Submits this

Sample Agricultural Energy Management Plan
Washington

60 Acres

Wednesday, July 24, 2013
Wednesday, July 24, 2013

Jane Smith
Smith Family Farm, LLC
23726 SE 424th Street
Hooftop, WA 94680

Dear Mrs. Smith:

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 Conservation Activity Plan 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.

Before moving forward with any of the recommendations in your plan, we encourage you to contact your local USDA NRCS and Rural Development offices to determine if any funding is available through the NRCS Environmental Quality Incentives Program (EQIP) or the USDA Rural Energy for America Program (REAP). Your local USDA NRCS representatives and Rural Development representatives can assist you with the application process for both programs. In the ‘Resources’ section of your plan, we’ve also included some helpful information and websites that can lead you to local utility and state programs where additional funding might also be available.

On behalf of all of us at EnSave, Inc. we want to thank you for the opportunity to help you evaluate your farm’s energy consumption and energy saving opportunities. This Energy Management Plan 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 in a few weeks to discuss the Energy Plan with you, but in the meantime, please feel free to contact us if you have any questions.

Sincerely,

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EnSave, Inc.
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Note:

- EnSave’s goal is to help our clients save energy and conserve natural resources on America’s farms and in food processing facilities. **EnSave does not represent any equipment manufacturer or dealer.**
- Any quotes or literature included in this report from a manufacturer are intended as illustrations only.
- Energy savings presented in this document are estimates and are based upon information gathered during the process of conducting this energy audit. Actual savings may vary from estimated savings due to a variety of factors including changes in energy usage and energy costs.
- Equipment costs presented in this report are estimates and are based upon available pricing information. Actual costs may vary from estimated costs due to variables such as product availability and geographic location. Numbers presented in this document may not add up precisely due to rounding.
- Mention of trade and company names used in this report do not imply endorsement nor does omission of names imply criticism.
SUMMARY

Overview
EnSave, Inc. conducted an agricultural energy use site assessment at Smith Family Farm, LLC on Friday, April 26, 2013. This report has been developed with the use of FEAT™, a product of EnSave, Inc, and provides a plan to increase the facility’s energy efficiency. The express written permission of EnSave, Inc. is required prior to reproducing information in this report in whole or in part. This Headquarters – Agricultural Energy Management Plan (AgEMP) covers the primary energy uses identified by EnSave, Inc. for this location. 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 $0.10 per kWh, an average cost of $1.02 per ccf of natural gas and an average cost of $3.50 per gallon of diesel were used in this report; however, if Smith Family Farm, LLC’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 assistance such as through the USDA NRCS Environmental Quality Incentives Program (EQIP), grants and/or loans through the USDA Rural Energy for America Program (REAP) Section 9007 of the Farm Bill, and utility company incentives. Your first step after deciding to move forward with some or all of these recommendations should be to explore these funding opportunities. Helpful links to these resources are provided at the end of this report to get you started.

Farmer Preferences
The farmer expressed an interest exploring any possible energy saving measures on the farm. Measures that were found to be cost effective can be seen in Tables S.1 and S.3.

Conservation Activity Plan
The recommended energy efficiency improvements could possibly be implemented through the use of NRCS Code 374, Farmstead Energy Improvement. Check with your NRCS representative for the most current listing of eligible measures that are applicable to this plan and to determine if any funding assistance is available.

Significant Findings
The dairy facility at Smith Family Farm, LLC is approximately 45 years old. Existing energy efficient equipment on the farm includes: a vacuum pump variable speed drive (VSD) and compact fluorescent lights. This report focuses on the remaining opportunities at Smith Family Farm, LLC for the installation of energy efficient equipment.

By taking action on the energy efficiency recommendations detailed in this report, you can save approximately $1,436 per year in natural gas costs (1,412 gallons), about $8,751 per year in electricity costs (90,059 kWh) and approximately $2,100 per year in diesel fuel costs (600...
gallons). With natural gas, electric and diesel combined, EnSave estimates that your net energy cost savings will amount to $12,287 per year. This represents about 40% of the baseline energy costs of $30,849.

**Bottom Line:** Installation of all the recommended energy efficient equipment identified within this report will result in annual energy cost savings of approximately $12,287.

**ENERGY EFFICIENT EQUIPMENT EVALUATION**

**Summary of Recommendations**
Smith Family Farm, LLC operates a 440 cow dairy farm that produces approximately 11,211,200 pounds (lbs.) of milk per year. This report presents cost effective recommendations for Smith Family Farm, LLC to upgrade to more efficient milk cooling, water heating, lighting and waste pumping.

Tables S.1 and S.2 summarize the benefits of the recommended energy saving measures with simple payback period of 10 years or less. These tables are presented as required by NRCS Conservation Activity Plan Code 122.

**Table S.1. Summary of Estimated Annual Efficiency Improvements**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>General Lighting</td>
<td>20,613</td>
<td>0</td>
<td>0</td>
<td>70</td>
<td>$4,518</td>
<td>$1,981</td>
<td>2.3</td>
<td>6,825.0</td>
<td>0.1</td>
<td>0.3</td>
<td>1.8</td>
</tr>
<tr>
<td>Refrigeration: Milk Cooling</td>
<td>79,753</td>
<td>0</td>
<td>272</td>
<td>$22,950</td>
<td>$7,760</td>
<td>3.0</td>
<td>26,407.0</td>
<td>0.5</td>
<td>1.3</td>
<td>7.1</td>
<td>33.8</td>
</tr>
<tr>
<td>Hot Water</td>
<td>0</td>
<td>1,362</td>
<td>139</td>
<td>$6,000</td>
<td>$1,385</td>
<td>4.3</td>
<td>15,936.1</td>
<td>0.5</td>
<td>2.7</td>
<td>0.1</td>
<td>13.6</td>
</tr>
<tr>
<td>Air Heating and Building Environment</td>
<td>0</td>
<td>50</td>
<td>5</td>
<td>$316</td>
<td>$51</td>
<td>6.2</td>
<td>590.2</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>100,366</strong></td>
<td><strong>1,412</strong></td>
<td><strong>486</strong></td>
<td><strong>$33,784</strong></td>
<td><strong>$11,177</strong></td>
<td><strong>3.0</strong></td>
<td><strong>49,758.3</strong></td>
<td>1.1</td>
<td>4.4</td>
<td>9.0</td>
<td>56.6</td>
</tr>
</tbody>
</table>

**Notes:**
1. Environmental Benefits are reduction estimates, values are as per [http://cometfarm.nrel.colostate.edu/](http://cometfarm.nrel.colostate.edu/).

