Top Money-Saving Practices on Missouri Dairy Farms

The dairy industry continues to be an important component of Missouri's economy. According to University of Missouri's "Dairy Resource Guide" as of December 2012, Missouri had 1,348 permitted dairy operations. Of these operations, 950 were Grade A dairies while the remaining 398 were manufacturing dairies. According to the USDA's "Milk Production Report of 23 Selected States," Missouri's milk production in July 2013 averaged 109 million pounds. Dairy operations use a substantial amount of energy to move and cool milk. However, substantial energy and monetary savings can be realized by implementing energy-efficient measures recommended in an energy audit.

An energy audit is an in-depth examination of a farm that determines:

- if and how energy is being lost,
- which systems are operating inefficiently, and
- what type of cost-efficient measures can be implemented to make the farm more energy-efficient.

To explain further, an energy audit evaluates a farm's current operation, makes calculations of existing systems' efficiency and compares it to proposed new systems. Based on these calculations, an Agricultural Energy Management Plan (AgEMP) is created to explain any energy-saving measures recommended for the farm. AgEMP reports may qualify for financial assistance from various funding sources, including but not limited to federal grants, loan programs and energy tax credits.

Energy audits and AgEMPs were created for Missouri dairy producers through the MAESTRO program, which was created to strengthen the financial viability of Missouri's livestock producers through energy efficiency. All data that will be shared concerning the potential for saving energy on dairy farms were obtained through this program. Participants of this program were not required to be permitted as a Confined Animal Feeding Operation (CAFO) and therefore will represent farms smaller in size than their CAFO counterparts. When entering the MAESTRO program, information was gathered on producers' current energy usage. Dairy farmers enrolled in the program used an average of 63,543 kilowatt-hours and 893 gallons of propane. Farmers who implemented energy-efficient retrofits for electricity saved an average of 25 percent, while those who implemented energy-efficient retrofits for propane saved an average of 40 percent. These savings reflect the costs of improvements recommended in AgEMPs as well as Technical Assistance reports. Table 1 indicates the amount of energy a farm used before the program, as well as average energy savings per year.

Energy savings were determined by analyzing energy usage data and current equipment used in individual dairy farms in Missouri. Missouri farmers reviewed energy audits and AgEMPs as part of the program. Participants were able to apply for grant funding to help share costs of implementing new practices. Researchers found that dairy operations had four practices with the greatest potential for saving energy: lighting, water heating, milk harvesting and milk cooling.

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Table 1. Average energy savings per farm

Energy type	Current usage	Average savings per farm	Average savings per farm	Savings per year	Installed cost per practice
Electricity	63,543 kwh	16,125 kwh	25%	$481.80	$4,958.88
Propane	893 gallons	360 gallons	40%	$883.29	$4,287.56

Lighting

Switching from older incandescent lighting to linear or compact fluorescent lighting (CFL) can make a substantial difference, depending on the number of fixtures, in terms of energy used on a farm. According to the MAESTRO Best Practices Guide, CFLs deliver the same amount of light as incandescent bulbs, but use only a quarter of the energy. Although the upfront cost of CFLs is higher, they last up

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to 25 times longer than incandescent bulbs, which will save money in the long run. New T8 and T5 linear fluorescent bulbs are replacing older T12s as they use 20 percent less energy and generate less noise, have more light per watt, better color rendering, minimal flickering and cooler operation.

Upgrading to energy-efficient lighting is a relatively easy change to make due to the fact that farmers can often do it themselves. The majority of lighting retrofits changed inefficient fixtures to CFL or linear fluorescent bulbs. Some farms replaced inefficient fixtures with new pulse-start metal-halide (PSMH) bulbs and, in one instance, LED lighting. Table 2 shows an average of the savings realized by those who participated in the MAESTRO program.

