Sh (Cogen)		4.5	PG&E	San Joaquin	1050 South Diamond Street Stockton 95205	209-467-6000	Diamond Walnut Growers Inc.	James Wagner Or Bo Thisted	209-467-6000	1050 S. Diamond St, Stockton Ca 95205
California Cedar Products	WTE	Biomass - Woodwaste (Cogen)		0.85	PG&E	San Joaquin	1340 W. Washington Street Stockton 95201	209-944-5800	California Cedar Products	Patrick Lam	209-944-5800	1340 W. Washington , Stockton Ca 95202

Annex G6: Wastewater Treatment Plants (continued)

Digester Gas

Plant Name (Alias)	Facility	Fuel Source (Cogen)	Technology	Online <MW)< B>	Service Area	County	Plant Address	Plant Phone	Operator / Owner (if different)	Operator-Contact / Owner-Contact	Operator-Phone# / Owner Phone#	Operator-Address / Owner Address
City Of Tulare	WTE	MSW - Digester Gas		0.41	SCE	Tulare	1875 South West Street Tulare		City Of Tulare	Milton Preszler		411 E. Kern Ave, Tulare 93274
Roy Sharp Jr.	WTE	MSW - Digester Gas		0.1	PG&E	Fresno	Caruthers					
Royal Farms #1-#2	WTE	MSW - Digester Gas		0.18	SCE	Tulare	Address Confidential Tulare 93274	209-686-9779	Royal Farms	Confidential	Confidential	Confidential

Industrial Waste

Plant Name (Alias)	Facility	Fuel Source (Cogen)	Technology	Online <MW)< B>	Service Area	County	Plant Address	Plant Phone	Operator / Owner (if different)	Operator-Contact / Owner-Contact	Operator-Phone# / Owner Phone#	Operator-Address / Owner Address

Landfill Gas

Plant Name (Alias)	Facility	Fuel Source (Cogen)	Technology	Online <MW)< B>	Service Area	County	Plant Address	Plant Phone	Operator / Owner (if different)	Operator-Contact / Owner-Contact	Operator-Phone# / Owner Phone#	Operator-Address / Owner Address
Fresno Wwtp	WTE	MSW - Landfill Gas		1.3	PG&E	Fresno	5607 West Jenson Avenue Fresno 93706	209-277-1475	Fresno Wastewater Treatment		209-498-1707	5607 West Jenson Ave, Fresno Ca 93706
Pacific Energy (Stockton)	WTE	MSW - Landfill Gas		0.8	PG&E	San Joaquin	9075 S. Austin Road Stockton 95206	209-462-4206	Pacific Energy Ogden Energy Group, Inc.	Denice Marsh	209-462-4206	9595 S. Austin Rd, Stockton Ca 95206
Tulare County Landfill	WTE	MSW - Landfill Gas	Gas Turbine Combined Cycle	1.9	SCE	Tulare	26951 Road 140 Visalia 93292		Minnesota Methane			

Annex G6: Wastewater Treatment Plants (continued)

Municipal Solid Waste												
Plant Name (Alias)	**Facility**	**Fuel Source (Cogen)**	**Technology**	**Online <MW)< B>**	**Service Area**	**County**	**Plant Address**	**Plant Phone**	**Operator / Owner (if different)**	**Operator-Contact / Owner-Contact**	**Operator-Phone# / Owner Phone#**	**Operator-Address / Owner Address**
Modesto Energy	WTE	MSW - Tires		14	PG&E	Stanislaus	4549 Ingram Creek Road Westley 95387	209-894-3161	Modesto Energy Co. Oxford Energy	 Carl Levesque	209-894-3161 209-894-3161	Po Box 302, Westley Ca 95837
Covanta Stanislaus Inc. (Stanislaus Waste Energy)	WTE	MSW - Waste		18	PG&E	Stanislaus	4040 Fink Road Crows Landing 95313	209-837-4423	Covanta Stanislaus Inc. Ogden Martin	 Fred Engelhardt	209-837-4423 209-837-4423	