**Table S.2. Energy Savings of Recommendations**

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Current Use</th>
<th>Current Use (MMBtu)</th>
<th>Savings</th>
<th>Savings (MMBtu)</th>
<th>Savings (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased Electricity (kWh)</td>
<td>264,610</td>
<td>903</td>
<td>100,366</td>
<td>343</td>
<td>38 %</td>
</tr>
<tr>
<td>Natural Gas (ccf)</td>
<td>3,255</td>
<td>332</td>
<td>1,413</td>
<td>144</td>
<td>43 %</td>
</tr>
<tr>
<td>Diesel (gal)</td>
<td>600</td>
<td>83</td>
<td>0</td>
<td>0</td>
<td>0 %</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>1,318</strong></td>
<td></td>
<td><strong>487</strong></td>
<td></td>
<td><strong>37 %</strong></td>
</tr>
</tbody>
</table>
Tables S.3 and S.4 summarize the benefits for all measures recommended by EnSave. 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.

Site specific actual cost quotations may affect payback period and eligibility for Code 374 Farmstead Energy Improvement.

### Table S.3. Overall Summary of Estimated Annual Energy Efficiency Improvements

<table>
<thead>
<tr>
<th>Measure</th>
<th>Estimated Reduction in Energy Use</th>
<th>Estimated Costs, Savings, Payback, and Prioritization for Implementation</th>
<th>Environmental Benefits¹</th>
<th>Greenhouse Gas (Estimated Values)</th>
<th>Air Pollutant Co-Benefits (Estimated Values)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electricity Savings (kWh)</td>
<td>Natural Gas Savings (ccf)</td>
<td>Installed Cost [a]</td>
<td>Energy Cost Savings [b]</td>
<td>CO₂ (lbs)</td>
</tr>
<tr>
<td>General Lighting</td>
<td>20,613</td>
<td>0</td>
<td>70</td>
<td>$4,518</td>
<td>$1,981</td>
</tr>
<tr>
<td>Refrigeration: Milk Cooling</td>
<td>79,753</td>
<td>0</td>
<td>272</td>
<td>$22,950</td>
<td>$7,760</td>
</tr>
<tr>
<td>Hot Water</td>
<td>0</td>
<td>1,362</td>
<td>0</td>
<td>$6,000</td>
<td>$1,385</td>
</tr>
<tr>
<td>Air Heating and Building Environment</td>
<td>0</td>
<td>50</td>
<td>5</td>
<td>$316</td>
<td>$51</td>
</tr>
<tr>
<td>Waste Water Lagoon Pump Motor</td>
<td>(10,307)</td>
<td>600</td>
<td>48</td>
<td>$11,228</td>
<td>$1,110</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>90,059</td>
<td>1,412</td>
<td>600</td>
<td>$45,012</td>
<td>$12,287</td>
</tr>
</tbody>
</table>

Notes:
1. Environmental Benefits are reduction estimates, values are as per [http://cometfarm.nrel.colostate.edu/](http://cometfarm.nrel.colostate.edu/).
2. Installing the recommended electric waste water lagoon pump motor will increase annual electricity usage by 10,307 kWh, but will reduce diesel fuel usage and result in a net energy and cost savings.

### Table S.4. Overall Energy Savings of Recommendations

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Current Use</th>
<th>Use (MMBtu)</th>
<th>Savings</th>
<th>Savings (MMBtu)</th>
<th>Savings (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased Electricity (kWh)</td>
<td>264,610</td>
<td>903</td>
<td>90,059</td>
<td>307</td>
<td>34 %</td>
</tr>
<tr>
<td>Natural Gas (ccf)</td>
<td>3,255</td>
<td>332</td>
<td>1,413</td>
<td>144</td>
<td>43 %</td>
</tr>
<tr>
<td>Diesel (gal)</td>
<td>600</td>
<td>83</td>
<td>600</td>
<td>83</td>
<td>100 %</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td><strong>1,318</strong></td>
<td><strong>535</strong></td>
<td></td>
<td><strong>41 %</strong></td>
</tr>
</tbody>
</table>

The measures recommended in this report are based on energy savings analysis, related energy cost savings, and estimated cost to implement. The simple payback periods (in years) are shown in the respective measure tables. When the payback period is less than or equal to the expected useful life of the measure (in years), the measure is recommended.

Estimated cost to implement an energy saving measure is based on EnSave research. Actual costs to your site may vary. The Simple Payback Period can be re-calculated as needed based on site-specific quoted costs.

*EnSave, Inc.*

3
Simple Payback Period is equal to the estimated cost to implement ($) divided by the estimated annual cost of energy saved ($/year) and is expressed as number of years. This method does not account for more complex financial considerations such as loan interest and fees, tax rates, depreciation or any other potential cost impacts. As with any business expenditure proper consideration should be given to all aspects of spending decisions.

There may be other factors to consider when making decisions to implement measures recommended and/or considered in this report. These may include aspects such as operational performance, throughput, operation and maintenance costs, labor costs, livestock productivity considerations, integrator contractual requirements, etc. These considerations are beyond the scope of this energy audit. Any new equipment should be properly reviewed for site-specific needs, concerns and applicability.

Information on operational schedules and run times is based on input from the producer.

**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 expenditures by turning off lights and shutting down engines during periods of inactivity. Another example of a low cost energy saving measure is periodic cleaning of fan blades in dusty environments (e.g., every 3 to 4 weeks) and maintaining belt tension on belt driven fans. This may increase existing fan efficiency by 10% or more without replacement. These actions can increase the useful life of fans.
Current vs. Projected Electricity Use
Figure EU.1 reflects on-site electricity use from January 2012 through December 2012. During the twelve month period evaluated, Smith Family Farm, LLC used approximately 264,610 kilowatt-hours (kWh) of electricity. The total cost of electricity was $25,439.

