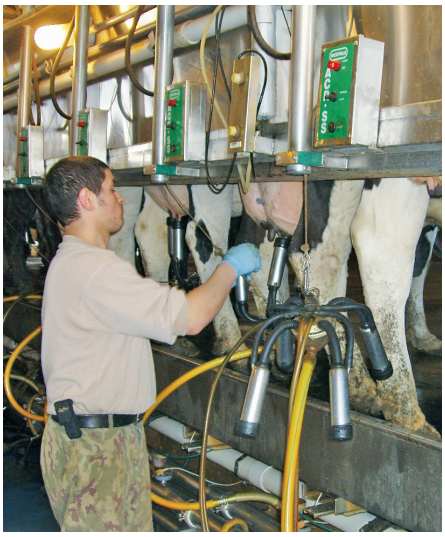
Energy efficiency for dairy milking equipment



Dairy farms typically require more energy for day-to-day operations than other farmsteads, especially daily kWh of electricity for milking the herd and for cooling and storing the milk. Scroll compressors, milk precoolers, and variable frequency drives can improve energy efficiency during the daily milking routine.

Equipment maintenance and planning

Milk prices have been especially volatile during the past decade. Maintaining existing milking equipment to operate at peak performance is an effective way to conserve energy on the dairy farm. If equipment is worn due to poor maintenance or age, this often leads to air leaks and inadequate sanitation, and excessive energy use may occur.

Before critical parts of the milking system reach the end of their useful life, take time to review energy efficient replacements. Consider new technologies that not only meet the needs of your dairy operation but also improve its energy efficiency.

Producers are encouraged to work closely with equipment suppliers and local utility service providers to evaluate their specific needs. This may include a site assessment or an energy audit when possible to determine eligibility for energy rebate programs. Some equipment upgrades will quickly pay back the initial cost by reducing energy consumption. Carefully consider the most energy efficient equipment to meet existing—and future—needs of the farm.

Energy needs for the milking routine

In general, the results of dairy farm energy assessments show that operations with large herd sizes typically have greater energy needs and greater energy savings potential than smaller dairies. However, like all farms, the specific energy demands of each dairy are unique. In particular, the configuration of the milking system impacts energy consumption: how many milking units are in the parlor and the level of vacuum needed to operate and clean them.

Three key areas for improving energy efficiency during the daily milking routine are milk cooling, water heating, and vacuum pumps. When combined, these three factors account for approximately half of the energy consumption on Midwestern dairy farms.

Compressors

Scroll compressors can provide energy savings for dairies of all sizes. Compared to conventional reciprocating compressors, scroll compressors typically use 15-20 percent less energy. Their design compresses refrigerant using two intermeshing scrolls. One scroll is fixed while the second oscillates around the first, providing continuous compression without the need for mechanical valves. This action is similar to rolling up a tube of toothpaste. If an existing compressor fails or needs to be replaced, consider installing a scroll compressor.

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Refrigeration and heat exchange

Milk refrigeration consumes a lot of energy. Milk precooling and refrigeration heat recovery (RHR) are proven to reduce energy and have been gaining popularity among dairy producers for decades. However, one may suit your needs more than the other.

A refrigeration heat recovery (RHR) unit can recover 20-60 percent of the energy that is removed from the milk as heat during the cooling process. However, RHR units and milk precoolers may interact and compete with one another, so an energy assessment should be done to determine if one or both units would be optimal for your dairy facilities.

The most common style of heat exchanger is the plate heat exchanger, also called a plate cooler or milk plate precooler. Plate heat exchangers contain a series of ribbed plates placed side by side. Two separate circuits are created between the plates using rubber gaskets. Milk flows along its designated circuit in direct contact with every other plate. At the same time, cold well water absorbs heat from the milk as it flows through the other circuit on the opposite side of the plate.

Older facilities may have "shell and tube" heat exchangers, sometimes called concentric tube heat exchangers. Compared to plate heat exchangers, which can be expanded or customized with additional plates, this older style is typically difficult to modify as the dairy grows.

Warm water from the heat exchanger can be used for washing or to supply drinking water for the dairy herd. For more details, see "Energy Conservation on the Farm: Well Water Precoolers" (A3784-3) by Scott Sanford.

Variable frequency drive

The motors on milking vacuum pumps are sized for wash cycles that require high vacuum capacity. However, less vacuum—and lower horsepower—is needed for milking versus washing. A variable frequency drive (VFD) can significantly reduce energy use without compromising the vacuum system.

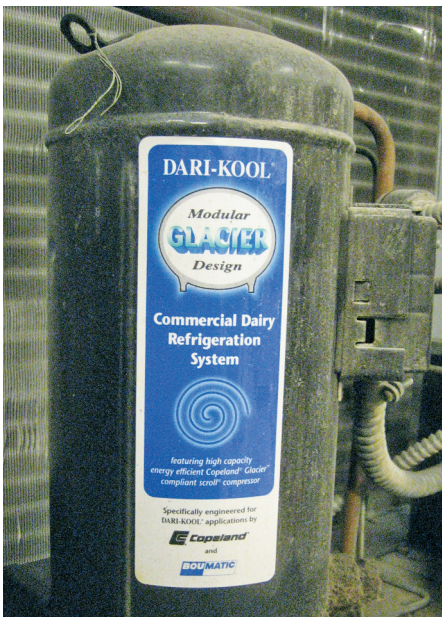
The VFD regulates the speed of the vacuum pump motor to match its load requirement at any given time. It measures changes in pressure with a sensor in the vacuum line and adjusts the speed of the pump motor to maintain vacuum pressure. With the VFD, the vacuum pump motor requires less horsepower and less energy during each milking.

Without a VFD, a conventional vacuum system runs the pump at a high speed for the entire milking. Air is bled into the system through a regulator to maintain vacuum pressure. Depending on the specifications of the milking system, installing a VFD can reduce vacuum pump energy consumption by 30-80 percent with typical savings of 50-65 percent.

Rotary lobe (blower) vacuum pumps are best paired with a VFD, but the technology can also be installed with a rotary vane pump. Carefully review the requirements of your equipment to ensure proper sizing. If the speed of the vacuum pump motor drops below its minimum recommended speed, the VFD may reduce the useful life of the vacuum pump.


Summary

A dairy can manage its energy costs by maintaining existing milking and cooling equipment for optimal performance. When expanding facilities or replacing equipment, review options such as scroll compressors, refrigeration heat recovery, precoolers, and variable frequency drives with your equipment supplier or utility provider. Also consider an on-farm energy assessment to gather specific information about the energy needs of your operation.



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