Annex G7: Landfills and Disposal Sites

Name	Land Use Name	County	Location	Place
American Avenue Disposal Site	Agricultural	Fresno	18950 W American Av 4 Mi W/O Madera Av	Tranquillity
Cedar Ave. Recycling & Transfer Station	Industrial, Commercial	Fresno	3457 S. Cedar Avenue	Fresno
City Of Clovis Landfill	Rural	Fresno	15679 Auberry Road	Fresno
Coalinga Disposal Site	Rural	Fresno	30825 Lost Hills Road	Coalinga
Craycroft Brick Inert Site		Fresno	2301 W Belmont @ Marks	Fresno
Gallo Vineyards, Inc Compost Operation	Agricultural	Fresno	5686 East Olive Avenue	Fresno
Jefferson Avenue Transfer Station	Industrial, Agricultural	Fresno	5608 Villa Avenue	Fresno
Jefferson Inert Disposal Site		Fresno	Jefferson & Maple	Fresno
Kochergen Property Grease Trap Disposal	Rural	Fresno	15485 W Republic	Huron
Orange Avenue Disposal Inc	Industrial	Fresno	3280 South Orange Ave	Fresno
Shaver Lake Transfer Station	Rural	Fresno	1 Mi E of Hwy 168 on Dinkey Creek Rd	Shaver Lake
Sunset Wastepaper MRF and TS	Residential, Open Space, Industrial	Fresno	2721 S. Elm Avenue	Fresno
Avenal Landfill	Residential, Industrial, Commercial, Agricultural	Kings	201 North Hydril Road	Avenal
CWMI - B18 Nonhazardous Codisposal	Agricultural	Kings	35251 Old Skyline Road	Kettleman City
CWMI Kettleman Hills Facility	Agricultural	Kings	35251 Old Skyline Road	Kettleman City
Kochergen Farms Composting	Agricultural	Kings	Avenal Cutoff Rd. and Omaha Ave.	Avenal
KWRA Composting Facility	Agricultural	Kings	7803 Hanford-Armona Road	Hanford
KWRA Material Recovery Facility	Agricultural	Kings	7803 Hanford-Armona Rd.	Hanford
Emadco Transfer Station	Residential	Madera	Black Oak River Road	Oakhurst
Fairmead Solid Waste Disposal Site	Rural, Residential, Agricultural	Madera	Avenue 22 At Road 19	Chowchilla
Mammoth Recycling Facility And TS	Rural	Madera	21739 Road 19	Chowchilla
North Fork Transfer Station	Rural	Madera	33699 Road 274	North Fork

Annex G7: Landfills and Disposal Sites (continued)

Name	Land Use Name	County	Location	Place
A&D Transport		Merced	25077 West Hearst Road	Gustine City
Atlas Materials Inc. - White Crane Ranch	Rural	Merced	11550 West Highway 140	Atwater
Billy Grissom Fertilizer	Agricultural	Merced	5331 Columbus Ave	Hilmar
Billy Wright Composting Facility		Merced	17173 Billy Wright Road	Los Banos
Billy Wright Disposal Site		Merced	Billy Wright Rd; 1 Mi West of I-5	Los Banos
Foster Farms Manure Storage Facility	Range Land, Open Space, Industrial, Agricultural	Merced	12997 W. Highway 140	Atwater
Highway 59 Compost Facility	Wetlands, Rural, Agricultural	Merced	6040 N. Highway 59	Merced
Highway 59 Disposal Site	Wetlands, Open Space, Agricultural	Merced	Hwy 59; 6 Mi N Merced	Merced
Highway 59 Research Composting Op.		Merced	6040 North highway 59	Merced
Kenneth Stone & Family Spreading Service		Merced	W. of Lupin Ave& 1/4 Mile N. of Palm Ave	Winton
Nakashima Farms Composting		Merced	10397 West Walnut Avenue	Livingston
Robeson Farms		Merced	Le Grand	Le Grand
Stone Family El Nido Composting Facility	Agricultural	Merced	Vineyard Way At Grant Road	Merced
Valley Fresh Foods Inc.	Agricultural	Merced	1220 Hall Road	Merced
A-Plus Materials Recycling, Inc.		San Joaquin	Port 23 Port of Stockton	Stockton
Central Valley Waste Services		San Joaquin	1333 East Turner Road	Lodi
Central Valley Waste Services		San Joaquin	1333 E. Turner Road	Lodi
Delicato Vineyards	Agricultural	San Joaquin	12001 S. Hwy 99, Manteca	Manteca
East Stockton Transfer & Recycling Stn	Residential, Industrial, Commercial	San Joaquin	2435 East Weber Avenue	Stockton
Foothill Sanitary Landfill	Range Land	San Joaquin	6484 North Waverly Road	Linden
Forward Landfill, Inc.	Residential, Range Land, Agricultural	San Joaquin	9999 S. Austin Road	Manteca
Forward Resource Recovery Facility		San Joaquin	9999 S. Austin Road	Manteca
Jensen Farms Compost Operation		San Joaquin	5793 West Delta Avenue	Tracy
Lovelace Transfer Station		San Joaquin	2323 Lovelace Road	Manteca