The actual monthly electricity use is depicted in Figure EU.1.

Figure EU.1. Twelve Month Electricity Use
Figure 2 illustrates the end uses of the electricity used on the farm. Motor usage does not include the milk transfer pump and vacuum pump motors, as they are included in the milk harvest section. Miscellaneous uses include small electrical end uses such as repair shop tools and milk agitators.

The electricity use breakdown by measure is depicted in Figure EU.2.

**Figure EU.2. Electricity Use Breakdown**

![Electricity Use Breakdown Chart]

- **Other Motors and Pumps**: 32%
- **General Lighting**: 16%
- **Miscellaneous**: 6%
- **General Ventilation**: 1%
- **Milk Harvest**: 13%
- **Refrigeration: Milk Cooling**: 33%
In Figure EU.3, calculated current electricity use is compared to projected use after the installation of all recommended electric energy efficiency equipment.

**Figure EU.3. Comparison of Current and Proposed Electricity Use**
Current vs. Projected Natural Gas Use

Figure NGU.1 reflects on-site natural gas use from January 2012 through December 2012, Smith Family Farm, LLC used approximately 3,255 centum cubic feet (ccf) of natural gas. The total cost of natural gas was $3,310.

The actual monthly natural gas use is depicted in Figure NU.1.

Figure NU.1. Twelve Month Natural Gas Use
The natural gas use breakdown by measure is depicted in Figure NU.2.

**Figure NU.2. Natural Gas Use Breakdown**

In Figure NU.3, calculated current natural gas use is compared to projected use after the installation of all energy efficient equipment.

**Figure NU.3. Comparison of Current and Proposed Natural Gas Use**
Current vs. Projected Diesel Fuel Use
Smith Family Farm, LLC used approximately 600 gallons (gal) of diesel fuel for the waste water lagoon pump from January 2012 through December 2012. The total cost of fuel oil was $2,100. If the farmer decides to convert his Waste Water Lagoon Pump Motor from a diesel engine to an electric motor there will be no diesel usage associated with stationary equipment on the farm. The diesel fuel documented in this report is only used for Waste Water Lagoon Pump Motor.

On-Site Energy Generation
Smith Family Farm, LLC currently operates one diesel PTO driven generator for testing, upkeep, and maintenance purposes. The generator serves as an emergency power supply and was not in operation for significant time during the twelve month period assessed for the farm. The generator was not evaluated for energy saving opportunities due to low run hours.

Table EGEN.1 contains the existing generator details.

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Manufacturer / Model</th>
<th># Generators</th>
<th>Fuel Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generator</td>
<td>N/A</td>
<td>1</td>
<td>Diesel (gal)</td>
</tr>
</tbody>
</table>

Milk Harvest
Smith Family Farm, LLC currently operates a 7.5 horsepower (hp) rotary lobe vacuum pump. The vacuum pump operates for approximately 21 hours per day during milking, and an additional 3 hours for the wash cycles. The milk transfer pump is a 1.5 hp milk transfer pump that operates about a quarter of the milking time. Smith Family Farm, LLC has a total of 18 milking units.

Smith Family Farm, LLC’s vacuum pump is currently equipped with an energy efficient variable speed drive (VSD). 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.

EnSave, Inc. does not recommend replacing the vacuum pump motor or the milk transfer pump motor due to the long payback period. The backup vacuum pump motor and backup milk transfer pump motor were not used during the period evaluated in the report; therefore there are no recommendations to upgrade this equipment.
Tables MH.1 and MH.2 contain the current milk harvest equipment.

**Table MH.1. Vacuum Pump Inventory**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Run Frequency</th>
<th>Vacuum Pump Type</th>
<th># Milking Units</th>
<th>Motor Manufacturer / Model</th>
<th>Year Motor Installed</th>
<th># Motors</th>
<th>Motor HP</th>
<th>RPM Rating</th>
<th>Casing Type</th>
<th>VSD?</th>
<th>Annual Run Hours</th>
<th>Est. Annual Use (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum Pump Motor</td>
<td>Primary</td>
<td>Rotary Lobe</td>
<td>18</td>
<td>BouMatic / GAEHDA0040</td>
<td>2003</td>
<td>1</td>
<td>7.5</td>
<td>2700 +</td>
<td>TEFC</td>
<td>Yes</td>
<td>8,736</td>
<td>30,502</td>
</tr>
<tr>
<td>Backup Vacuum Pump Motor</td>
<td>Backup</td>
<td>Sliding Vane</td>
<td>18</td>
<td>Tatung Co. / WJ0154FFAC</td>
<td>2001</td>
<td>1</td>
<td>15</td>
<td>1500 - 2700</td>
<td>N/A</td>
<td>No</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Table MH.2. Milk Transfer Pump Inventory**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Motor Manufacturer / Model</th>
<th>Year Motor Installed</th>
<th># Motors</th>
<th>Motor HP</th>
<th>RPM Rating</th>
<th>Casing Code</th>
<th>Annual Run Hours</th>
<th>Est. Annual Use (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk Transfer Pump Motor</td>
<td>Lincoln / SRF2S1.5TLC186028</td>
<td>1993</td>
<td>1</td>
<td>1.5</td>
<td>2700 +</td>
<td>TEFC</td>
<td>2,184</td>
<td>2,645</td>
</tr>
<tr>
<td>Backup Milk Transfer Pump Motor</td>
<td>DeLaval / 018359</td>
<td>1993</td>
<td>1</td>
<td>2</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table MH.3 lists evaluated equipment options that were not recommended.

**Table MH.3. Milk Harvest: Evaluated Equipment Not Recommended**

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Current Equipment</th>
<th>Considered Equipment</th>
<th># to Install</th>
<th>Est. Annual Electricity Savings (kWh)</th>
<th>Est. Annual Cost Savings</th>
<th>Est. Installed Cost</th>
<th>Est. Payback (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum Pump Motor</td>
<td>7.5 HP, TEFC, 2700+ RPM, 88.5% Efficiency</td>
<td>7.5 HP, TEFC, 2700+ RPM, NEMA Premium®, 89.5% minimum nominal efficiency</td>
<td>1</td>
<td>341</td>
<td>$33</td>
<td>$1,000</td>
<td>30.2</td>
</tr>
<tr>
<td>Milk Transfer Pump Motor</td>
<td>1.5 HP, TEFC, 2700+ RPM, 78.5% Efficiency</td>
<td>1.5 HP, TEFC, 2700+ RPM, NEMA Premium®, 84% minimum nominal efficiency</td>
<td>1</td>
<td>173</td>
<td>$17</td>
<td>$520</td>
<td>30.9</td>
</tr>
</tbody>
</table>

**Refrigeration: Milk Cooling**

Smith Family Farm, LLC cools around 30,800 lbs of milk per day from approximately 98° Fahrenheit (F) to about 38° F using two 15 hp scroll glycol chiller compressors. There is a well water plate cooler that was not used during the period evaluated in the report.

