

Opportunities Abound for Dairy Farm Energy Efficiency

Adapted from *Dairy Farm Energy Efficiency*, by Andy Pressman, NCAT Agriculture Specialist

Dairy farms today face challenges and opportunities fueled by rapidly rising energy costs and concerns about environmental impacts. Dairy farms use more energy than almost any other agricultural operation. Energy is used in the milking process and for cooling and storing milk, heating water, lighting and ventilation. Determining the best energy-efficiency and energy-management opportunities for dairy farms will help reduce energy costs, enhance environmental quality, and increase productivity and profitability.

Energy Efficiency in the Milking Process

The vacuum pump operates during the milk harvest and equipment washing and can consume 20 to 25 percent of all electrical energy use on a dairy farm. Sizing the vacuum pump to meet the needs of the milking and washing system can reduce capital costs for equipment, reduce energy operating costs during the life cycle of the pump, and ensure that the pump is performing properly.



Dairy farms use vast amounts of energy to harvest milk. Photo courtesy of The Lands at Hillside Farms

A variable-speed drive (VSD), also referred to as an adjustable-speed drive or variable-frequency drive, is an energy-efficient technology used for controlling the vacuum level on sliding-vane rotary pumps and rotary-lobe pumps. Energy operating costs of a vacuum system with a VSD can be reduced by up to 60 percent.

Milk Cooling Systems

Cooling milk accounts for most of the electrical energy consumption on a dairy farm. Heat exchangers cooled by well water, variable-speed drives on the milk pump, refrigeration heat-recovery units, and scroll compressors are all energy-conservation technologies that can reduce the energy consumed in the cooling system.

Installing a properly sized precooler can reduce refrigeration energy consumption by about 60 percent. A properly sized well-water heat exchanger can reduce milk temperatures to within 5 to 10 degrees of the groundwater temperature.

A refrigerant heat recovery (RHR) unit can recover 20 to 60 percent of the energy that is removed from the milk cooling process. It is possible for RHR units and milk precoolers to interact and compete with each other, however. For maximum energy savings, an energy audit should be conducted to determine if one or both units would be optimal.

Heating Water

There are several ways to reduce the amount of energy used for heating water. Whether using a direct or indirect water heater, overall efficiency is determined by the combustion efficiency of the fuel source and the amount of heat loss from the storage tank, known as standby loss. A direct water heater combines the water storage tank and the heating element. The

storage tank in an indirect water heater contains a heat exchanger that is connected to a separate boiler unit. Insulating the storage tank and connecting pipes can reduce standby losses for both types of water heaters. The sides and top of an electric water heater and the sides of gas and oil water heaters can be insulated.

Lighting

Replacing inefficient light sources with an appropriate and higher-efficiency light can result in better task lighting with energy savings that continue over the life of the lamp. Energy-conservation opportunities involve changing incandescent lamps to compact fluorescents, upgrading to smaller diameter and more efficient fluorescent lamps, and upgrading to HID lighting.

Ventilation

Proper ventilation is needed in dairy barns throughout the year to help maintain animal health and productivity, the barn's structural integrity, milk quality, and a comfortable work environment for the laborers.

Dairy ventilation systems require routine maintenance to keep fans operating at high performance levels. Poorly maintained fans and obstruction to air inlets and fan outlets can reduce fan efficiency by as much as 40 to 50 percent. Cleaning fan parts, lubricating bearings and other moving parts, checking belt tension and alignment and removing any obstructions will keep fans performing at peak efficiency and reduce energy costs.

To learn more about implementing efficiency improvements in your dairy farm, consult the ATTRA publication *Dairy Farm Energy Efficiency*.

Harvesting Sunlight for Your Stock

Adapted from *Solar-Powered Livestock-Watering Systems*, by Mike Morris, Vicki Lynne, and Chris Lent, NCAT

Remote or off-grid power sources—including solar panels, mechanical windmills, wind turbines, and portable generators—can pump water for livestock in locations where electricity from power lines is unavailable. By encouraging animals to move away from ponds and streams, these systems give livestock greater access to forage. They also reduce livestock pressure on stream banks, preventing nutrient loading, streamside vegetation damage, erosion, and pollution.