Annex G7: Landfills and Disposal Sites (continued)

Name	Land Use Name	County	Location	Place
Nilsen Farms		San Joaquin	17200 Liberty Road Galt, CA 95632	Acampo
North County Recycling Ctr.& Sanitary LF	Residential, Industrial, Agricultural	San Joaquin	17900 East Harney Lane	Victor
Scotts Regional Composting Facility	Agricultural	San Joaquin	23390 Flood Road	Linden
Stockton Recycling & Transfer Station		San Joaquin	401 South Lincoln Street	Stockton
Super Pallet Recycling Corporation	Residential, Park, Industrial, Commercial	San Joaquin	2430 South California Street	Stockton
Tracy Material Recovery & T.S.	Rural	San Joaquin	30703 S. Macarthur Drive	Tracy
USA Waste of California, Inc	Industrial	San Joaquin	1240 Navy Drive	Stockton
Bertolotti Transfer & Recycling Center	Commercial	Stanislaus	231 Flamingo Drive	Modesto
Bonzi Sanitary Landfill	Rural	Stanislaus	2650 West Hatch Road	Modesto
Central Valley Agricultural Grinding, Inc		Stanislaus	5707 Langworth Road	Riverbank
City Of Modesto Co-Compost Project	Agricultural	Stanislaus	7007 Jennings Road, Modesto	Modesto
City of Turlock Waster Qual. Control Fac		Stanislaus	901 South Walnut Road	Turlock
Covanta Stanislaus, Inc.		Stanislaus	4040 Fink Road	Crows Landing
Fink Road Landfill	Rural	Stanislaus	4000 Fink Road	Crows Landing
Gilton Resource Recovery CandD Proc Fac.		Stanislaus	800 South McClure Road	Modesto
Gilton Resource Recovery Composting Fac.	Industrial	Stanislaus	800 S. McClure Rd.	Modesto
Gilton Resource Recovery/Transfer Fac	Industrial	Stanislaus	800 McClure Road	Modesto
Grover Environmental Products/Salida	Industrial	Stanislaus	6131 Hammett Road	Modesto
Grover Environmental Products/Vernalis	Open Space, Agricultural	Stanislaus	3401 Gaffery Road	Vernalis
Modesto Disposal Svc TS/Res Rec Fac	Residential	Stanislaus	2769 West Hatch Road	Modesto

Annex G7: Landfills and Disposal Sites (continued)

Name	Land Use Name	County	Location	Place
Turlock Transfer	Industrial	Stanislaus	1100 South Walnut	Turlock
Valley Wood Disposal		Stanislaus	1800 reliance Street	Modesto
Badger Transfer Station	Rural	Tulare	Road 260 At Avenue 468	Badger
Balance Rock Transfer Station	Rural	Tulare	Balance Rock Landfill	California Hot Springs
Camp Nelson Transfer Site	Rural	Tulare	1/4 Mi N Camp Nelson	Camp Nelson
Earlimart Transfer Station	Agricultural	Tulare	7012 Road 136	Earlimart
Kennedy Meadows Transfer Station	Rural	Tulare	Goman Road West Of M-152 Station	Johnsondale
New Era Farm Service #1		Tulare	Hoffman Dairy Ave 216 & Rd 140	Tulare
New Era Farm Service #2		Tulare	Jim Nance Dairy 6440 Ave 160	Tulare
Pine Flat Transfer Station	Rural	Tulare	1/4 Mi S Pine Flat	California Hot Springs
Soil Foods, Inc.		Tulare	20002 Road 140	Tulare
Springville Transfer Station	Rural	Tulare	Avenue 122 At Road 338	Springville
Sunset Material Recovery Facility		Tulare	1707 East Goshen Road	Visalia
Teapot Dome Disposal Site	Rural, Residential, Agricultural	Tulare	Avenue 128 And Road 208	Porterville
Tulare County Compost And Biomass	Rural	Tulare	24487 Road 140	Tulare
Tulare County Recycling Complex	Rural	Tulare	26951 Road 140, Visalia	Visalia
Visalia Disposal Site	Rural, Agricultural	Tulare	Road 80 At Avenue 332	Visalia
Wood Industries Co	Agricultural	Tulare	7715 Ave. 296	Visalia
Woodville Disposal Site	Rural	Tulare	Rd 152 At Ave 198; 10 Mi Se Tulare	Tulare