CLEARING THE AIR:
MITIGATING THE IMPACT OF DAIRIES ON FRESNO COUNTY'S AIR QUALITY AND PUBLIC HEALTH

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EXECUTIVE SUMMARY

Fresno County suffers from some of the worst air quality in the United States. Among other economic and social impacts, the health-related costs of poor air quality in Fresno County are estimated at $1.7 billion per year. This pollution comes not only from automotive traffic and electricity generation, but from its large agricultural base as well - the dairy sector in particular. Dairies are responsible for some of the most harmful emissions in Fresno County, including smog-forming volatile organic compounds (VOC) and toxins like ammonia, which are associated with deadly particulate pollution.

However, there are numerous mechanisms that can reduce emissions associated with dairies. This report found that enclosed barns with biofilters and covered manure lagoons with anaerobic digesters could significantly mitigate the negative impacts of dairy-related air pollution:

- Enclosed barns can reduce an estimated 80% of smog-forming VOC emissions.
- Anaerobic digesters can reduce VOC emissions by an estimated 46%.
- Enclosed barns can also cut 65% of emissions that form fine particulate matter.

These technologies have the potential to remove more than 1,300 tons of dangerous emissions from Fresno County's air each year. Yet the cost of implementing enclosed barns and anaerobic digesters is less than three cents per gallon of milk produced. The implementation of these relatively low cost emission reduction strategies could substantially reduce the production of harmful pollutants and still allow dairy farmers to realize significant profits.

Enacting these standards would significantly improve air quality in Fresno County and surrounding areas. At the same time, the dairy industry will be able to continue to grow at a healthy rate, avoiding negative impacts to the local economy. This approach would successfully address the public health and environmental needs of Fresno County residents while allowing Fresno's dairy sector to remain a growing sector of our economy.

INTRODUCTION

In 2007, the American Lung Association ranked Fresno the 4th most polluted county in the country for fine particulate matter and 6th for ozone pollution (ALA, 2007). It is no coincidence that three years earlier, Fresno County ranked 6th nationwide for potential health problems from air pollution (Scorecard, 2004). It also holds the dubious honor of a "Top Five" ranking among U.S. metropolitan areas for premature deaths caused by poor air quality (Shprentz, 1996).

The nexus between air pollution and asthma, lung disease, cardiac arrest, and even premature mortality is well established. But despite growing awareness, the problem has been getting worse in recent years. For example, the percentage of San Joaquin Valley residents with asthma rose from 14% in 2001 to 17% in 2005 (CHIS, 2005).

The health and related economic costs of poor air quality have significant impacts on the current and future well-being of Fresno County's communities and residents. However, air pollution is not due solely to automobiles and energy production, where most regulatory attention has long been focused. Other sources, such as Fresno's dairy industry, are in fact responsible for significant amounts of emissions contributing to poor air quality. In fact, Fresno's dairies are one of its top sources of the most dangerous forms of air pollution.

Until recently, air quality regulations have remained largely silent on dairies as a contributor to air pollution. However, in order for efforts to improve air quality in Fresno County to succeed, they must address air pollution all sources of emissions, including dairies. This would also assure that the economic burden of controlling emissions would be justifiably shared by all sectors that play a leading role in causing air pollution.

Given the current magnitude and projected growth of dairies in Fresno, we must also recognize the important role this sector plays in Fresno County, where milk represented the 6th most valuable commodity in 2006 (Fresno, 2006). Just as it would be unthinkable to propose the elimination of cars or power plants to improve air quality, this paper does not propose eliminating the dairy sector. Rather, it is a call for responsible planning, so that the future growth of Fresno County's dairy sector takes place within a context of concern for public health, quality of life and the attractiveness of Fresno County for all industries.

This paper presents an analysis of the dairy sector in Fresno County. It discusses the principal impacts of the dairy sector on air quality and present alternatives for mitigating dairy emissions. The analysis then offers an assessment of the costs and feasibility of mitigating dairy emissions. It concludes that there are relatively low cost emission reduction technologies available to the dairy industry that can drastically reduce the industry's negative impact on public health and the environment within the context of continued economic viability.

