

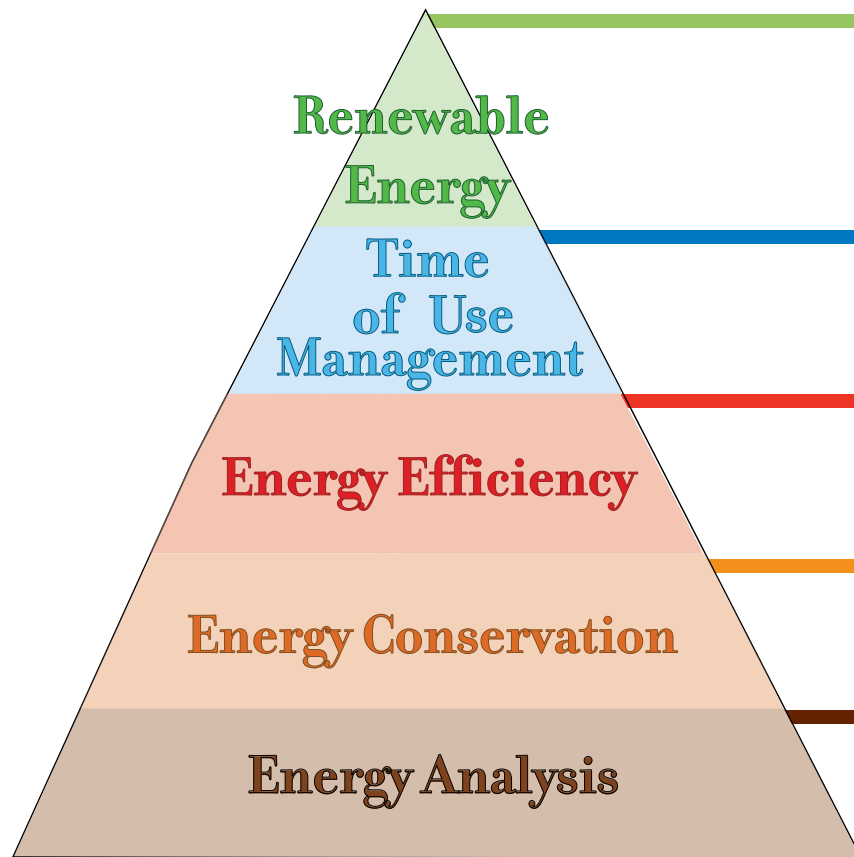
Best Practices Guide

Energy Savings Opportunities for Dairy



The logo for EnSave, featuring a yellow arc above the text. The text "EnSave" is in a blue, serif font, with "En" and "Save" in a larger size than the "S".
EnSave

The Energy Pyramid



The last step on the energy pyramid is renewable energy, which is using resources that are naturally replenished. Solar power, wind power, hydroelectricity, and biofuels (like methane) are examples.

Electricity costs can vary over the course of the day. Running equipment during peak hours can be costly. By running equipment during off-peak hours, money and energy can be saved.

The third level on the energy pyramid is energy efficiency, which is performing the same services while using less energy. Work smarter and save money with more energy efficient equipment.

The easiest way to conserve energy is to change current behavior: turn off lights if no one is using them, unplug unused equipment, and turn the thermostat lower in the winter and higher in the summer.

This is the very first level towards reducing energy usage. By having an audit or assessment done (or doing an assessment on your own), opportunities to reduce energy use and costs can be identified.

What is the Energy Pyramid? The energy pyramid is a useful concept designed to help people understand the process of using energy efficiently. In some cases too much emphasis is put on renewable energy to solve the nation's energy needs. Rather than being the first course of action, renewable energy should be considered only after a farm has considered all other steps of the pyramid.

The energy pyramid illustrates the steps in the process of becoming more energy independent, from the simplest and least expensive technique to the most complex.

Throughout this brochure, you will find helpful ideas that address each step of the pyramid, from bottom to top. They are arranged according to their relevance on the pyramid, and color coded for easy reference.

If you have any questions about the energy pyramid or would like to learn more about how these ideas can work on your farm or facility contact:

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Farm Energy Audits



There is a tremendous opportunity on the farm to save energy and money by upgrading or adding energy efficient equipment.