EnSave, Inc. recommends installing an open well water chilled plate cooler with a milk pump variable speed drive (VSD). This will allow Smith Family Farm, LLC to pre-cool their milk down to within approximately 4 ° F of the incoming well water temperature by regulating the milk flow over the plates, thereby allowing time for maximum cooling to take place. The ideal milk transfer would pump the milk at the slowest and most constant rate possible through the pre cooler. We also recommend working with your dairy equipment service provider to install, if necessary, a large enough receiver tank, so that the increase in milk volume in the receiver will allow for a more constant flow of milk through the plate cooler. The pump should have a motor that meets the NEMA Premium® standard.
There are several considerations that should be made when installing a well-water plate cooler. An adequate water supply is necessary for the plate cooler to operate properly. The common flow rate is about two times the flow of the milk through the plate cooler, and the amount of cooling from the plate cooler increases as the flow rate ratio of water to milk increases. So the farm would require approximately 7,163 gallons of water per day for the plate cooler.

A second consideration is where the water will go after it exits the plate cooler. The water can be recycled and used to water the cows, although some states have regulations against recycling waste plate cooler water. Check your state regulations before installing a well-water plate cooler. A third consideration is the temperature of the well water on the farm. Warm water is less effective at removing heat than cold water is. An option for areas with warm well water (above 60 °F) is to chill the water using a chiller system. All of these considerations should be evaluated before installing a well-water plate cooler.

The estimated cost for the well water plate cooler is based on installing new equipment although the farmer may wish to explore the option of fixing the existing plate cooler.

We also recommend exploring the option of upgrading the existing glycol chiller compressors to more energy efficient compressors. High efficiency discus compressors are an option that have similar performance rating to scroll compressors. Discuss compressors can often be more efficient than scroll compressors for capacities above 10 hp, and digitally controlled models with capacity modulation are also available for discus compressors. Work with your refrigeration technician to choose the most efficient compressor available that best meets the needs of the farm.

A supply water temperature of 52°F was used to calculate milk cooling usage and savings figures.

Tables MC.1 and MC.2 contain the current milk cooling equipment. Energy Efficiency Ratio (EER) is a measure of cooling output per energy input (BTUs / Watt-hour) at a specific operating condition. When installing cooling compressors, be sure to select ones with the highest EER for your application. A larger EER value reflects increased energy savings.

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Manufacturer / Model</th>
<th>Year Installed</th>
<th>Refrigerant</th>
<th>Compressors</th>
<th>Compressor Type</th>
<th>Compressor HP</th>
<th>EER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chillers</td>
<td>Copeland / CRN5-0500-PFV-970</td>
<td>1995</td>
<td>R-404</td>
<td>2</td>
<td>Scroll</td>
<td>15</td>
<td>9.5</td>
</tr>
</tbody>
</table>

Table MC.1. Gycol Chiller Compressor Inventory

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Manufacturer / Model</th>
<th>Year Installed</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Cooler</td>
<td>Boumatic</td>
<td>1998</td>
<td>Well Water</td>
</tr>
</tbody>
</table>

Table MC.2. Plate Cooler Inventory
Figure MC.1 shows the current milk cooling energy use and the projected milk cooling energy use with recommended equipment installed. Table MC.3 provides economic details the recommendation.

**Figure MC.1. Refrigeration: Milk Cooling: Comparison of Electricity Use**

![Bar chart showing current and projected electricity use for milk cooling](chart.png)

**Table MC.3. Refrigeration: Milk Cooling: Recommended Energy Saving Equipment**

<table>
<thead>
<tr>
<th>Location</th>
<th>Current Equipment</th>
<th>Recommended Equipment</th>
<th># to Install</th>
<th>Est. Annual Electricity Savings (kWh)</th>
<th>Est. Annual Cost Savings</th>
<th>Est. Installed Cost</th>
<th>Est. Payback (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milking Parlor</td>
<td>None</td>
<td>Plate Cooler, 5,800 lbs./Hour Capacity or Less</td>
<td>1</td>
<td>49,754</td>
<td>$4,841</td>
<td>$3,700</td>
<td>0.8</td>
</tr>
<tr>
<td>Milking Parlor</td>
<td>1 milk transfer pump without VSDs.</td>
<td>VSD for Milk Transfer System</td>
<td>1</td>
<td>11,707</td>
<td>$1,139</td>
<td>$4,280</td>
<td>3.8</td>
</tr>
<tr>
<td>Milking Parlor</td>
<td>2 compressors with inefficient compression.</td>
<td>2 compressor retrofit kits.</td>
<td>2</td>
<td>18,292</td>
<td>$1,780</td>
<td>$14,970</td>
<td>8.4</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
<td><strong>79,753</strong></td>
<td><strong>$7,760</strong></td>
<td><strong>$22,950</strong></td>
<td></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>

**Notes:**
1. 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.
2. We also recommend making sure the refrigerant lines are properly insulated and the condensing units are cleaned periodically following the manufacturers specifications.

**Lighting**

Smith Family Farm, LLC has an opportunity to improve the energy efficiency of its lighting system. EnSave, Inc. recommends replacing the farms’ T12 lighting fixtures in the office bathroom, milking parlor, and milk house with either High Performance (HP) T8 or T5 High-Output (HO) fluorescent fixtures. HPT8 and T5HO 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. EnSave, Inc. recommends installing HPT8 and T5HO 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. Please work with your electrician to decide whether the HPT8 or T5HO fluorescent fixtures are more appropriate for your specific operation and geographical location.