BACKGROUND: THE DAIRY SECTOR IN FRESNO COUNTY

Fresno is home to a large and rapidly growing dairy industry. The most current inventory provided by the California Department of Food and Agriculture (CDFA) indicates that there were 125 dairies in Fresno County in 2006, with a total of 108,945 milk cows and an average of 872 milk cows per dairy (CDFA, 2006b).[1] When support stock are included, the total number of cows is approximately 163,418, and could be as high as 217,890. As illustrated in Exhibit 1, dairies with over 500 cows account for 90% of all Fresno County milk cows.

Exhibit 1: Fresno County Dairy Size Distribution

Dairy Size*	Number of Dairies	% of Dairies	Number of Milk Cows	% Milk Cows	Total Estimated Cows**
< 500 milk cows	40	37.74%	10,925	10.29%	21,850
> 500 milk cows	66	62.26%	95,213	89.71%	190,426
Total Dairies	**106**	**100.00%**	**106,138**	**100.00%**	**212,276**

Source: Central Valley Regional Water Quality Control Board and Kings County Dairy Element.

* The Central Valley Regional Water Quality Control Board does not include dairies with less than 100 cows in their dairy inventory.

**This estimate is including estimated support stock based upon the assumption that the sum of all support stock including dry cows, heifers, calves and baby calves is equal to one cow per milk cow.

Fresno's 163,418 dairy cows are a product of dairy industry growth in the County in recent years. Many dairy operators have chosen to leave Southern California's Inland Empire where urban development has inflated land prices. Capitalized by land sales, Southern California operators have joined San Joaquin-based operators in constructing new large dairies in Fresno County.

The five southern San Joaquin Valley counties – Fresno, Kern, Tulare, Kings and Madera – experienced a net increase of 45 dairies between 2002 and 2006. The largest gains were in Fresno and Tulare counties, with a net increase of 16 and 18 new dairies respectively. In 2006, Fresno and Tulare Counties tied with the highest growth of dairies in the San Joaquin Valley – both with a net increase of seven new dairies (CDFA, 2006b; CDFA, 2005; CDFA, 2004; CDFA, 2003; Cash and Zilberman, 2004). In summary, from 2002-2006:

- 16 new dairies have been built in Fresno County.
- The total number of milk cows in Fresno County increased by 27%, representing an additional 22,830 milk cows.

[1] The figure for the total number of cows in Fresno County varies depending upon the source of information. The Central Valley Regional Water Quality Control Board lists 106,138 as the total number of milk cows in the County with an average of 1001 cows per dairy. However, this total does not include dairies with less than 100 milk cows.

- Fresno County gained approximately 45,660 additional cows when support stock (i.e. non-lactating cows) is included.2
- The average number of milk cows per dairy also increased by 10% (CDFA, 2006b; CDFA, 2005; CDFA, 2004; CDFA, 2003).

This tremendous growth has made the dairy industry a significant and growing sector of Fresno County's agricultural economy. According to 2006 data:

- Milk production is the 6th most valuable crop in Fresno County (Fresno, 2006).
- Milk production is valued at $296.7 million per year (Fresno, 2006).
- Milk production represents 6% of total agricultural production in Fresno County (Fresno, 2006).
- Fresno County became the 6th highest Grade A milk producing county in the state between 2005 and 2006 with 2.5 billion pounds of milk produced (CDFA, 2006b).
- Pending San Joaquin Valley Air Pollution Control District permits for new dairies indicate that over 35,000 more cows will arrive shortly in Fresno County.[3]

[2] The estimated support stock (all non-lactating cows in addition to milk cows) multiplier is approximately a total of 1 support to 1 milk cow according to U.C. Cooperative Extension (Kings, 2002), however this estimate can be as low as 50-75% support stock (ARB, 2005).

[3] Fresno Dairy Count spreadsheet provided by San Joaquin Valley Air Pollution Control District.

AIR POLLUTION IN THE SAN JOAQUIN VALLEY

While the growth and economic success of the dairy industry is a key part of Fresno's economy, it is also a growing contributor to air pollution. There are two main air pollutants that are considered harmful to public health and the environment: ground level ozone and particulate pollution. This section describes these two pollutants as well as the types and sources of emissions, including dairies, which create these pollutants.

Pollutants

Ozone (Smog)

Ground level ozone – commonly known as smog – forms in a chemical reaction between Oxides of Nitrogen (NO_x) and Volatile Organic Compound (VOC) emissions from motor vehicles, industry and agricultural operations. Heat and sunlight contribute to this reaction, which is why the Valley is an optimal environment for ozone formation, particularly in the summer.