All of EnSave's energy audits begin with an initial interview with the farmer to gather information about the operation and what to expect from an energy audit. EnSave then collects energy usage data for:

- Heating/cooling
- Water heating
- Lighting
- Motors
- Heat exchange
- Pumping
- Variable speed drives
- Compressors
- Ventilation
- Production increase techniques
- Space heating



Following the data collection, EnSave analyzes the data and produces recommendations for energy efficient upgrades. The recommendations are compiled into a comprehensive, narrative audit report for the producer.

Audits are customized to fit the farmer's objectives. It also identifies opportunities for pollution prevention and renewable energy on the farm. It focuses on electric energy savings as well as propane, natural gas, and diesel. Just as every farm is unique, so is each farm's energy priorities.

As energy and fuel prices climb, agricultural producers need customized solutions in order to stay competitive. A good farm energy audit educates producers about energy efficiency, and provides them with a decision-making tool they can use immediately as well as in the future.

Preventative Maintenance

If the time is not right for an upgrade, some simple preventative maintenance can often help reduce bills in the short term, and help extend the life of the equipment. Here are some ideas that can be implemented today.

Clean Equipment

Removing dust, soot, and debris from equipment will allow it to do more work with less effort, extending its life and reducing energy usage.

Inspect Regularly

Equipment should be checked regularly. Replace parts that are showing excessive wear before they break and cause irreparable damage.

Plug Leaks

Be it a pinprick hole in a hose or a drafty barn, leaks waste money, fuel, and electricity. By plugging the leaks, savings can be considerable.

Remove Clutter

Hoses should be regularly flushed to clear them of debris. Ensure fan and motor intakes and exhausts are clear of clutter for maximum circulation and efficiency.

Mercury



Did you know?

- Mercury is extremely toxic to the nervous system
- Mercury evaporates at room temperature, making it easy to inhale
- Land tainted with mercury can lower its property value significantly

Mercury is an odorless, silvery liquid with a metallic luster. It expands and contracts with temperature and pressure changes, which makes it perfect for use in vacuum gauges (manometers).

The mercury in manometers can become tainted with milk, water, dirt, or cleaning solutions. It is also considered hazardous waste, so mercury disposal can be dangerous and even deadly if not properly done.

When possible, manometers containing mercury should be replaced with non-mercury gauges. An acceptable alternative is a digital gauge. They can be powered by the same source as the vacuum pump or auto-washer so they can be turned on and off with the system. Digital gauges can make it easier to run a milking system at an efficient pressure level, thus reducing milking time and energy consumption.

Diesel Fuel Reduction



Gear Up/Throttle Down

If using a high horsepower tractor while pulling a lighter loads, fuel can be saved by running it in a higher gear and a lower engine speed. Be sure to stay within the engine RPM working range as specified in the operator's manual, and do not overload the engine.

Tractors are an integral part of agriculture. Unfortunately, they also consume vast amounts of diesel fuel. Luckily, regular maintenance and other practices will help tractors perform more efficiently. Consider integrating these fuel saving ideas into a regular maintenance schedule:

- Replace air and fuel filters regularly
- Check tire pressures frequently, and replace worn tires
- Use proper ballast for each operation
- Do not idle diesel engines over 10 minutes
- Clean dirty fuel injectors
- Keep ground-engaging tools sharp
- Use the right tractor for the job (match the horsepower to the load)
- Combine trips whenever possible, by modifying equipment if necessary

Milk Vacuum Pump VSD



Benefits of a Vacuum Pump VSD

- Can cut electricity usage up to 67%
- Maintains a constant vacuum level
- Provides a quieter working environment

A Variable Speed Drive (VSD) is a digital controller that regulates the speed of the milking vacuum pump motor. Before variable speed technology, dairy operators had to run their pumps at a constant high speed to perform adequately during the short intervals of high vacuum need.

The VSD determines how much vacuum the system requires and regulates the speed of the pump motor. The result is a pump and motor that work only as hard as they need to, which often leads to substantial energy savings.

