EnSave

Technical Service Provider TSP-B-09-845

Submits this

Agricultural Energy Management Plan

To:

Fred R. Hero
Milk Moustache Dairy
100 Weight Lane
Family Farm, US 54321

December 2010

EnSave

December 2010

Fred R. Hero
Milk Moustache Dairy
100 Weight Lane
Family Farm, US 54321

Dear Fred:

I have enjoyed working with you over the past few weeks. As promised, enclosed is your completed Agricultural Energy Management Plan (AgEMP - Headquarters) in which I have identified several opportunities for you to reduce your energy bills by installing energy-efficient equipment and making other operational changes. This plan has been developed in accordance with NRCS Practice/Activity Code 122. Our Lead Energy Engineer, Gary Gawor, has reviewed and signed off on the Energy Plan. Energy savings estimates are based upon information gathered during the site visit and therefore are as accurate as possible. However, changes in equipment operation, such as an increase in operating hours, may affect actual savings.

You may be eligible for federal, state and/or local tax credits as well as grants and loans through USDA's Rural Energy for America Program (REAP), if you choose to implement the measures recommended in this report. Be sure to apply for any grants and loans *before* you make any changes to your farm. Your local USDA Rural Development representative, at the Regional Service Center (555.555.1212) can assist you with your REAP application. You may also find the state and federal websites listed on the last page of this report helpful in the application process.

On behalf of all of us at EnSave, we want to thank you for the opportunity to help you evaluate your farm's energy consumption. This Energy Audit will help you determine the best way for you to increase your farm's energy efficiency and profitability. Even if you are not able to implement all of the recommendations immediately, this report will serve as a useful guide for future decisions and improvements.

I will be calling you within a few weeks to discuss the Energy Audit with you, but in the meantime, please feel free to contact us if you have any questions.

Sincerely,

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Reviewed by: ______________________________ (Producer name / date)	NRCS Acceptance: ______________________________ (NRCS representative name / date

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY

OVERVIEW

EnSave conducted an agricultural energy use site assessment at Milk Moustache Dairy on December 8, 2010. This report has been developed with the use of AutoAudit™, a product of EnSave, and provides a plan to increase the facility's energy efficiency. This Headquarters – Agricultural Energy Management Plan (AgEMP) covers the primary energy uses on this farm as identified by EnSave. These include stationary equipment and processes. Non stationary energy uses such as motor vehicles, tractors, trucks, and skid steers are outside the scope of a Headquarters AgEMP.

An average electricity cost of $0.105 per kWh was used in this report; however, if Milk Moustache Dairy's actual costs are different from these documented values, the energy cost savings in this report would vary accordingly.

TOTAL PROJECT ECONOMICS

Installation of the recommended energy efficient equipment identified within this report will result in annual energy cost savings. The recommended equipment may be eligible for federal, state and/or local incentives as well as grants and/or loans such as through Section 9007 of the Farm Bill. Your first step after deciding to move forward with some or all of these recommendations should be to apply for Section 9007 funding and other incentives. Helpful links to these resources are provided at the end of this report to get you started.

SIGNIFICANT FINDINGS

The dairy facility at Milk Moustache Dairy was equipped with many energy efficient technologies at the time of our visit. This report focuses on the remaining opportunities at Milk Moustache Dairy for the installation of energy efficient equipment and has identified the potential for approximately $5,485 in annual energy cost savings, if all of the recommended equipment is installed. This represents about 41.3% of the baseline energy costs of $13,251.

Bottom Line: Installation of all the recommended energy efficient equipment identified within this report will result in annual energy cost savings of approximately $5,485.

ENERGY EFFICIENT EQUIPMENT EVALUATION

SUMMARY OF RECOMMENDATIONS

Milk Moustache Dairy operates a 90 cow dairy farm that produces approximately 2,463,750 pounds (lbs.) of milk per year. This report presents cost effective recommendations for Milk Moustache Dairy to upgrade to more efficient milk harvest, milk cooling, water heating, lighting, and ventilation.

During a recent twelve-month period, Milk Moustache Dairy used 126,400 kilowatt-hours (kWh) of electricity with a total cost of $13,251, for an average cost of $0.105 per kWh. This average cost is used here and throughout the report.

Tables 1 and 2 summarize the benefits of the recommended energy saving equipment. Energy saving equipment lowers usage costs by performing the same or greater work with lower energy inputs. More detailed explanations of energy efficiency equipment are provided later in this report.

Table 1. Benefits of Recommended Energy Saving Measures

Measure	Estimated Annual Electricity Savings (kWh)	Estimated Annual Energy Cost Savings	Estimated Cost to the Farm	Estimated Payback in Years
Lighting	5,400	$567	$1,400	2.5
Milk Harvest	16,427	$1,725	$6,800	3.9
Ventilation	3,854	$405	$2,000	4.9
Milk Cooling	10,801	$1,134	$6,997	6.2
Water Heating	15,750	$1,654	$12,480	7.5
Totals	**52,232**	**$5,485**	**$29,677**	**5.4**

Table 2. Energy Savings of Recommendations

Fuel	Current Usage	MBtu Usage	Savings	MBtu Savings	% Savings
Electricity (kWh)	126,400	431	52,232	178	41.3%

LOW COST ENERGY SAVING TIPS

Some energy savings potential involves primarily management and requires either no or minimal investment other than minor planning or labor. Examples include combining trips and eliminating unnecessary energy expenditure by turning off lights and shutting down engines during periods of inactivity. In another example although replacing older ventilation fans with those of higher efficiency can be cost effective, periodic cleaning of fan blades in dusty environments (e.g., every 3 to 4 weeks) and maintaining belt tension may increase existing fan efficiency by 10% or more before replacement.