Table 2. Average lighting practice energy savings per farm

Energy savings	Savings per year	Installed cost
1,541 kwh	$307.79	$178.53

Water heating

Compressor heat recovery (CHR) units can be one of the most cost-effective purchases a dairy farmer can make, according to the MAESTRO Best Practices Guide. When milk cools in a bulk tank or with a chiller, compressors remove heat from the milk. A CHR reuses that heat to raise water temperatures as high as 110 degrees Fahrenheit.

Up to 50 percent of the energy required for a water heater can be recovered from heat removed from milk. If farmers need to purchase a water heater, note that the efficiency of water heaters varies greatly. An electric water heater converts electricity into water at nearly 100 percent. Gas and oil water heaters have a thermal efficiency of 80 percent unless they are of the condensing type that get around 95 percent thermal efficiency, or the percent of energy transferred to the water. Water heaters greatly differ in standby losses, so you should consult a dealer on the ratings of various water heaters. Tables 3 shows the average CHR practice energy savings per farm broken down by type of water heater.

Table 3. Average energy savings per farm

Type of water heater	Energy savings	Dollar savings per year	Installed cost
Electric	10,076 kwh	$874.50	$5,269.50
Propane	530 gallons	$1,008.25	$4,267.25

Milk cooling

Milk cooling is usually the largest source of energy use on dairy farms. Switching from an inefficient, older reciprocation compressor to a newer scroll compressor can save a farmer up to 41 percent energy, according to the MAESTRO Best Practices Guide. Scroll compressors have fewer moving parts and their upfront price isn't that much higher. When purchasing a new bulk tank, you should specify your preference for scroll-type compressors. They work well in cool weather and can start under any system load.

A plate cooler can contribute significantly to energy savings. Cows typically produce milk at 98 degrees Fahrenheit which then flows, absent a milk pre-cooler, into a receiver and is pumped into the bulk tank. Compressors cool the milk to a storage temperature of about 38 degrees Fahrenheit. A plate cooler is a set of stainless steel plates installed in the milk line before the bulk tank. Well water passes through the plate cooler in one direction and absorbs heat from the warm milk pumped through the plate cooler in the opposite direction. According to the MAESTRO Best Practices Guide, a dairy farm that produces 3 million pounds of milk per year can save about $800 annually by using a precooler. Table 4 shows energy savings realized after retrofits to milk cooling operations. These savings reflect the switch from reciprocating to scroll compressors and, in some cases, the addition of a plate cooler.

Table 4. Average energy savings for milk cooling retrofits per farm

Energy savings	Savings per year	Installed cost
5,535 kwh	$468.67	$4,976.75

Milk harvest

Before variable speed drive (VSD) controllers were available, dairy producers had to run pumps at a constant high speed to adequately create short intervals of high vacuum, according to the MAESTRO Best Management Practices. VSD controllers regulate the speed of the milk vacuum pump motor. VSD measures how much vacuum the system needs and adjusts the speed of the pump motor accordingly, resulting in substantial savings because the pump and motor work only as hard as they need to (Table 5). Individual savings will depend on the pump's horsepower and the number of milkings. Additional benefits of VSD include a quieter working environment and a constant vacuum level. MAESTRO faculty found that many times a new motor is needed in conjunction with a VSD, as older motors with low horsepower are inadequate for the new VSD digital controllers.

Table 5. Average energy savings for milk harvest retrofits per farm

Energy savings	Savings per year	Installed cost
6,720 kwh	6,720 kwh	$6,854.38

Determine whether an energy audit is necessary

Dairy producers considering an energy audit may wonder how to determine if an audit is necessary for their operation. If the answer to any of these four basic questions is yes, an energy audit may be in order.

- Has equipment recently been added to the farm?
- Have there been any technological or industrial advancements that improve efficiency?

- Has your farming operation grown or expanded to include new property?
- Is there an opportunity to apply for financial assistance (grant, loan or cost-share)?

For more information

Visit ***extension.missouri.edu/energy*** for more information and access to tools developed by MU Extension that allow producers to conduct self-evaluations to assess potential energy loss or inefficiency in a farming operation.

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