Particulate Matter - $PM_{2.5}$ & PM_{10}

Particulate pollution is created by direct emissions like soot, smoke and dust as well as being the product of a chemical reaction between ammonia, NO_x, Sulfur Oxides (SO_x) and other pollutants. There are two types of particulate matter pollution. The smaller, finer form of particulate is known as $PM_{2.5}$, and is less than 2.5 micrometers in diameter. Larger PM_{10} particles are below 10 micrometers in diameter. Fine particulate pollution is far more detrimental to public health than ground level ozone.

Types and Sources of Emissions

Breathing smog and particulate matter is associated with a range of negative health impacts, including respiratory ailments, cardiovascular and pulmonary disease, cardiac arrest, decreased lung function and growth, and premature mortality. It is important to understand the source of precursor emissions that cause smog and particulate matter in order to successfully mitigate these pollutants. The three main precursor emissions that cause smog and particulate matter are:

- Oxides of Nitrogen (NOx) Emissions
- Volatile Organic Compound (VOC) Emissions
- Ammonia

Oxides of Nitrogen (NO_x) Emissions

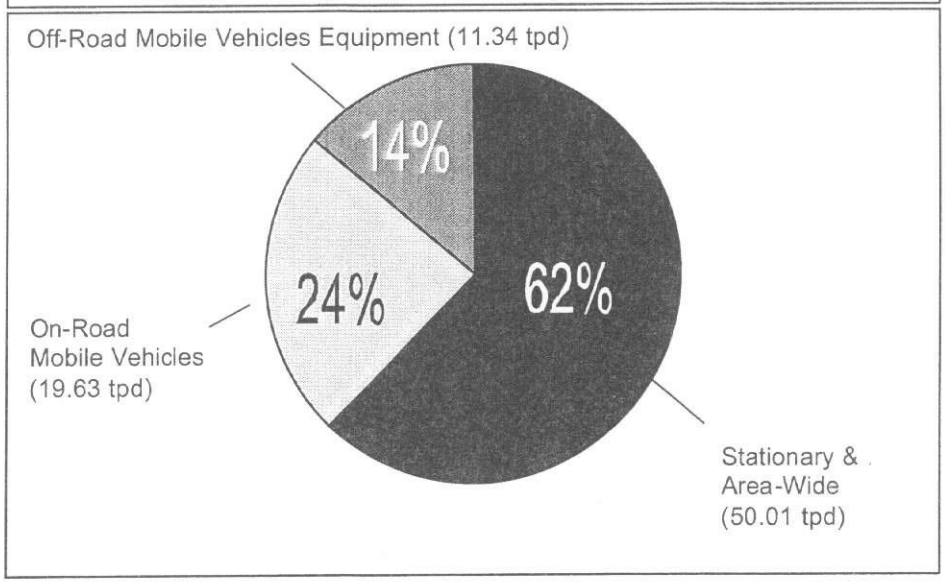
Total Nitrogen Oxides (NO_x) emissions in Fresno County are 93.57 tons per day (tpd)[4]. On-road mobile vehicles are the largest source category of NO_x emissions, and are responsible for 46% of total emissions. Off-road vehicles and equipment represent the second largest source category, accounting for 31% of NO_x emissions in Fresno County (ARB, 2006). Dairies are a relatively small source of NO_x emissions.

[4] All NO_x and VOC emission estimates are for 2005 and reflect the most current data available.

Volatile Organic Compound Emissions

Volatile Organic Compound (VOC) emission sources are far more diverse than NO_x emissions. Total VOC emissions for Fresno County are 80.99 tpd. Stationary and area-wide sources such as pesticides, consumer products and dairies emit 62% of VOC emissions in Fresno County. On and off-road vehicles account for the remaining 38% (ARB, 2006).

EXHIBIT 2: Fresno County VOC Emission Source 2005 80.99 tpd Total



The four largest individual sources of VOC emissions include passenger vehicles, pesticides, consumer products, and dairies (ARB, 2006).