CURRENT VS. PROPOSED ELECTRIC USE

Figure 1 and 2 reflect farm electricity usage from October 2009 through September 2010, Milk Moustache Dairy used approximately 126,400 kilowatt-hours (kWh) of electricity. The total cost of electricity was $13,251. The actual monthly electricity usage is depicted in Figure 1.

Figure 1. Twelve Month Electricity Usage

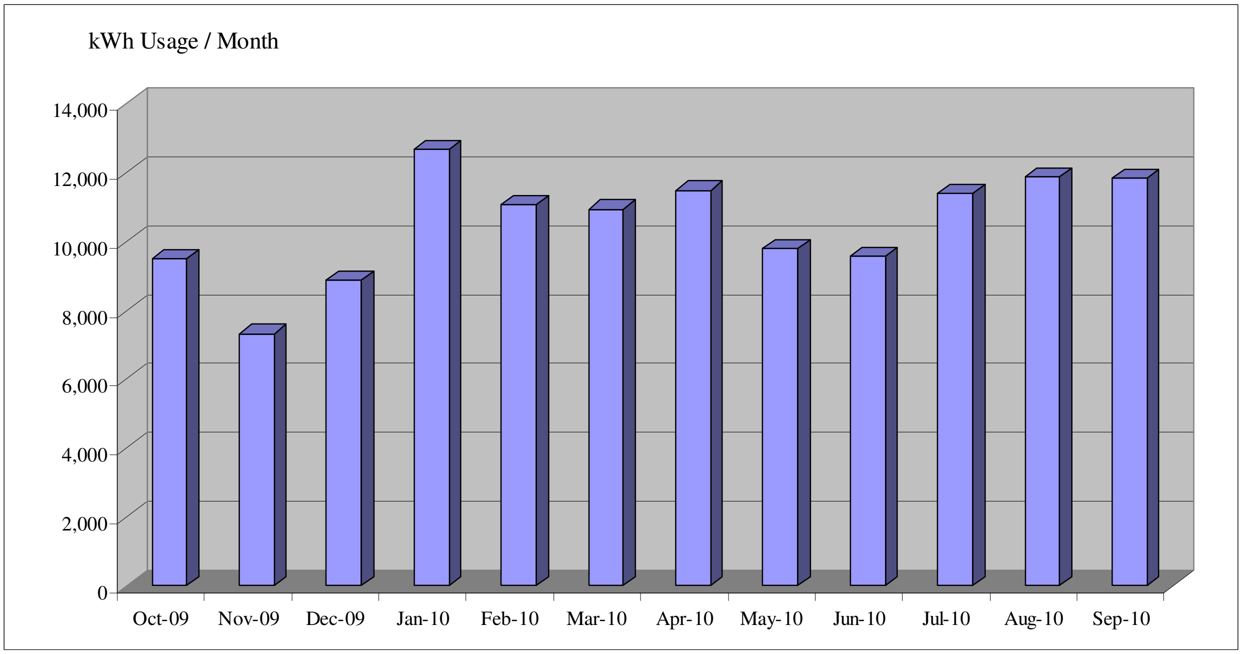
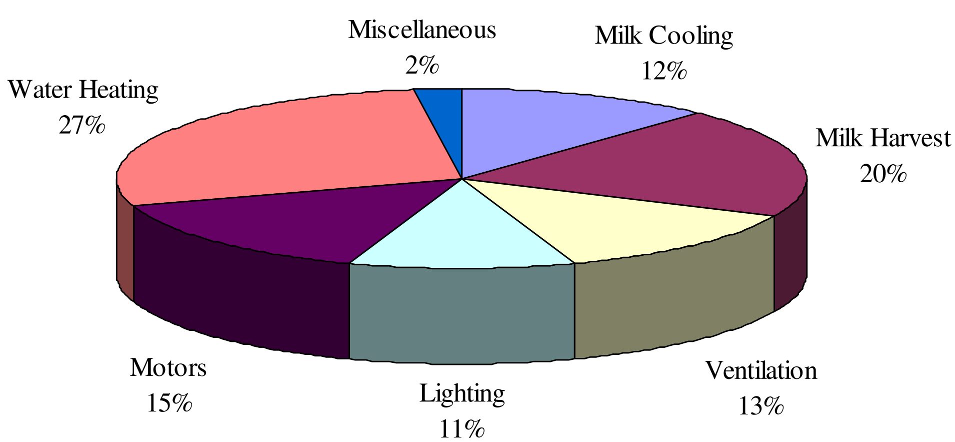


