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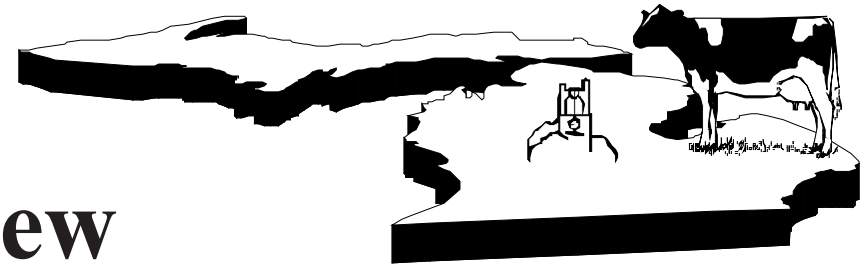

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Opportunities for Conserving Energy and Saving Money in Dairy Operations

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Planning an energy budget is difficult, but with the cost of natural gas, heating oil, and other energy sources higher than a year ago, budgeting for the increased price of fuel and electricity is imperative. Fortunately, there are alternative methods dairy producers can employ to lessen the strain of skyrocketing energy costs. Recent studies, several of which will be reviewed in this article, indicate that installing plate coolers, variable speed drives (VSD) for pumps, energy saving lights, and other measures can slash energy bills. In fact, a dairy farm with an energy-efficient milking system can save 50 to 70% of electricity costs and have a payback period of less than 2 years (1).

The first study to be reviewed is based on a set of 32 farm audits done by DLTech, Inc. and supported by the New York State Energy Research and Development Authority's FlexTech Program (2). The objective of the study was to provide dairy operators with good data on energy use for decision-making. Eighteen farms with free stalls and milking parlors and 14 farms with tie stalls and milk pipelines were used to examine energy use and conservation.

It is apparent from Figure 1 that the largest consumers of energy in both types of farms in decreasing order are milk cooling (25%), lighting (24%), ventilation (22%) and vacuum pumps (17%). The improved efficiency of VSDs in vacuum pumps has dropped this long-run use to fourth place whereas features associated with housing such as lighting and ventilation have increased energy consumption.

This study focuses on energy used in farms with both free and tie stalls, but these results indicate the areas on all dairy farms that have the greatest potential impact on energy conservation. Ultimately, the study recommends milk plate pre-coolers as having the fastest payback in farms with free stalls, but energy efficient lighting provides the fastest payback in farms with tie stalls. VSDs for the vacuum system saved the most energy in both types of farms.

The DLTech study parallels the recommendations from Efficiency Vermont (3). The Vermont study recommends the following strategies.

- Milk cooling– plate coolers reduce cooling costs by 50%.
- Milk transfer– move your milk through the plate cooler with a VSD pump.

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- Vacuum pump controllers– VSDs and variable frequency drives (VFDs) can drop pump operating costs by 66%.
- Water heating– utilize a heat recovery system from your compressor to pre-heat water.
- Fuel– switch to a less expensive fuel or a more efficient fuel burning system (80 to 93% efficiency gas burner).
- Energy-saving lights– replace incandescent lights with compact fluorescent lights, or replace T-12 fluorescent tubes and mechanical ballasts with T-8 tubes and electronic ballasts to see 65% electrical savings.

Efficiency Maine (4) amplifies the function of in-line water-cooled plate coolers with the following information. The well water flowing through the plate cools the milk as it is being pumped to the bulk tank, which can reduce the tank milk temperature some 30 degrees Fahrenheit. This pre-cooling dramatically decreases the electricity used by the tank refrigeration system for milk cooling. For maximum efficiency, optimize your pre-cooling performance by selecting a large enough heat exchanger and fine-tuning ground water flow rates so that the water flowing through the plate is as cool as possible (1).

Fluid pumping system controllers such as VFDs and VSDs reduce energy use. Single speed drives operate at a constant 7 to10 cubic feet per minute for each milking unit. A VSD responds by adjusting the motor speed to maintain a stable vacuum pressure. The VSD usually will allow use of a lower horsepower pump, which further reduces electrical consumption. Ten horsepower of excess motor capacity results in $400 to $600 per month of excess electricity costs (1). A similar savings is available for milk pumps, although VSDs are not recommended for some rotary vane pumps and water ring pumps (3, 5). Scroll compressors of equivalent horsepower (3 hp) use 42% less electricity (4) and centrifugal pumps are a recommended alternative (1). Payback for both options is usually less than 3 years.

Another study found that 70% of vacuum controllers were located improperly. Controllers need to be located as close to the cow as possible, usually near a sanitary trap. This location improves the efficiency of the vacuum control with corresponding energy savings (4). Lastly, leaks in the system cause the pumps to run longer than necessary. Automatic milking take-offs provide the potential to save hundreds of dollars per year (10) and other advantages such as reduced labor, consistent end of milking time, and decreased worker movement.