As an alternative, we recommend that you also look into the option of upgrading the existing eight-foot T12 lamps and magnetic ballasts to eight-foot HPT8 lamps and electronic ballasts using retrofit kits where applicable. This can save on time and material costs by reusing the existing fixture body. For information on high-performance fluorescent lamps and ballasts, see the Resources section of this report, including: T-8 and T-5 Efficient Fluorescent Lighting, published by EnSave; and High-Performance 4' T8 Lamp and Ballast Qualifying List, published by CEE.

We also recommend replacing the 250 watt high pressure sodium fixtures with 4-bulb, 4-foot, High Performance T8 (HPT8) 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. EnSave, Inc. 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.

We recommend replacing standard incandescent lights in the holding pen with energy efficient compact fluorescent lights (CFL). CFLs deliver the same lighting levels as incandescent lights, but are approximately four times more energy efficient. The technology is less expensive to install than electronically ballasted strip fluorescent T-8 and T-5 fixtures. However, in some cases we would recommend replacing incandescent lighting fixtures with T-8 or T-5 fixtures because they deliver less noise, more light per watt, better color rendering, no flickering, cooler operation, and more energy savings to the user.

*EnSave, Inc.*
Although we are not recommending the replacement of T12 fluorescent fixtures in your office and electrical room at this time due to the long payback period, when the lights burn out we advise replacing these fixtures with either T8 or T5 vapor-proof fixtures. This will result in energy cost savings and protect the lights.

Tables L.1 and L.2 contain the current lighting inventory.

**Table L.1. Current Lighting Inventory**

<table>
<thead>
<tr>
<th>Location / Area Description</th>
<th># Fixtures</th>
<th>Fixture Type</th>
<th>Bulb Wattage</th>
<th>Annual Run Hours</th>
<th>Total Fixture Wattage</th>
<th>Est. Annual Use (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed Barns and Free Stalls</td>
<td>17</td>
<td>High Pressure Sodium</td>
<td>250</td>
<td>4,368</td>
<td>295</td>
<td>21,906</td>
</tr>
<tr>
<td>Holding Pen</td>
<td>8</td>
<td>Standard Incandescent</td>
<td>100</td>
<td>8,736</td>
<td>100</td>
<td>6,989</td>
</tr>
</tbody>
</table>

**Table L.2. Current Linear Fluorescent Inventory**

<table>
<thead>
<tr>
<th>Location / Area Description</th>
<th># Fixtures</th>
<th>Fixture Type</th>
<th>Length of Bulbs (ft)</th>
<th>Bulb Wattage</th>
<th>Annual Run Hours</th>
<th>Total Fixture Wattage</th>
<th>Est. Annual Use (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>1</td>
<td>T12</td>
<td>8</td>
<td>75</td>
<td>1,456</td>
<td>150</td>
<td>262</td>
</tr>
<tr>
<td>Milk House</td>
<td>4</td>
<td>T12</td>
<td>8</td>
<td>75</td>
<td>7,280</td>
<td>150</td>
<td>5,242</td>
</tr>
<tr>
<td>Milking Parlor</td>
<td>4</td>
<td>T12</td>
<td>8</td>
<td>75</td>
<td>8,736</td>
<td>150</td>
<td>6,290</td>
</tr>
<tr>
<td>Office Bathroom</td>
<td>1</td>
<td>T12</td>
<td>8</td>
<td>75</td>
<td>8,736</td>
<td>150</td>
<td>1,572</td>
</tr>
<tr>
<td>Electrical Room</td>
<td>1</td>
<td>T12</td>
<td>8</td>
<td>75</td>
<td>182</td>
<td>150</td>
<td>33</td>
</tr>
</tbody>
</table>

Figure L.1 shows a comparison of the estimated current and projected lighting electricity use. Table L.3 provides economic details for each lighting upgrade recommendation. Table L.4 lists equipment options that were evaluated but not recommended.
Table L.3. General Lighting: Recommended Energy Saving Equipment

<table>
<thead>
<tr>
<th>Location / Area Description</th>
<th>Current Equipment</th>
<th>Recommended Equipment</th>
<th># to Install</th>
<th>Est. Annual Electricity Savings (kWh)</th>
<th>Est. Annual Cost Savings</th>
<th>Est. Installed Cost</th>
<th>Est. Payback (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holding Pen</td>
<td>100W Standard Incandescent (100 Total Input Watts)</td>
<td>23W Compact Fluorescent (23 Total Input Watts)</td>
<td>8</td>
<td>5,381</td>
<td>$517</td>
<td>$72</td>
<td>0.1</td>
</tr>
<tr>
<td>Feed Barns and Free Stalls</td>
<td>250W High Pressure Sodium (295 Total Input Watts)</td>
<td>4-Lamp, 4ft. T8 (32W Bulbs, 134 Total Input Watts), Vapor-Proof Fixture</td>
<td>17</td>
<td>11,955</td>
<td>$1,149</td>
<td>$2,927</td>
<td>2.5</td>
</tr>
<tr>
<td>Office Bathroom</td>
<td>2-Lamp, 8ft. 75W T12 (180 Total Input Watts)</td>
<td>Appropriate T8 or T5 Linear fluorescent fixture (135 Total Input Watts)¹</td>
<td>1</td>
<td>393</td>
<td>$38</td>
<td>$169</td>
<td>4.5</td>
</tr>
<tr>
<td>Milking Parlor</td>
<td>2-Lamp, 8ft. 75W T12 (180 Total Input Watts)</td>
<td>Appropriate T8 or T5 Linear fluorescent fixture (135 Total Input Watts)¹</td>
<td>4</td>
<td>1,572</td>
<td>$151</td>
<td>$675</td>
<td>4.5</td>
</tr>
<tr>
<td>Milk House</td>
<td>2-Lamp, 8ft. 75W T12 (180 Total Input Watts)</td>
<td>Appropriate T8 or T5 Linear fluorescent fixture (135 Total Input Watts)¹</td>
<td>4</td>
<td>1,310</td>
<td>$126</td>
<td>$675</td>
<td>5.4</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
<td><strong>20,613</strong></td>
<td><strong>$1,981</strong></td>
<td><strong>$4,518</strong></td>
<td></td>
<td><strong>2.3</strong></td>
</tr>
</tbody>
</table>