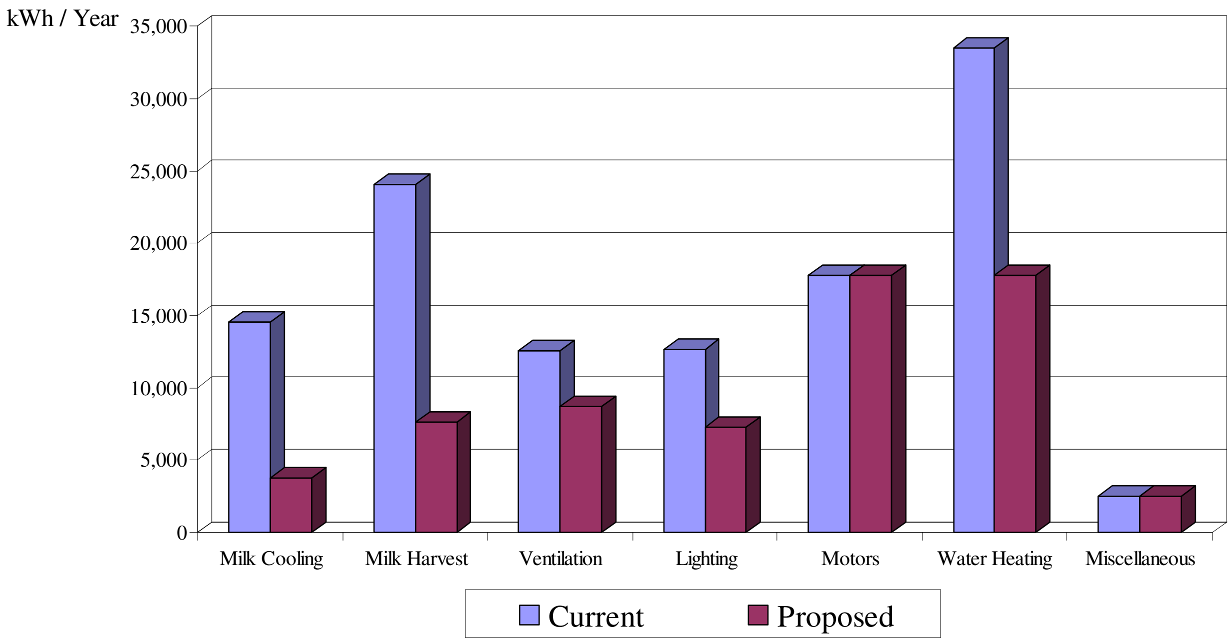
Figure 2 illustrates the end uses of the electricity used on the farm. Miscellaneous uses include pump motors and small electrical end uses such as repair shop tools and lighting.

Figure 2. Electricity Use Breakdown



In Figure 3, calculated current electricity use is compared to calculated proposed usage after the implementation of all recommended electric energy efficiency measures.

Figure 3. Comparison of Current and Proposed Electricity Use



MILK HARVEST

Milk Moustache Dairy currently operates a 10 horsepower (hp) vacuum pump. The vacuum pump operates for approximately 4 hours per day for milking time, and an additional half hour for the wash cycle. The milk pump is a 1½ hp motor that operates about a quarter of the milking time, and there is a total of 16 milking units used.

Milk Moustache Dairy has an opportunity to improve the energy efficiency of its milk vacuum pump system. The installation of a vacuum pump variable speed drive (VSD) is recommended. This equipment gauges the amount of vacuum suction needed in the parlor and adjusts the speed of the pump motor to deliver no more than is actually needed. The energy savings is from the reduced demand of the vacuum pump. Check with a licensed electrician to determine if the farm's wiring will accommodate a VSD. Figure 4 shows a comparison of the current and the proposed vacuum pump motor electricity usage with a vacuum pump VSD installed. Table 3 provides economic details for this recommendation.

Figure 4. Milk Harvest Electricity Usage

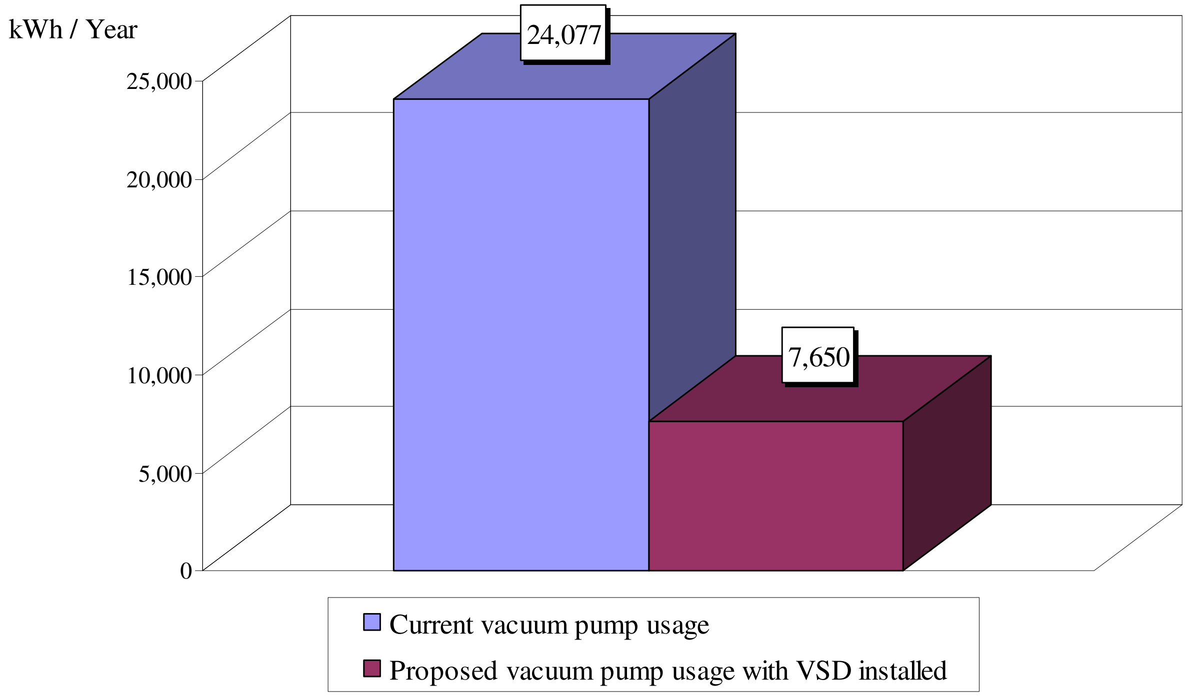


Table 3. Milk Vacuum Pump: Recommended Energy Saving Equipment

Recommended Equipment	Estimated Annual Electricity Savings (kWh)	Estimated Annual Energy Cost Savings	Estimated Cost to the Farm	Estimated Payback in Years
Vacuum Pump VSD	16,427	$1,725	$6,800	3.9

MILK COOLING

Milk Moustache Dairy cools around 6,750 lbs of milk per day from approximately 98° Fahrenheit (F) to about 38° F with cooling that takes place in the bulk tank using two 5 hp reciprocating compressors during and after each milking.