The energy and money savings from installing a VSD varies from farm to farm, depending on several variables. On some farms, the energy savings have made the payback period as short as two years. This makes the VSD one of the best investments a dairy farmer can make.

Milk Transfer Pump VSD



Low-Cost Tips

- Conduct regular maintenance, including cleaning evaporator and condensor coils
- Check insulation on supply and return refrigerator lines and re-insulate where appropriate

Many farmers use plate coolers, which use either glycol or ground water to absorb the heat from the milk before transferring it to the bulk tank. The plate cooler's efficiency depends on the cold water temperature and the flow rates of both the milk and the water.

Standard milk pumps cannot provide a constant flow of milk into the cooler, reducing the efficiency. A VSD on the milk transfer pump will produce a steady flow of milk through the plate cooler, optimizing cooling.

This improved performance reduces cooling costs associated with bulk tank compressors while maintaining milk quality. Tests have shown an average energy savings of 30% on the run time of the bulk tank compressor when the milk pump is controlled by a VSD coupled with a plate cooler.

Scroll Compressor



Benefits of a Scroll Compressor

- Saves energy, money
- Lasts longer than other compressors
- Delivers consistent cooling

For many years reciprocating compressors have cooled milk in bulk tanks. Historically, these compressors are inefficient, require regular maintenance, and are noisy. Scroll compressors use dual spinning scrolls to compress refrigerant. As the scrolls spin they create ever-smaller gas pockets and generate greater pressure. Suction is continuous and pulse-free.

Scroll compressors use significantly less energy than reciprocating compressors. One study found that a 3-hp scroll compressor saved 41% more electricity over a 3-hp reciprocating compressor. They are also quieter. With only four moving parts and no metal-on-metal contact, there are no seals to tear and no lubrication needed. They also work well in cool weather and can start under any system load. Installation costs are comparable to conventional reciprocating compressors.

Plate Coolers



Benefits of a Plate Cooler

- Extends the life of equipment by reducing load and run time
- Increases milk quality by inhibiting bacterial growth
- Saves electricity, money

In dairy operations without milk pre-cooling, milk typically comes from the cow at about 98° F, flows into a receiver, and is then pumped into the bulk tank. Compressors then cool the milk to a storage temperature of about 38° F.

A milk pre-cooler, or 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.

Milk cooling costs account for some of the greatest energy expenses on a dairy farm. For example, a dairy farm that produces 3 million pounds of milk per year uses around 112,000 kWh of electricity annually. The installation of a plate cooler could save the farm about 8,000 kWh or \$800 annually (at \$0.10 per kWh).

Efficient Fluorescent Lighting



- Low-Cost Tips
- Turn off lights when not in use
- Light work areas, not the entire building
- Use daylight when possible
- Install dimmable ballasts to control light levels

Incandescent light bulbs are inefficient, converting only 10% of the energy they use to light. There are many styles of fluorescent lights available that are much more energy efficient.

Compact Fluorescent Lamps (CFLs) deliver the same amount of light as incandescent bulbs, but use only 1/4 of the electricity. Installing CFLs may cost a little more initially, but they can last up to 10 times longer. Cold Cathode Fluorescent Lamps (CCFLs) can last up to 25 times longer and have around the same efficiency as CFLs.

T-8 and T-5 lights with electronic ballasts replace the older T-12s and have several benefits. The T-8 and T-5 generate less noise, more light per watt, better color rendering, minimal flickering, cooler operation, and provide electric cost savings.

High Pressure Sodium Lighting



High pressure sodium lighting is an excellent choice for barn yards and other exterior areas. These yellowish lights are also suitable for indoor areas where color rendition is not important.

High pressure sodium lights are long lasting with an expected life of about 24,000 burning hours or six years for photo-controlled fixtures. They are very energy efficient and produce more lumens per watt than mercury vapor bulbs.

Units inside barns should be wired to a common photocell in a bright area to minimize operation hours. Indoor fixtures should also have enclosed and gasketed optics to protect the lamp and reflector, and increase the life and light output of the fixture. This will reduce the time required to clean the fixture as only the lens will need to be cleaned.