Note:
1. Retrofit kits are available for changing T12 fixtures to High Performance T8 fixtures and may be more cost effective. Work with your electrician to determine whether the T5HO, HPT8, T5, and T8 fixture is optimal for your specific operation. Considerations when choosing between the different types of fixtures include, cost, availability from suppliers, geographic location of your farm, and operating conditions. It is also important to consider the temperature range that the ballast will be performing in as some ballasts are optimum for cold starting but may be too warm for enclosed or vapor-sealed fixtures, a High Output ballast may not be recommended if the ambient temperature will not go below 50 degrees Fahrenheit.
Table L.4. General Lighting: Evaluated Equipment Not Recommended

<table>
<thead>
<tr>
<th>Location / Area Description</th>
<th>Current Equipment</th>
<th>Considered Equipment</th>
<th># to Install</th>
<th>Est. Annual Electricity Savings (kWh)</th>
<th>Est. Annual Cost Savings</th>
<th>Est. Installed Cost</th>
<th>Est. Payback (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>2-Lamp, 8ft. 75W T12 (180 Total Input Watts)</td>
<td>Appropriate T8 or T5 Linear Fluorescent Fixture (135 Total Input Watts)¹</td>
<td>1</td>
<td>66</td>
<td>$6</td>
<td>$169</td>
<td>26.8</td>
</tr>
<tr>
<td>Electrical Room</td>
<td>2-Lamp, 8ft. 75W T12 (180 Total Input Watts)</td>
<td>Appropriate T8 or T5 Linear Fluorescent Fixture (135 Total Input Watts)¹</td>
<td>1</td>
<td>8</td>
<td>$1</td>
<td>$169</td>
<td>214</td>
</tr>
</tbody>
</table>

Ventilation
It has been determined that Smith Family Farm, LLC has a limited amount of energy saving opportunities from improving the efficiency of their circulation fans by upgrading to more energy efficient fans. In general, it is not cost effective to install any equipment with a payback that will exceed the expected life of the equipment. Therefore, at this time there are no recommendations to upgrade any of the existing circulation fans on the farm. It is 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 as discussed in “Agricultural Ventilation Fans: Selection and Maintenance”, published by the Rural Electricity Resource Council (RERC).

Table V.1 provides a list of the fans analyzed in this report.

Table V.1. Current LVHS Exhaust Inventory

<table>
<thead>
<tr>
<th>Location / Area Description</th>
<th>Manufacturer / Model</th>
<th>Model</th>
<th># Fans</th>
<th>Diameter</th>
<th>Run Hours</th>
<th>Est. Annual Use (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Room</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
<td>24 - 26in.</td>
<td>4,368</td>
<td>1,871</td>
</tr>
</tbody>
</table>

Table V.2 lists equipment options that were evaluated but not recommended.

Table V.2. General Ventilation: Evaluated Equipment Not Recommended

<table>
<thead>
<tr>
<th>Location / Area Description</th>
<th>Current Equipment</th>
<th>Considered Equipment</th>
<th># to Install</th>
<th>Est. Annual Electricity Savings (kWh)</th>
<th>Est. Annual Cost Savings</th>
<th>Est. Installed Cost</th>
<th>Est. Payback (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Room</td>
<td>24 - 26in. Exhaust Fan (5,740 cfm, 13.4 cfm / Watt), running 4,368 Hours / Year</td>
<td>24 - 26in. Exhaust Fan (6,060 cfm, 16.1 cfm / Watt)</td>
<td>1</td>
<td>227</td>
<td>$22</td>
<td>$650</td>
<td>29.4</td>
</tr>
</tbody>
</table>

Notes:
1. Fans considered 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
Smith Family Farm, LLC heats approximately 705 gallons of water a day from 52°Fahrenheit (F) to 180°F. They currently use a natural gas fired water heater. We recommend 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.

EnSave, Inc. 17
to determine the preferred and practical number of CHR units that will operate most efficiently with your system. Also request 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.

Tables WH.1 and WH.2 contain information on the hot water and wash basin equipment.

Table WH.1. Water Heater Inventory

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Manufacturer / Model</th>
<th>Year Installed</th>
<th>Capacity (gal)</th>
<th>Hot Water Temp. (°F)</th>
<th>Est. Gallons Used Daily</th>
<th>CHR?</th>
<th>Fuel Type</th>
<th>Est. Annual Energy Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Heater</td>
<td>Universal / G100-200</td>
<td>2011</td>
<td>100</td>
<td>180</td>
<td>705.1</td>
<td>No</td>
<td>Nat. Gas (ccf)</td>
<td>3,196</td>
</tr>
</tbody>
</table>

Table WH.2. Wash Sink Inventory

<table>
<thead>
<tr>
<th>Type</th>
<th>(A) Length / Diameter (in)</th>
<th>(B) Width (in)</th>
<th>(C) Avg. Fill Depth (in)</th>
<th># Hot Washes / Rinses</th>
<th># Warm Washes / Rinses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiver Vat</td>
<td>72</td>
<td>16</td>
<td>16</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Figure WH.1 shows a comparison of the estimated current and projected energy use. Table WH.3 provides economic details for the recommendation.
Air Heating and Building Environment
EnSave, Inc. recommends replacing the forced hot air space heater in the office with a more energy efficient radiant heater. We recommend the replacement heater to have the same heating output as the existing heater. While the heating capacity for the existing forced hot air heater and
the proposed radiant heater will be similar, the radiant heater will be able to generate the same heating load at a lower fuel consumption.

Table SH.1 provides a list of the heaters evaluated on the farm.

### Table SH.1. Current Heater Inventory

<table>
<thead>
<tr>
<th>Location / Equipment Description</th>
<th>Manufacturer / Model</th>
<th>Total # Heaters</th>
<th>Heater Type</th>
<th>Ignition Type</th>
<th>Fuel Type</th>
<th>Output Rating (Btu/ Hour)</th>
<th>Run Hours</th>
<th>Input Rating (Btu/ Hour)</th>
<th>Est. Annual Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office Heater</td>
<td>N/A</td>
<td>1</td>
<td>Forced Hot Air</td>
<td>Pilot Light</td>
<td>Nat. Gas (ccf)</td>
<td>20,000</td>
<td>728</td>
<td>28,125</td>
<td>201</td>
</tr>
</tbody>
</table>

Figure SH.1 shows a comparison of the estimated current and projected energy use. Table SH.2 provides economic details for each recommendation found to be cost effective.