We recommend installing an open well water chilled plate cooler. This device is an efficient heat exchanger that uses cool water to reduce the temperature of the milk before it enters the bulk tank reducing the compressor run time and saving energy.

We also recommend exploring the option of upgrading the bulk tank compressors from reciprocating compressors to more energy efficient scroll compressors. Scroll compressors compress gas more efficiently by constantly compressing the refrigerant gas in a smooth motion, while reciprocating compressors use up and down motions of a piston to compress the gas over a much smaller volume repeatedly. Scroll compressors are also quieter and have fewer moving parts, making them quieter than reciprocating compressors. When using scroll compressors we recommend digitally-controlled scroll compressors with capacity modulation.

A supply water temperature of 47 °F was used to calculate milk cooling usage and savings figures. Figure 5 shows the current milk cooling energy use and the proposed milk cooling energy use with a well water plate cooler and scroll compressors installed. Table 4 provides economic details for this recommendation.

Figure 5. Milk Cooling Electricity Usage

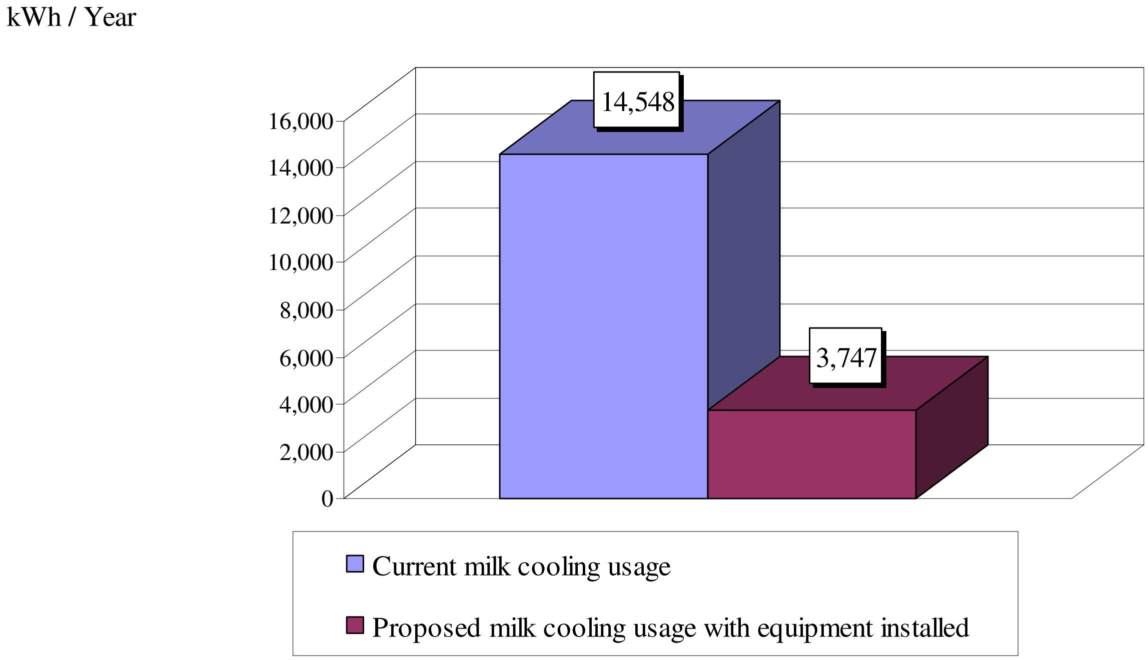


Table 4. Milk Cooling: Recommended Energy Saving Equipment

Recommended Equipment	Estimated Annual Electricity Savings (kWh)	Estimated Annual Energy Cost Savings	Estimated Cost to the Farm	Estimated Payback in Years
Milk Pre-cooler	7,431	$780	$4,500	5.8
Scroll Compressor(s)	3,370	$354	$2,497	7.1
Totals	**10,801**	**$1,134**	**$6,997**	**6.2**

Notes:

- Energy savings for each recommended piece of equipment assume that all other recommended equipment has been installed
- Condensing units and fans must be properly maintained and in good operating condition to insure uniform airflow through the condenser to maximize the energy efficiency ratio. EnSave also recommends making sure the refrigerant lines are properly insulated and the condensing units are cleaned periodically following the manufacturers specifications.