Compressed Air Savings



Compressed air is used on dairy farms to open gates to manage the flow of cows in and out of the milking parlor. It can also be used to operate other machinery, tools, and applications.

When looking to reduce the energy used by a compressed air system, take a moment to review how it functions. Is the right amount of compressed air being used, or is the compressor oversized? Is it required for all applications? A baseline (kW, pressures, cost, etc.) may need to be established to compare what the current compressor provides versus what is needed on the farm.

One of the easiest ways to save energy and money is to conduct preventive maintenance on the current compressor, which includes checking the lines for leaks.

Ventilation



Low-Cost Tips

- Clean fan blades, motors and controls
- Lubricate pivot points of shutters and inlets
- Check all wiring from service entrance box to point of use

Heat and moisture build-up in confined areas can adversely affect the health of animals and humans. Research has shown that inadequate barn ventilation can result in a production drop of 6 to 14 pounds of milk per cow per day.

Most agricultural ventilating systems rely on exhaust fans to remove moisture build-up. A common goal is to provide four complete air changes in the barn per hour. Properly sized and located air inlets are necessary for an effective and efficient system. Research indicates that milk production is optimized at an ambient air temperature of about 48 degrees Fahrenheit.

Fans of different manufacturers differ markedly in air delivery and energy efficiency. When upgrading or replacing existing fans, be sure to use the most efficient fans possible.

NEMA Premium® Motors



Low-Cost Tips

- Select the right size motor for the job
- Inspect all motors on a regular basis
- Clean regularly
- Replace V-type belts with notched belts

When installing a new motor or replacing an old motor, consider using a NEMA Premium® motor. While they may cost more initially, they are often cheaper to operate in the long run.

When purchasing a new motor, take into account the length of time the motor will run, how high electric bills currently are, and the right sized motor for the job. If the motor is only running sporadically, a retrofit to a NEMA Premium® motor may not make sense. However, the longer the motor runs, the greater the potential for savings. In new installations, NEMA Premium® motors are the standard.

Premium efficiency motors are usually made to higher manufacturing standards, and stricter quality controls. For more information, visit: www.nema.org/gov/energy/efficiency/premium/

3-Phase Power Conversion



There are two main types of 3-phase power converters:

1. Rotary 3-phase converters are reliable, last the longest, and produce balanced 3-phase power.
2. Static phase provides 3-phase power long enough for a motor to start up. They can be used after the motor starts, but only at 2/3 the rated horsepower.

When using converters, ensure the voltages are being balanced. Damage from overloading or overheating could result otherwise.

While variable frequency drives (VFDs) can be adapted to work as a 3-phase power converter, it is not recommended. They are short-lived, do not produce balanced 3-phase power, and can burn out equipment. They are for use with motors only, and should not be used to power multiple loads.

VFDs for Irrigation Systems



Low-Cost Tips

- Water only when necessary
- Move irrigation to off-peak hours to take advantage of lower time-of-use electric rates

A variable frequency drive (VFD) is an electronic device that changes the frequency of the AC power going to a motor, varying its speed. This then affects the flow and pressure of the water being pumped. VFDs are energy efficient because they regulate water flow to match demand, eliminating the need for a flow control valve at the pump station.

VFDs for well and booster pumps are not useful in all applications, and an irrigation engineer should always be consulted before installation. Situations where VFDs may be useful include:

- Booster pumps for irrigation where incoming pressure and discharge demand vary
- Dramatic varying flow rates
- Steep pump curves

Irrigation Pump Upgrades



Testing irrigation pumps for pumping efficiency is a good way of learning if they are working at their optimum efficiency, and can help determine if it is time for a pump upgrade.

Pump efficiency testing measures gallons pumped per minute, total dynamic head (pumping water level and operating pressure), and input horsepower. This information determines if the pump is working efficiently, or if it is time to upgrade. Prior to upgrading, consider the following:

Low-Cost Tips

- Test well and pump at least every two years
- Inspect the well to ensure there is no clogging or corrosion

- Upgrade to a premium efficiency motor. It will last longer and cost less to run. Use the right size motor for the job.
- Replace/repair the pump impeller/bowl.
- Make sure the impeller and bowl are properly adjusted to ensure the proper amount of water is pumped.