### Figure SH.1. Air Heating and Building Environment: Comparison of Natural Gas Use

<table>
<thead>
<tr>
<th>Location / Equipment Description</th>
<th>Current Equipment</th>
<th>Recommended Equipment</th>
<th># to Install</th>
<th>Est. Annual Natural Gas Savings (ccf)</th>
<th>Est. Annual Cost Savings</th>
<th>Est. Installed Cost</th>
<th>Est. Payback (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office Heater</td>
<td>Office Heater: Heater with Pilot Light and Output Rating of 20,000 Btus</td>
<td>Radiant Heater with Electronic Ignition and Output Rating of 20,000 Btus</td>
<td>1</td>
<td>50</td>
<td>$51</td>
<td>$316</td>
<td>6.2</td>
</tr>
</tbody>
</table>

### Controllers

There are no activities or equipment at this site that are applicable to this section.
Air Cooling
There are no activities or equipment at this site that are applicable to this section.

Other Motors and Pumps
It has been determined that Smith Family Farm, LLC 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 M.1 provides a list of the motors analyzed in this report.

<table>
<thead>
<tr>
<th>Location / Equipment Description</th>
<th>Manufacturer / Model</th>
<th>Year Installed</th>
<th># Motors</th>
<th>Motor HP</th>
<th>RPM Rating</th>
<th>Casing Type</th>
<th>Annual Run Hours</th>
<th>Motor Estimated Annual Electricity Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manure Transfer From Separator to Lagoon Pump Motor</td>
<td>Baldor / EM3710T</td>
<td>2010</td>
<td>1</td>
<td>7.5</td>
<td>1500 - 2700</td>
<td>ODP</td>
<td>2,016</td>
<td>10,829</td>
</tr>
<tr>
<td>Pressure Hose Pump Motor</td>
<td>N/A</td>
<td>2003</td>
<td>1</td>
<td>10</td>
<td>N/A</td>
<td>N/A</td>
<td>1,092</td>
<td>7,734</td>
</tr>
<tr>
<td>Separator Motor</td>
<td>N/A</td>
<td>2001</td>
<td>1</td>
<td>5</td>
<td>N/A</td>
<td>N/A</td>
<td>2,016</td>
<td>7,302</td>
</tr>
<tr>
<td>Dry Cow Lagoon Pump Motor</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
<td>30</td>
<td>N/A</td>
<td>N/A</td>
<td>546</td>
<td>11,236</td>
</tr>
<tr>
<td>Dry Cow Agitator Motor</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
<td>15</td>
<td>N/A</td>
<td>N/A</td>
<td>546</td>
<td>5,705</td>
</tr>
</tbody>
</table>

To consistently have the lowest possible energy consumption from motors, when a motor greater than 1 horsepower (HP) burns out, always replace them with the most energy efficient motor available. EnSave, Inc. recommends replacing motors with units that meet the National Electrical Manufacturers Association (NEMA) Premium® standard. For more information on NEMA Premium®, see [http://www.nema.org/Policy/Energy/Efficiency/Pages/NEMA-Premium-Motors.aspx](http://www.nema.org/Policy/Energy/Efficiency/Pages/NEMA-Premium-Motors.aspx).

Table M.2 lists equipment options that were evaluated, but not recommended.
Table M.2. Other Motors and Pumps: Evaluated Equipment Not Recommended

<table>
<thead>
<tr>
<th>Location / Equipment Description</th>
<th>Current Equipment</th>
<th>Considered Equipment</th>
<th># to Install</th>
<th>Est. Annual Electricity Savings (kWh)</th>
<th>Est. Annual Cost Savings</th>
<th>Est. Installed Cost</th>
<th>Est. Payback (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manure Transfer From Separator to Lagoon Pump Motor</td>
<td>7.5 HP, ODP, 1500-2700 RPM, 88.50% Efficiency</td>
<td>7.5 HP, ODP, 1500-2700 RPM, NEMA Premium®, 91% minimum nominal efficiency</td>
<td>1</td>
<td>298</td>
<td>$29</td>
<td>$1,000</td>
<td>34.5</td>
</tr>
<tr>
<td>Separator Motor</td>
<td>5 HP, TEFC, 1500-2700 RPM, 87.50% Efficiency</td>
<td>5 HP, TEFC, 1500-2700 RPM, NEMA Premium®, 89.5% minimum nominal efficiency</td>
<td>1</td>
<td>163</td>
<td>$16</td>
<td>$700</td>
<td>44.1</td>
</tr>
<tr>
<td>Manure Separator Pump Motor</td>
<td>30 HP, TEFC, 1500-2700 RPM, 92.40% Efficiency</td>
<td>30 HP, TEFC, 1500-2700 RPM, NEMA Premium®, 93.6% minimum nominal efficiency</td>
<td>1</td>
<td>532</td>
<td>$52</td>
<td>$3,000</td>
<td>58</td>
</tr>
<tr>
<td>Pressure Hose Pump Motor</td>
<td>10 HP, TEFC, 1500-2700 RPM, 89.50% Efficiency</td>
<td>10 HP, TEFC, 1500-2700 RPM, NEMA Premium®, 91.7% minimum nominal efficiency</td>
<td>1</td>
<td>186</td>
<td>$18</td>
<td>$1,200</td>
<td>67</td>
</tr>
<tr>
<td>Dry Cow Agitator Motor</td>
<td>15 HP, TEFC, 1500-2700 RPM, 91.00% Efficiency</td>
<td>15 HP, TEFC, 1500-2700 RPM, NEMA Premium®, 92.4% minimum nominal efficiency</td>
<td>1</td>
<td>86</td>
<td>$8</td>
<td>$1,500</td>
<td>178</td>
</tr>
<tr>
<td>Dry Cow Lagoon Pump Motor</td>
<td>30 HP, TEFC, 1500-2700 RPM, 92.40% Efficiency</td>
<td>30 HP, TEFC, 1500-2700 RPM, NEMA Premium®, 93.6% minimum nominal efficiency</td>
<td>1</td>
<td>144</td>
<td>$14</td>
<td>$3,000</td>
<td>214</td>
</tr>
</tbody>
</table>

Waste Handling
The location uses a tractor to remove manure from the barns. The manure is pumped from the waste water lagoon using a 160 hp diesel pump. This pump is evaluated in the Irrigation section of the report.