Solar pumping works anywhere the sun shines, and most parts of the United States have plenty of sunlight to run these systems. Solar pumping is a natural match for summer grazing applications, since it produces the greatest volumes of water in sunny weather and during long summer days—exactly when animals need water the most. With proper precautions, solar pumping systems can also be used during the winter months, even though shorter daylight hours will cause reduced water output.

Why should you consider installing a solar-powered livestock watering system on your farm or ranch? These factors may affect your decision:

- Distance from power lines and the cost of a line extension
- Operation and maintenance costs of a solar system compared to the alternatives, such as a mechanical windmill or a gasoline, propane, or diesel-powered generator
- The uncertainty of future electricity, propane, gasoline, and diesel prices
- Environmental benefits such as riparian protection, energy independence, and demonstrating non-fossil energy alternatives

Solar-powered systems have a relatively high initial cost compared to low-quality, generator-powered systems, but they are long-lasting and require little maintenance. Solar watering systems have few moving parts, and the components have proven to be very reliable when installed properly. Warranties on solar panels are usually 20 years or more.

A typical solar-powered stock-watering system includes a solar array (a group of solar modules), a pump, a storage tank (generally three to 10 days' worth of water storage tanks), and a controller, which varies voltage to optimize the amount of water pumped in less-than-ideal light conditions and protects the pump from high or low voltage that would damage the pump.

The average consumer is likely to be intimidated by the prospect of sizing and designing a solar pumping system, and most people need help from a qualified solar dealer.

In order to size and design a system correctly, the dealer will want to know:

- How much water you need
- When you need the water
- Whether your water source is a stream, pond, spring, or well
- Water available in gallons per minute
- Well depth
- Distance from the top of the water source to ground level and storage tank
- Size and type of piping you plan to use (a dealer can make recommendations)
- How far the water needs to be pumped
- Water-quality problems (e.g., silt or high mineral content) that may damage the pump
- How much volume is available in storage tanks and how the tanks are arranged

Based on these factors, the dealer will recommend a system, putting together a list of suitable components. This is one area where the dealer's experience and familiarity with systems is essential. A dealer can also save you time and aggravation by providing the correct hardware: clips, screws, nuts, bolts, washers, cable (cut to correct lengths), and assorted wiring and connectors. The customer usually provides peripheral items, such as water piping and fittings, tanks, mounting structure support post, concrete, and grounding materials.

Installing a solar pumping system, however, is generally something the landowner can do. A few words of caution are necessary, however. Installing one of these systems is a complex task, combining elements of electrical work, plumbing, and heavy construction (often including earthmoving, concrete-pouring, and welding). Written instructions are not always as complete as they should be. A backhoe or tractor with a front-end loader is almost a necessity for some larger projects.

Because of falling prices, long life, and low maintenance requirements, solar is rapidly becoming the first choice for pumping water in remote locations. Is it right for your farm or ranch? Learn more in the ATTRA publication *Solar-Powered Livestock Watering Systems*.



Solar-powered livestock watering system. Photo: NREL

Applying for 2014 CSP Funding? ATTRA Can Help!

The Natural Resources Conservation Service (NRCS) Conservation Stewardship Program (CSP) has been announced and applications are due by January 17, 2014. CSP is a voluntary program that rewards farmers and ranchers for current conservation practices, including energy conservation, and for putting in place additional new conservation practices and enhancements over a five-year contract period.

Through CSP, NRCS will provide financial and technical assistance to eligible producers to conserve and enhance soil, water, air, and related natural resources on their land.

Depending on your desire to maintain and make new conservation efforts, this program can provide up to \$200,000 in support over five years. The higher the operational performance, the higher the payment.

Farmers and ranchers can apply at any time, but to receive funding in the current 2014 federal fiscal year, your application should be started by January 17, 2014.