Exhibit 3: Fresno County – Principal (>5%) VOC Emission Sources, 2005

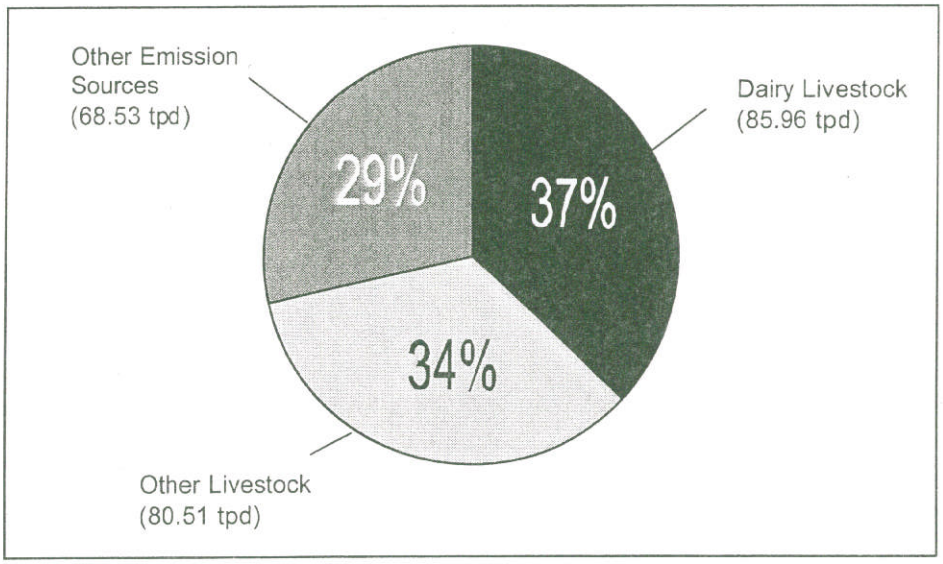
Source Category	Tons per Day (tpd)	% of Total VOC Emissions
Passenger Vehicles	15.63	19.3%
Pesticides	6.82	8.4%
Consumer Products	6.29	7.8%
Livestock Waste (Dairy Cattle)	5.30	6.5%
Subtotal	34.04	42.0%
All Other Sources contributing <5% individually	46.95	58.0%
Total	80.99	100%

Source: California Air Resources Board (ARB, 2006)

Ammonia

The California Air Resources Board estimated total 2004 ammonia (NH_3) emissions in the Valley at 235 tpd. [5] Dairy livestock account for 37% of ammonia emissions, while other livestock account for 34%. Other sources of ammonia emissions, including motor vehicles and fertilizer manufacturing account for the remaining 29% of those emissions (ARB, 2005). A growing body of research points to the negative impacts of ammonia on human health—particularly due to its role as a precursor associated with particulate pollution— and the importance of controlling ammonia emissions as a means of improving air quality. [6]

EXHIBIT 4: San Joaquin Valley Ammonia Emission Source 2004
235 tpd Total



[5] Calculating ammonia emissions is significantly more complex than other emissions. There are consequently fewer analyses of those emissions and a complete ammonia inventory was not available for all sources in Fresno County.

[6] A few studies outlining the importance of ammonia reduction include EPA, 2006a; and Pinder, 2007.

DAIRY IMPACTS ON AIR QUALITY

The current impacts of dairy emissions on air quality in Fresno County are substantial. The California Air Resources Board projects dairies to become the largest source of VOC emissions in Fresno County, with an increase of 34% between 2005 and 2020. Meanwhile, the Air Board projects that VOC emissions from passenger vehicles will actually decline over the next several years (ARB, 2006).

At the same time, the Environmental Protection Agency (EPA) regards animal husbandry operations as the single largest source of ammonia emissions in the nation (EPA, 2004). Fresno County dairies are responsible for approximately 4,000 tons of ammonia emissions each year, representing nearly 5% of ammonia emissions for the entire San Joaquin Valley (ARB, 2005).[7] As noted earlier, dairies throughout the Valley are responsible for 37% of all ammonia emissions.

Estimating dairy emissions is highly complex and there are different emission factors for each stage of the dairy process. The San Joaquin Valley Air Pollution Control District is responsible for estimating emission factors for dairy cows. The VOC emission factor used for permitting purposes is 21.0 lbs VOC per year per milk cow. The emissions factor for ammonia is 74.0 lbs NH_3 per year per milk cow. The emission factors are broken down into smaller factors for the various stages of the dairy manure management cycle (SJVAPCD, 2004; SJVAPCD, 2005a; and SJVAPCD, Dairy). For example:

- The emission factors for cow housing are 12.4 lbs VOC per year and 28.0 lbs NH_3 per year.
    - Using these emission factors, a dairy with 800 milk cows emits 4.96 tons VOC per year and 11.2 tons of NH_3 per year from cow housing.