LIGHTING

Milk Moustache Dairy has an opportunity to improve the energy efficiency of its lighting system. We recommend replacing the farms 100 watt metal halide fixtures with 1-bulb, 4-foot, High Performance (HP) T8 fixtures. HPT8 fixtures, specifically designed for demanding agricultural applications, are readily available on the market. Desirable features include a gasketed enclosure to keep out moisture, dust, and insects and to facilitate hosedown, premium efficiency ballasts, and optically efficient reflectors. The higher efficiency and longer service life will lead to energy savings. HPT8 bulbs maintain around 95% of their initial light output over their lifetime, whereas metal halides lose up to 50% as they age. EnSave recommends installing HPT8 lamps with a high correlated color temperature (CCT), greater than 4,000 Kelvin (K) if possible, and a high color rendering index (CRI), greater than 82% if possible. These attributes will result in a higher quality of light and increased apparent brightness. We also recommend the installation of occupancy and daylight harvesting sensors where appropriate in the facility, which will further reduce electrical usage in those areas by reducing the runtimes of the lighting fixtures. For more information on metal halide vs. fluorescent lighting applications, see http://www.aboutlightingcontrols.org/education/papers/high-low-bay.shtml.

We generally recommend installing vapor-proof fixtures, where appropriate, to keep strip fluorescent fixtures clean, dry, and protected. We also recommend installing vapor-proof lamp guards that can be used on standard incandescent bulb sockets when replacing them with compact fluorescent lamps to also keep them clean, dry, and protected, where appropriate. For safety reasons, it is advised to never fully enclose compact fluorescent lamps greater than 23-Watts in order to prevent heat from building up inside the fixture, which can lead to a potential fire hazard. We also recommend the installation of photocell, occupancy and daylight harvesting sensors where appropriate in the facility, which will further reduce electrical usage in those areas by reducing the runtimes of the lighting fixtures. An example would be to install occupancy sensors in bathrooms and hallways where there is infrequent use.

Figure 6 shows a comparison of the estimated current and proposed lighting electricity usage. Table 5 provides economic details for each lighting upgrade recommendation.

Figure 6. Lighting Electricity Usage

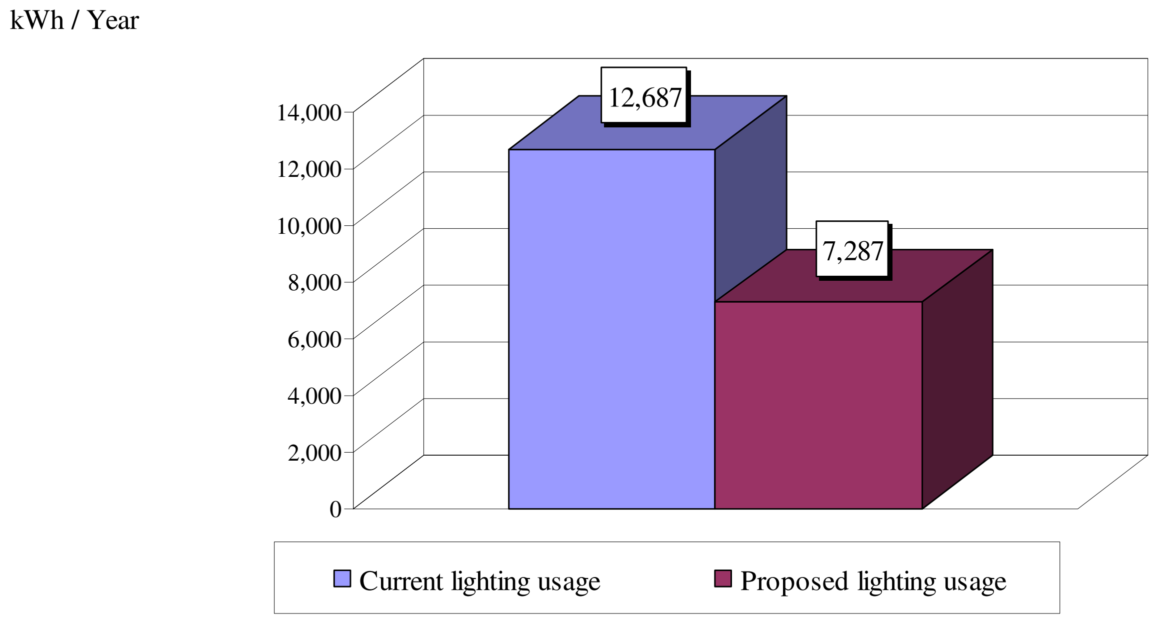


Table 5. Lighting: Recommended Energy Saving Equipment

Area	Existing Lighting Fixture to be Replaced	Recommended Lighting Fixture	Number of Fixtures to Install	Estimated Annual Electricity Savings (kWh)	Estimated Annual Energy Cost Savings	Estimated Cost to the Farm	Estimated Payback in Years
Freshening Area	100W High Pressure Sodium (138W Total Input Watts)	1-Lamp, 4ft.T8 (32W Bulbs, 33.6W Total Fixture Wattage)	1	914	$96	$100	1.0
Open Barn	100W High Pressure Sodium (138W Total Input Watts)	1-Lamp, 4ft.T8 (32W Bulbs, 33.6W Total Fixture Wattage)	1	914	$96	$100	1.0
Freestall	100W High Pressure Sodium (138W Total Input Watts)	1-Lamp, 4ft.T8 (32W Bulbs, 33.6W Total Fixture Wattage)	8	3,048	$320	$800	2.5
Machine Shed	100W High Pressure Sodium (138W Total Input Watts)	1-Lamp, 4ft.T8 (32W Bulbs, 33.6W Total Fixture Wattage)	4	523	$55	$400	7.3
			Totals	**5,399**	**$567**	**$1,400**	**2.5**

VENTILATION

Milk Moustache Dairy has an opportunity to improve the energy efficiency of its ventilation system by installing high efficiency fans. Figure 7 shows the estimated current and proposed ventilation electricity usage. Table 6 provides economic details for each fan upgrade recommendation.