The National Sustainable Agriculture Coalition developed an excellent step-by-step guide to applying for the CSP in 2014. It is available at <https://attra.ncat.org/csp/docs/CSP-FY-2014-Info-Alert.pdf>.

If you're not sure whether CSP is right for you, you can start by filling out CSP's Producer Self-Screening Checklist, available at www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046173.pdf. If you have questions about the checklist, contact your local NRCS office.

If you need assistance or further information about accessing this program, ATTRA can help! Call the ATTRA toll-free hot-line at 800-346-9140 (English) or 800-411-3222 (Spanish).

An example:

CSP provides support for existing conservation efforts plus support to undertake further effort to conserve natural resources, called *conservation enhancements*. One example of an enhancement related to energy conservation is the enhancement called "Variable frequency drive electric motors" (ENR09).

This enhancement supports upgrading existing single-speed electric motors through the addition of variable-frequency electric drives. These motors are often used for pumping irrigation water. A variable-frequency drive motor

improves the system's energy efficiency under most operating conditions by matching the motor speed to the load. In contrast, the output of a single speed motor-drive system will rarely match the actual demand and is controlled in some way that often wastes a large part of the power it produces. A replacement may also be included in some cases.

Want more details? Check out "Energy Enhancement Activity – ENR09 - Variable frequency drive electric motors," available at www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1048990.pdf.

Farm Energy Audit: The Audit You'll Want to Have

A farm energy audit is a tool to help agricultural producers conserve energy and save money by implementing energy-efficient equipment. The audit collects and analyzes information on farm energy consumption and its associated costs, and then recommends ways to reduce them. Farm energy audits also explore ways to capture renewable energy resources that are available on a farm. Dairy operations are often good candidates for farm energy audits as there are significant opportunities for dairies to save energy and money through conservation and efficiency measures. Farm energy audits can be conducted by a professional or through do-it-yourself energy-efficiency calculators. For more information on energy audits and farm energy calculators, see the ATTRA publication *Farm Energy Calculators: Tools for Saving Money on the Farm*.

Save the Date!



Register now at www.harvestcleanenergy.com!
First 50 registrants save \$50! Use code HCE.



ATTRA Publications

Here is a sampling of ATTRA publications related to farm energy. Be sure to check out our new and updated publications, too!

Farm Energy Publications

- Biodiesel: Do-it-yourself Production Basics IP263
- Comparing Energy Use in Conventional and Organic Cropping Systems IP339
- Conserving Fuel on the Farm IP310
- Dairy Farm Energy Efficiency IP355
- Efficient Agricultural Buildings: An Overview IP220
- Energy Saving Tips for Irrigators IP278
- Energy-Efficient Lighting for the Farm IP369
- Farm Energy Calculators: Tools for Saving Money on the Farm IP326
- Freeze Protection for Livestock Watering Systems IP215
- Micro-Hydro Power: A Beginners Guide to Design and Installation IP383

- Renewable Energy Opportunities on the Farm IP304
- Solar-Powered Livestock Watering Systems IP217
- Direct Marketing IP113

You can find lots of resources on farm energy alternatives at https://attra.ncat.org/attra-pub/farm_energy/.

See the full list of ATTRA publications at <https://attra.ncat.org/publication.html>.

Call 800-346-9140 for a printed copy. Prices vary. Many resources are free.

New and Updated Publications

- Conservation Financing for Farm Transfer IP460
- Getting Into Farming: A Workbook for Beginning Farmers in North Carolina IP462

ATTRAnews

Carl Little, Project Manager
Karen Van Epen, Editor

December • www.attra.ncat.org

ATTRAnews is the newsletter of the National Sustainable Agriculture Information Service. The free newsletter is distributed throughout the United States to farmers, ranchers, Cooperative Extension agents, educators, and others interested in sustainable agriculture. ATTRA is funded through the USDA Rural Business-Cooperative Service and is a project of the National Center for Appropriate Technology (NCAT), a private, non-profit organization that since 1976 has helped people by championing small-scale, local, and sustainable solutions to reduce poverty, promote healthy communities, and protect natural resources.