- The emission factors for a manure storage lagoon are 2.7 lbs VOC per year and 15.4 lbs NH_3 per year.
    - Using these emission factors, a dairy with 800 milk cows emits 1.08 tons VOC per year and 6.16 tons NH_3 per year. (SJVAPCD, 2004; SJVAPCD, 2005a; SJVAPCD, Dairy).[8]

While dairies have not traditionally been viewed as a primary source of air pollution, they are in fact playing a significant role in the production of harmful pollutants. Given the current magnitude and projected growth of the dairy sector in Fresno County we must take steps to mitigate the impact of these pollutants to improve our environment and our public health.

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[7] Due to the complexity of estimating ammonia emissions, a complete ammonia inventory was not available for all sources in Fresno County. While it was not possible to calculate the percentage of Fresno County ammonia emissions represented by dairies, the figure is clearly greater than the 5% of all San Joaquin Valley emissions.

[8] Additionally see SJVAPCD (2005c) and SJVAPCD (Subpoena) for an example of the SJVAPCD permitting process as well as cost analysis.

HEALTH AND ECONOMIC IMPACTS OF POOR AIR QUALITY

Hundreds of studies conducted over the past 35 years document the connection between air pollution and negative health impacts. Fresno County knows this connection too well. Fresno County has some of the worst air quality in the nation (ALA, 2007; Scorecard, 2004), and ranks among the nation's most challenging places to live with asthma (AAFA, 2007). Fresno County also ranks as one of the top five metropolitan areas in the United States with respect to premature mortality rates resulting from poor air quality (Shprentz, 1996).

The economic burden of poor air quality in terms of health care and related costs in the San Joaquin Valley is estimated at over $6 billion per year. The health-related costs alone are estimated at $1.7 billion per year in Fresno County, or $1,124 per person. Fresno County accounts for nearly a third of all health-related costs of poor air quality of the entire San Joaquin Valley (Hall, 2006). [9]

As described earlier, there are two main air pollutants that are considered harmful to public health and the environment: ground level ozone and particulate pollution.

The annual health-related costs associated with non-attainment of California standards for ground level ozone (CAAQS) are $20.4 million in Fresno County (Hall, 2006). Health impacts associated with ozone include lung inflammation and irritation and exacerbation of asthma and other respiratory ailments (Hubbell et al., 2005; Hall, 2006; EWG, 2007).[10]

Fine particulate matter ($PM_{2.5}$) has significantly greater health impacts than ozone. That is because the fine particles can easily penetrate and lodge deep within the lungs. $PM_{2.5}$ is associated with asthma, chronic bronchitis, cardiac problems and – of particular concern – premature mortality. Given the severity of these health impacts, the health-related costs of fine particulate matter ($PM_{2.5}$) are estimated at $1.6 billion per year for Fresno County.[11] These costs are 80 times higher than the health related costs of ground level ozone.

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[9] Additional costs not included above are lost federal funding for schools due to absenteeism (a per capita average of $25 per student per day - nearly $4 million) and at least 24 cases of premature mortality attributed to ozone ($160.8 million) each year(EWG, 2007).

[10] Hubbell et al. reviewed several recent studies indicating a consistent association between ozone exposure and premature mortality.

[11] The standard cost estimate used by the EPA for premature mortality is $6.5 million. This figure is based on lost wages and the economic concept of willingness to pay (WTP) - the amount a person is willing to pay in order to avoid something (Hubbell et al, 2005).

DAIRY EMISSIONS CONTROLS AND COSTS OF REDUCING EMISSIONS

Given the health and economic impacts of poor air quality, the role of dairies in the production of harmful pollutants, and the growth of the dairy industry in Fresno County, it is imperative that we examine potential ways to reduce emissions associated with dairies. The San Joaquin Valley Air Pollution Control District has outlined a menu of optional Best Available Control Technologies for limiting VOC emissions from dairies in its Rule 4570. Of these numerous mechanisms for reducing emissions associated with dairies, two that are widely considered to be among the most effective for reducing multiple forms of emissions are enclosed barns with a biofiltration system and anaerobic digesters.