Circulation fans are typically rated based on the pounds of force per kW of power rating (lb_f/kW) at 0.00" water gauge static pressure; the higher the (lb_f/kW) the higher the efficiency. Exhaust fans are typically rated based on the cubic feet of air moved per minute per Watt of power rating (cfm/Watt) and airflow ratio, which gives an indication of a fan's ability to push air when there is contrary pressure acting against the fan from either wind or higher static pressure inside a building. Exhaust fans are commonly rated at a static exhaust pressure of 0.10" water gauge.

We recommend installing more energy efficient 24" exhaust fans. The fans we generally recommend represent the top 5% of energy efficient fans tested by Bioenvironmental and Structural Systems (BESS) Laboratory. Our minimum recommended cfm and cfm/Watt ratings for each fan can be found in Table 6. For more specific information on fan selection and maintenance please refer to the Resources section of this report.

Also, if Milk Moustache Dairy were to increase the size of their fans in order to maximize the airflow and energy savings potential, we would recommend considering working with a dairy ventilation specialist to determine if the required air movement for a particular area could be achieved in order to optimize cow comfort. It is also good practice to develop proper maintenance and monitoring techniques that will help to detect problems early on and help determine solutions for creating more efficient ventilation systems.

We also recommend that any fans being installed be models previously tested by BESS Lab http://www.bess.uiuc.edu/ or the Air Movement and Control Association (AMCA) http://www.amca.org/. For more specific information on circulation fan selection and maintenance please refer to the Resources section of this report.

Figure 7. Ventilation Electricity Usage

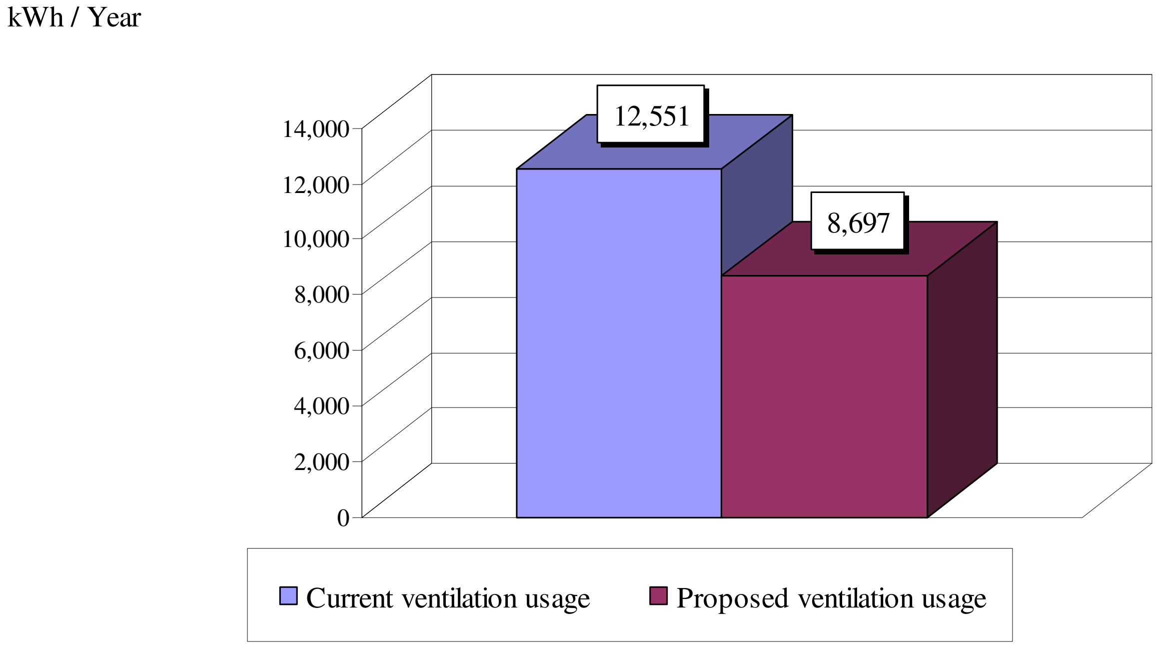


Table 6. Ventilation: Recommended Energy Saving Equipment

Area	Existing Equipment to be Replaced	Recommended Equipment	Number of Fans to Replace	Estimated Annual Electricity Savings (kWh)	Estimated Annual Energy Cost Savings	Estimated Installation Cost	Estimated Payback (Years)
Old Tiestall Barn	24" Exhaust fan, running 5600 hours/year at 10.8 cfm/Watt	24" Exhaust fan with 5630 cfm, and 14.5 cfm/Watt rating	4	3,854	$405	$2,000	4.9

Notes:

- Fans recommended represent the midpoint between the minimum efficiency threshold and the highest efficiency fan as grouped and tested by Bioenvironmental and Structural Systems (BESS) Laboratory. To be eligible for incentives, fans must be tested by BESS Lab http://www.bess.uiuc.edu/ or the Air Movement and Control Association (AMCA) http://www.amca.org/

WATER HEATING

Milk Moustache Dairy heats approximately 250 gallons of water a day from 47 °Fahrenheit (F) to 180 °F. They currently use an electric water heater. EnSave recommends the installation of compressor heat recovery units (CHR) in your refrigeration system. These devices are insulated storage tanks with heat exchangers that use the heat extracted from the milk through the hot gas refrigerant line from the refrigeration system's compressors, to pre-heat the water to approximately 110 °F before it enters the conventional water heaters. The actual number of heat recovery units and their location will depend on the operating hours of the compressor and the configuration of the existing system. Please contact your EPA certified refrigeration technician to determine the preferred and practical number of CHR units that will operate most efficiently with your system, and that low ambient controls and or condenser variable speed drives are part of the installation. The energy savings comes from the reduced heating required in the actual water heater. Figure 8 below shows the farm's current water heating usage and the proposed usage once the compressor heat recovery units are installed. Table 7 provides economic details for the recommended upgrade.