Material Handling
The location uses a mixer wagon to deliver feed. Non-stationary equipment is beyond the scope of a headquarters AgEMP.

Crop and Feed Storage
There are no activities or equipment at this site that are applicable to this section.

Water Management
The water source used for agricultural purposes on this farm is a well. NEMA Premium efficiency standards do not apply to submersible electric motors and thus there are no efficiency recommendations for these pumps.

Irrigation
Smith Family Farm, LLC also has one 160 hp waste water lagoon pump that utilizes a diesel-fired engine. This pump is inventoried in Table I.1.

As per conversation with the farmer, EnSave, Inc. evaluated the energy savings associated with replacing the diesel-fired engine with an electric motor. As pump curves could not be obtained, EnSave, Inc. evaluated the electric motor replacement to be 175 hp. This is a conservative approach as in some cases electric motors can supply the same pumping results as the existing engines but at a reduced horsepower.

Pump performance and efficiency are also important aspects of irrigation systems. EnSave recommends pump tests be performed every two to three years to assure that the pump is operating properly; flow rates and pressures are as expected and not adversely affected by
impeller wear, bearing wear, or other problems; suction side conditions are clear, etc. The testing is beyond the scope of this AgEMP.

EnSave, Inc. recommends replacing the 160 hp diesel waste water lagoon pump with a 175 hp electric motor. Installing the recommended electric waste water lagoon pump motor will increase annual electricity usage by 10,307 kWh, but will reduce diesel fuel usage and result in a net energy and cost savings.

Table I.1 provides details on the irrigation systems analyzed in this report.

Table I.1. Irrigation: System Inventory

<table>
<thead>
<tr>
<th>System Description</th>
<th>Engine / Motor Description</th>
<th>Year Installed</th>
<th>Annual Run Hours</th>
<th>Est. Annual Diesel Use (gal)</th>
<th>Est. Annual Diesel Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Water Lagoon Pump Motor</td>
<td>160 hp Diesel Engine; Halco / H64016002A0-V3</td>
<td>2003</td>
<td>75</td>
<td>600</td>
<td>$2,100</td>
</tr>
</tbody>
</table>

Note:
1. EnSave, Inc. estimated a fuel consumption of 8 gallons per hour (gph) for a diesel engine of this size. Based on the 600 gallons of annual diesel usage provided by the farmer and a fuel consumption of 8 gph; this computes to an estimated 75 annual run hours for this pump.

Table I.2 provides economic details the recommendation.

Table I.2. Irrigation: Recommended Energy Saving Equipment

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Water Lagoon Pump Motor</td>
<td>160 hp Diesel Engine; Halco / H64016002A0-V3</td>
<td>175 hp, NEMA Premium®, 95% minimum nominal efficiency</td>
<td>1</td>
<td>(10,307)</td>
<td>600</td>
<td>$1,097</td>
<td>$11,228</td>
<td>10.2</td>
</tr>
</tbody>
</table>

Note:
1. As the waste water lagoon does not have the appropriate power capabilities to support an electric motor, the estimated cost to the farm includes an estimate of $10.76 / foot of wiring in addition to the material costs for the proposed electric motor.
2. Installing the recommended electric waste water lagoon pump motor will increase annual electricity usage by 10,307 kWh, but will reduce diesel fuel usage and result in a net energy and cost savings.
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, alley scrapers, 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 alley 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.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Soil</th>
<th>Water</th>
<th>Animal*</th>
<th>Plant</th>
<th>Air</th>
<th>See Tables S.1, S.3 and Note 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Milk Cooling</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Air Heating and Building Environment</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Water Heating</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Lighting</td>
<td>See Note 1</td>
<td>See Note 1</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

*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.

Note 2: This report recommends replacing an old refrigeration system. Refrigerant is regulated by the EPA under section 608 of the Clean Air Act and cannot be released to the atmosphere, it is against the law. Please make sure that the contractor that is replacing the refrigeration system is aware of this and other applicable regulations, as well as how to properly dispose of the refrigerant. Section 608 can be found by following this link: http://www.epa.gov/ozone/title6/608/608fact.html.
ENERGY PYRAMID

EnSave uses an energy pyramid as a model to outline the steps necessary for reducing energy usage. Figure EP.1 shows the energy pyramid.

Figure EP.1. Energy Pyramid

The energy pyramid is a concept used to help guide farmers toward energy independence. The energy pyramid has been proven to be very effective, and it serves as a road map to show where a farm is on their way to energy independence. Smith Family Farm, LLC has done a great job with energy analysis and conservation. The next step for the farm would be to implement the energy efficiency measures recommended in this report.
RESOURCES

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

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


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

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

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


7. *Variable Speed Drive for the Milk Pump*, published by EnSave, Inc.

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


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

11. *Compact Fluorescent Lighting*, published by EnSave, Inc.


13. *High Performance 4’ T8 Lamp and Ballast Qualifying List*, published by CEE


17. *NEMA Premium® Motors*, published by EnSave, Inc.

18. *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.


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

4. Database of State Incentives for Renewables & Efficiency (DSIRE), http://www.dsireusa.org/


Appendix A

Environmental Benefits

Guidance on how to determine values for greenhouse gases and air pollutant co-benefits environmental benefits.

In order to estimate the environmental benefits associated with estimated energy savings, NRCS has developed a Quick Energy calculator that transforms energy saving measures for fuels and electricity into atmospheric emission reductions. The Quick Energy Tool relies on EPA’s state-level aggregated emission factors for electricity, to generate estimates of emissions savings for electricity. The Quick Energy Tool relies on the EPA Energy Information Agency’s emission factors for liquid and gaseous fuels, to generate estimates of emissions savings for liquid and gaseous fuels.

The Web link to the NRCS COMET Quick Energy Calculator for converting Energy Savings into Emissions Reductions is located at: http://www.comet2.colostate.edu/