Enclosed Barns with Biofiltration Systems

Enclosed barns with biofilters reduce emissions by trapping pollutants, which are broken down by microorganisms. The amount of pollutants reduced by biofilters is 80% for VOC and 65% for ammonia.[12] Cow housing represents 59% of all VOC emissions from freestall flush dairies. Therefore, enclosed barns with biofilters would reduce dairy VOC emissions by 47%. Cow housing also represents 38% of all NH_3 emissions. Freestall flush style dairies with enclosed barns with biofilters would also reduce ammonia emissions by 25% (SJVAPCD, Emission Factors 2007).

The implementation of enclosed barn technology in all Fresno County dairies with more than 500 cows would result in emissions reductions of 472.3 tons VOC annually, or 1.6% of all VOC emissions in Fresno County. It would also result in emissions reductions of 866.4 tons of ammonia (SJVAPCD, 2006; SJVAPCD, 2004; SJVAPCD, Subpoena; and Schmidt, 2005). These emission reduction estimates only include emissions mitigated from milk cows; in actuality, the reductions would be much greater when support stock is included.

Anaerobic Digesters

Anaerobic digester systems use bacteria that break down manure. In addition to reducing the production of harmful pollutants, the gases resulting from anaerobic digestion are captured and can be used to generate heat and electricity. Anaerobic digesters can reduce VOC production by 46% (SJVAPCD, 2004) and, furthermore, the lagoon covers used for anaerobic digesters also reduce the volatilization of ammonia from the lagoon (Iowa, 2004). If Fresno County dairies with more than 500 milk cows were to install anaerobic digesters, 59.13 tons of VOC would be mitigated, or 0.44% of annual Fresno County VOC emissions (SJVAPCD, 2004; EPA, 2006b).

Costs and Feasibility of Adopting Emissions Control Strategies

Tested and effective air pollution control measures, including lagoon covers and barn enclosure systems, are cost effective measures for new and expanding large dairies to implement. Dairies throughout California already use digester systems to limit air pollution and generate electricity.

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[12] The SJVAPCD in Preliminary Draft Best Available Control Technology (BACT) Dairy Operations (SJVAPCD, 2004) and the DPAG Recommendations (SJVAPCD, 2006) develop the control efficiency estimates. It should be noted that some sources indicate a higher control efficiency (Iowa, 2004).

Western Dairy Design in the Sacramento region is currently preparing a barn enclosure system for a new Central Valley dairy and similar systems are already in use elsewhere in the country.

The difference in annualized costs between a free stall barn, typically used in San Joaquin Valley, and an enclosed barn for 800 cows is $49,167.[13] This represents a difference of $61 per cow, or $0.02 per gallon of milk.[14] Although initially more expensive than traditional freestall barns, enclosed barns offer a number of economic benefits. The enclosed barn design reviewed for this cost analysis uses evaporative cooling technology to create a climate-controlled environment conducive to dramatically reducing heat stress. Reducing heat stress provides other economic benefits associated with a 5% increase in milk production, increased quality of milk, increased breeding and conception rates, increased cow longevity and lower levels of cow mortality (SJVAPCD, 2004; SJVAPCD, Subpoena; Jones, 1999).[15]

The 10-year annualized cost of implementing an anaerobic digestion system in dairies with 800 milk cows is $3,622 or $4.53 per cow or $0.002 per gallon of milk (SJVAPCD, 2004).[16] The low cost of this technology is a result of cost savings associated with electricity generation, which dramatically offsets the costs of this technology. In some cases, selling excess energy to local utilities may provide an additional benefit.

There are more than18 anaerobic digestion systems in operation in California with at least seven systems in the planning phase. Some examples of dairies with operational anaerobic digesters in the San Joaquin Valley include Castelanelli Bros. Dairy in San Joaquin County, Gallo Cattle Company in Merced County, Koetsier and Hilardes in Tulare County, and Eden-Vale Dairy in Kings County (EPA, 2006).

These costs are comparable to other emission reduction strategies, such as the SJVAPCD's Indirect Source Rule (ISR), which targets emissions from new development and growth in the Valley. According to the Indirect Source Rule, development projects not in compliance with required emission reductions must pay fees of $9,350 per ton for reducing NO_x emissions and $9,011 per ton for reducing PM_{10} emissions (SJVAPCD, 2005b).