Figure 8. Water Heating Energy Usage

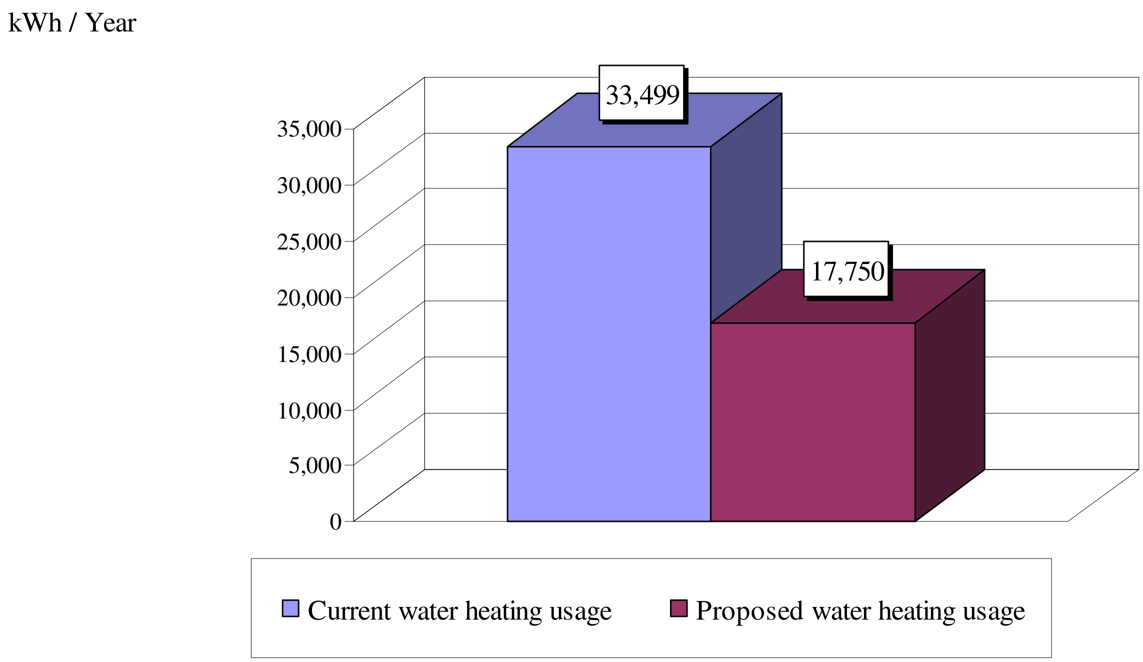


Table 7. Water Heating: Recommended Energy Saving Equipment

Recommended Equipment	Estimated Annual Electricity Savings (kWh)	Estimated Annual Energy Cost Savings	Estimated Cost to the Farm	Estimated Payback in Years
Compressor Heat Recovery System	15,750	$1,654	$12,480	7.5

SPACE HEATING

It is quite costly to heat the air in a dairy parlor using a forced hot air furnace. Rather than heating the air, radiant heaters use radiant energy to efficiently heat the objects in a room (Cows and floor). Like sitting in a room with a wood stove, greater comfort can be achieved at lower air temperatures and lower energy costs. The forced hot air furnace transfers 40% of their energy as radiant heat to the floor and 60% to the air as convection heat. Because of their design, radiant heaters are able to transfer 90% of their heat to the floor. As a result radiant heaters consume 15-30% less fuel than the forced hot air heaters.

MOTORS

It has been determined that Milk Moustache Dairy has very little energy saving opportunities from improving the efficiency of their motors by upgrading to motors that meet the NEMA Premium® standards. Therefore, at this time there are no cost effective recommendations to upgrade any of the existing motors on the farm. It is also important to understand that improving the efficiency of a pump or a compressor motor will likely increase the life of the equipment and reduce operating costs. Proper maintenance and monitoring techniques will help to detect problems early on and determine solutions for creating a more efficient system.

Table 8 provides a list of the motors analyzed in this report.

Table 8. Motors: Existing Equipment

Area	Existing Motor Description	Proposed Motor Description	Number of Motors to Install	Estimated Annual Electricity Savings (kWh)	Estimated Annual Energy Cost Savings	Estimated Cost to the Farm	Estimated Payback in Years
Milk Transfer Pump Motor	1 hp, TEFC, 1800 RPM, 70% efficiency	1 hp, TEFC, 1800 RPM, NEMA Premium®, 85.5% minimum nominal efficiency	1	67	$12	$500	42.7
Vacuum Pump Motor	5 hp, TEFC, 3600 RPM, 87.5% efficiency	5 hp, TEFC, 3600 RPM, NEMA Premium®, 88.5% minimum nominal efficiency	1	67	$12	$700	60.0
Silo Unloader	7.5 hp, TEFC, 1800 RPM, 89.5% efficiency	7.5 hp, TEFC, 1800 RPM, NEMA Premium®, 91.7% minimum nominal efficiency	1	16	$3	$1,000	357.9
Gutter Chain System	5 hp, TEFC, 1800 RPM, 87.5% efficiency	5 hp, TEFC, 1800 RPM, NEMA Premium®, 89.5% minimum nominal efficiency	1	6	$1	$700	682.8

Note: To consistently have the lowest possible energy consumption from motors, when a three phase motor, 1 hp or greater burns out always replace them with the most energy efficient motor available. EnSave recommends replacing motors with units that meet the NEMA Premium® standard. For information on NEMA Premium®, see http://www.nema.org/gov/energy/efficiency/premium/

Manure Management and Transfer

Milk Moustache Dairy uses an 18” gutter chain system powered by a 5 hp electric motor for manure management in the barn. The manure management system was part of the scope of this headquarters energy management plan and was evaluated in the motor section of this report.