Because a compressor system liberates a lot of waste heat, a heat recovery system attached to your compressors can pre-heat your water, thereby saving energy. The issue then is picking a system that has a reasonable payback period. Two technologies are available: desuperheating units and fully condensing units. Desuperheating units are less expensive, but the energy savings for condensing units are sufficient to show a 3 to 4 year payback period (1). Refrigeration heat recovery units also are available, but they usually are not used with plate coolers. The Ministry of Agriculture, Food and Rural Affairs in Ontario (6) adds a list of other considerations on heating water on farms.

- Link water heater to a timer to ensure water is not continuously heated unnecessarily.
- Purge 2 to 3 gallons twice yearly from the drain tank of the water heater.
- Convert to a high efficiency heater/boiler system.
- Insulate the water heater and the first 20 feet of pipe.

Lighting, at 24% of energy use, is also important (Figure1). Another list from Ontario (8) also offers useful energy reduction solutions.

- Install and set timers, adjust photocells and motion sensors.
- Light work zones specifically, not the entire area.
- Design lighting systems for the correct light levels (16 to 20 hours of light per day over the cow stalls).
- Clean lamps and covers with detergent and water for best light delivery.
- Replace incandescent bulbs with compact fluorescent bulbs.
- Install florescent fixtures or convert from T-12 fluorescent tubes to T-8 tubes. T-5 tubes are more expensive without significant savings.
- Use high intensity discharge, high pressure sodium or metal halide lamps for the outdoors and ceilings over 12 feet high.
- Use light emitting diode (LED) lighting where appropriate.
- Use automatic dimmable level controllers where possible.
- Use energy efficient heat lamps or heat pads if needed.

Efficient fans can make a major contribution to energy savings in your operation (7). Fans, of course, are a necessary component of mechanical ventilation system to drive the air movement in animal housing. Testing of 36-inch fans by the Bioenvironmental and Structural Systems Laboratory at the University of Illinois found great variation in performance for flow and electricity use. Fans with roughly similar air flow (9000 to 9900 cubic feet minute) ranged from 8.4 to 18.6 cfm/watt. These efficiency differences are particularly important in mild and warm weather when fans are operating. This study found that more efficient fans cost $150 to $250 more, but because of electricity savings payback time was less than 2 years and resulted in a $1,900 savings over the 10-year potential life of the fan (9). Continuous flow fans may be needed to adequately move air, and if efficient fans are used they also

can contribute to significant energy savings (9).

Though not dairy specific, there are some other agricultural efficiency opportunities worth considering (10).

- Livestock waterers— waterers with 2 inches of insulation and adjustable thermostats, no or low hydro units, solar, wind and ram pumps are options.
- Low–pressure irrigation systems— these reduced pressure systems deliver the water needed, but at a significant energy savings.
- Water Pumps — permanent soft-start motors are more efficient.
- Other electrical motors—Place high efficiency motors sized to load in clean, cool, dry places and maintain motors, belts, pulleys. Covert V belts to toothed belts if possible.
- Electrical components—bad contacts waste energy and have fire hazard potential. Clean breaker panels, thermostats and fans.
- Tractor heater timers—A timer can have a payback of less than a year and still keep the block warm enough for easy turn over.
- Fencing—Utilize photovoltaic panels for power because they save labor and electricity costs.

If all of this seems daunting there are auditing specialists (check with your utility or rural energy cooperative) that can assist you with an evaluation of your operation. An auditor should be able to provide a list of recommendations and the savings that each of the upgrades can provide you. Qualifications and experience are extremely important for this task, so this is a good time to ask for references and examine previous efforts.

If you are interested in applying for USDA Farm Bill 9006 energy funding for efficiency projects, an audit is a requirement and more information is available from the USDA Rural Development offices on-line at <http://www.rurdev.usda.gov/rbs/farmbill/index.html>.

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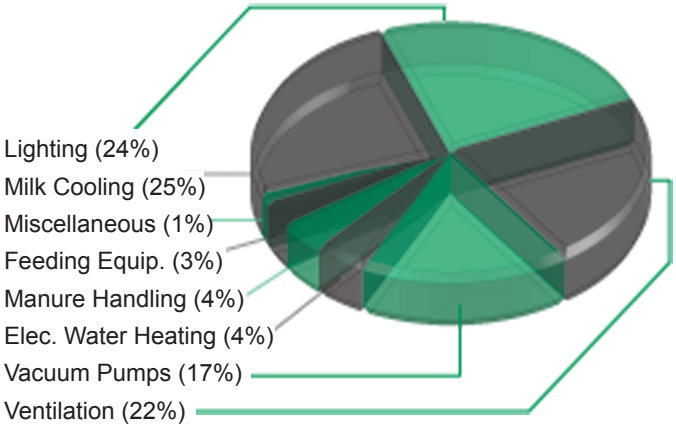

Figure 1. Energy use by equipment category.