The dairy industry can afford to implement these emissions reducing technologies. United States Department of Agriculture (USDA) figures (CARB, 2005) indicate a net profit of $669 million for the California dairy sector as a whole. With an estimated 1.7 million cows, California dairies realized a net profit of $394 per cow. For a mega-dairy with 5,000 cows, this could result in close to $2 million in profit each year. The cost of implementing the two technologies discussed

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[13] The cost analysis for enclosed barns from the SJVAPCD subpoena documents is based on the most conservative emission control efficiency estimate which assumes a lower capture efficiency for the enclosed barn . Annualized costs are based on an interest rate of 10% and an equipment life of 10 years as per SJVAPCD policy.

[14] The cost per gallon of milk is calculated based on the total milk production for an 800-milk cow dairy. The cost analysis for enclosed barns includes the added benefit of increased milk production from reducing heat stress in hot weather conditions.

[15] Additional information regarding enclosed barns and reduced heat stress benefits were provided through personal communication with David Avila of Western Dairy Designs.

[16] The cost analysis for anaerobic digesters reflects the most current district emission factors for manure lagoons and in this respect varies for the initial analysis presented in Preliminary Draft Best Available Control Technology (BACT) Dairy Operations (SJVAPCD , 2004).

in this paper – enclosed barns and anaerobic digester systems – is approximately $66 per cow. These figures indicate that the implementation of these systems is financially feasible, and would allow an average dairy operator to retain a net profit of $328 per cow.[17]

[17] The profitability of individual dairies will vary, which may affect the feasibility of implementing these systems on some farms.

CONCLUSIONS

Reducing emissions associated with poor air quality is an essential component of efforts to improve public health in Fresno County. Mitigating emissions from traditionally regulated sources such as motor vehicles and homes will become increasingly expensive and less effective, because the most cost-effective approaches will already have been implemented. As these emission reduction strategies become subject to the law of diminishing returns, it will be increasingly necessary to focus emission control efforts on historically unregulated industries, such as dairies, in order to achieve significant emissions reductions. There is also a growing body of evidence indicating that significant VOC and ammonia reductions in attainment strategies will help with pollution reduction in the near-term (Panorama, 2004; Pinder, 2007; SJVAPCD, 2007).[18]

The 10-year annualized cost of implementing an anaerobic digestion system is $3,622, or $4.53 per milk cow. The cost difference between enclosed barns and traditional freestall barns is $49,167, or $61 per milk cow. As described earlier, these costs are comparable to other emission reduction strategies, such as the SJVAPCD's Indirect Source Rule (ISR), which targets emissions from new development and growth in the Valley. Emission reduction technologies on dairies also offer additional benefit in terms of reducing ammonia emissions, a precursor to fine particulate matter. As noted, fine particle emissions have a significantly higher economic burden than other emissions given their association with premature mortality.

These emission reductions could substantially reduce the $1.7 billion price tag associated with poor air quality in Fresno County. In addition to improved health and reduced health-related costs, improved air quality will have a number of additional benefits for Fresno County. By making Fresno County a significantly more attractive place to live, improved air quality will allow Fresno County to attract additional industry that will greatly contribute to the overall economy.[19] Improved air quality will also likely result in improved yields, since agricultural production – like human health – is negatively affected by air pollution. By implementing these relatively low-cost emission reduction strategies, the dairy industry will be able to continue growing while allowing Fresno County to successfully address the public health and environmental needs of its residents and meet air quality standards.

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[18] State Implementation Plans (SIP) tend to focus on NOx reduction strategies in order to reach attainment (SJVAPCD, 2007).

[19] Ultimately, if dairies are not required to mitigate their polluting emissions, other regulated industries will need to make further reductions in order for the San Joaquin Valley to reach attainment. Analyzing an industry's payroll to its pollution contribution presents a helpful means of evaluating an industry's emission burden. The food-processing industry is responsible for 2.59% of total VOC & NOx emissions in the San Joaquin Valley, yet contributes 5.58% to the Valley's payroll, a ratio of 2 to 1. Conversely, dairies are responsible for 6.37 % of pollution causing emissions, yet contribute only 1.06% to the Valley's payroll, a ratio of 1 to 6. (CA partnership for the SJV-overview). Dairies employed approximately 923 workers in 2006, or an average of 1 worker per 118 milk cows. This represents 0.2% of the total labor force and 2.92% of farm labor with in Fresno County. Estimated annual wages are $35.4 million for Fresno County dairy workers (CDFA, 2006).

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