Feed Handling and Storage

The majority of the feeding is done by a front end loader and was therefore not part of the scope on this headquarters agricultural energy management plan. The silo unloader was part of the scope and was evaluated in the motor section of this report.

MISCELLANEOUS ELECTRICAL USE

On the dairy there are minor electrical uses that are not accounted for in the previous sections. These uses include grain auger motors, shop tools, and milk agitators. These motors may operate every day, yet there are three reasons why it is not justifiable to replace these motors based on energy savings:

- **First**, they do not operate for a sufficient number of hours, annually, to justify replacement. Typically, to justify replacing a motor, based upon energy savings alone, it needs to run a minimum of 2,000 hours annually. A motor would have to run about five hours a day to justify replacement.

- **Second**, most of these motors are small, 3/4 hp or 1 hp, and motors of that size do not consume enough energy to justify replacing them.

- **Third**, motors such as ally scrapers and milk agitators run at very low speeds. A slower moving motor uses less electricity than a higher speed motor. These motors do not consume enough energy to justify replacement

ENVIRONMENTAL ASPECTS

Measure	Soil	Water	Animal*	Plant	Air
Milk Harvest	N/A	N/A	N/A	N/A	See Summary of All Measures below
Milk Cooling	N/A	N/A	N/A	N/A	
Ventilation	N/A	N/A	N/A	N/A	
Water Heating	N/A	N/A	N/A	N/A	
Lighting	See Note 1	See Note 1	N/A	N/A	

*This resource refers to endangered species.

Note 1: This report recommends using compact fluorescent lights. Fluorescent lights are regulated under the Resource Conservation and Recovery Act. These lights cannot be disposed with trash, it is against the law. Please contact your local waste district for information on how to properly dispose of fluorescent lamps. Additional information is provided in the resource section of this report.

Summary of All measures: If implemented, the energy saving recommendations made in this report will reduce emissions by the following estimated amounts:

Contaminant	Amount
Sulfur Dioxide, SO_2 (tons)	0.24
Nitrogen Oxides, NOx (tons)	0.04
Carbon Dioxide, CO_2 (tons)	32.50
Nitrous Oxides, N_2O (pounds)	1.09

SOx and NOx are ambient air contaminants; CO_2 is a green house gas.

RESOURCES

The following resources provide additional information on ways to save energy at your facility.

1. *Best Environmental Management Practices Farm Animal Production*, publication funded by USDA Special Needs, Purdue University, and Michigan State University

2. *Best Practices Guide: Energy Savings for Dairy*, published by EnSave, Inc.

3. *Farm Safely With Electricity*, published by the Rural Electricity Resource Council (formerly NFEC)

4. *Dairy Heat Reclaimers,* published by the Rural Electricity Resource Council (formerly NFEC)

5. *Variable Speed Drive for the Milking Vacuum Pump*, published by EnSave, Inc.

6. *Milk Pre-Coolers*, published by EnSave, Inc.

7. *Scroll Compressors on the Dairy Farm,* published by EnSave, Inc.

8. *Dairy Farm Lighting,* published by EnSave, Inc.

9. *High-Performance T8 Specification*, published by the Consortium for Energy Efficiency (CEE), see http://www.cee1.org/com/com-lt/com-lt-specs.pdf (not attached)

10. *High Performance 4' T8 Lamp and Ballast Qualifying List*, published by CEE

11. *Outdoor Lighting for Safety and Productivity: A Guide for Rural Homes, Farms, and Related Businesses*, published by RERC

12. *Compressor Heat Recovery,* published by EnSave, Inc.

13. *Agricultural Ventilation Fans: Selection and Maintenance*, published by the RERC

14. *Energy Efficient Fan Ranking Guide: 24-26" Single Phase / Circulation Fan Test Results, page 24*, published by EnSave, Inc.

15. *Managing Mercury on the Farm*, published by EnSave, Inc.

INTERNET RESOURCES

The following resources provide additional information on ways to save energy at your facility.

1. *Bioenvironmental and Structural Systems Laboratory (BESS Labs)*
   http://www.bess.uiuc.edu/

2. *Database of State Incentives for Renewables & Efficiency (DSIRE)*
   http://www.dsireusa.org/index.cfm?EE=1&RE=1

3. *USDA Section 9007 Information*
   http://www.rurdev.usda.gov/rbs/farmbill/

4. *PV Watt Calculator*
   http://www.pvwatts.org/

5. *Small Wind Turbine Market Study*
   http://www.awea.org/smallwind/documents/AWEASmallWindMarketStudy2007.pdf

6. *National Renewable Energy Laboratory*
   http://www.nrel.gov/

7. *National Renewable Energy Laboratory Wind Map*
   http://rredc.nrel.gov/wind/pubs/atlas

8. *Northwestern Rural Electric Coop*
   www.northwesternrec.com

9. *Dairy Marketing Services*
   www.dairymarketingservices.com/

10. *American Wind Energy Association*
    http://www.awea.org/faq/

11. *US Department of Energy, Wind and Hydro Technologies Program*
    http://www.windpoweringamerica.gov/