Energy Star® Qualified Washers



Dairies do several loads of laundry a day. By switching to an Energy Star® clothes washer, significant savings could be realized. Energy Star® is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy that helps save money and protect the environment with energy efficient products.

Energy Star® qualified washers use 40% less energy than standard washers. Most full-sized Energy Star® washers use 18–25 gallons of water per load, compared to 40 gallons used by a standard machine. They also extract more water during the spin cycle, which saves energy by reducing drying time and wear and tear on fabric.

To buy an Energy Star® qualified washer, just look for the Energy Star® label or go online and review the list of Energy Star® qualified washers at:

www.energystar.gov

Stock Waterers



Did you know?

- Many factors determine how much water a cow drinks, including size, milk yield, feed, temperature, and water quality and availability.
- With low usage, the waterers must be well insulated and have reliable heaters so the floating cover will not freeze in place.

In cold weather climates, keeping livestock drinking water from freezing during the winter is critical. This has historically been done by heating drinking water with an electric heater that often draws 1000 to 1500 watts. However, well insulated, plastic stock waterers have proven their ability to keep drinking water from freezing using 250 watts of electricity or even no electricity at all.

Since the year-round ground water temperature is about 50° F, it must fall to 20° F to freeze solid. If enough animals drink from the waterer, the incoming water will keep it from freezing. The unit's insulation helps to keep the heat in the water. Many units have plastic covers that float on the water and seal the opening of the reservoir when not in use. Not all sites are suitable for the energy-free models.

Water Heaters



Water heating can consume up to 20% of the energy used on a dairy farm. Having the properly sized water heater will help minimize water heating costs.

Heaters should be chosen based on how much hot water is needed over a specific period of time. On dairy farms, this is usually how many gallons per cycle are required for the milking system and bulk tank.

Use the highest Energy Factor (EF) rating for fuel type used on the farm. If gas or oil is used, select a heater with an EF rating of 0.61 or more. If electric is used, look for an EF rating of 0.91 or more.

Low Cost Tips

- Inspect and repair system for leaks
- Insulate water heater and lines from tank

Compressor Heat Recovery



Benefits of Installing a Compressor Heat Recovery Unit

- Cools milk faster
- Improves long-term milk storage
- Can cut water heating costs by 50–75%

When cooling milk in a bulk tank or with a chiller, compressors are used to remove the heat from the milk. The heat removed is usually released back into the air by condenser fans. By installing a compressor heat recovery unit, this otherwise wasted heat can be reused to heat water.

A compressor heat recovery unit can raise water temperatures as high as 110° F. Since the incoming water is pre-heated, the water heater has less work to do and will likely last longer as a result. In addition, these units can often help improve compressor performance.

A compressor heat recovery unit can be one of the most cost effective purchases a dairy farmer can make. For example, a dairy farm using 225 gallons of heated water every day can save as much as \$1,300 on their annual electricity costs. Larger farms could see even more savings.

Time of Use Management



A Dairy Farm Can Cut Costs By:

- Shifting milking times to off-peak hours
- Shifting pressure washing, conveyer use, and silo unloading to off-peak hours
- Using timers to shift irrigations and electric water heating to off-peak hours

Dairies often have the opportunity to reduce their electricity costs by participating in demand response programs offered by their utility.

Electric utilities must maintain the ability to supply sufficient electricity to the grid during periods of extremely high demand. These periods typically occur in the middle of hot summer weekdays when air conditioning and refrigeration loads are at their peak. Thus, utilities often provide incentives to their customers for reducing electric use during these times.

We recommend contacting your electric utility to determine what opportunities exist for reducing electric costs through Time of Use Management.

Renewable Energy



It is recommended that, before pursuing a renewable technology, current operations be as energy efficient as possible.

However, once a farm has implemented all cost effective energy efficient equipment, renewable energy projects may make sense.

EnSave offers services to help you decide what your next steps should be regarding renewable energy.

For resource information on wind energy, photovoltaic and thermal energy, geothermal, and other renewable energy technology, call EnSave at 800-732-1399.

About EnSave

EnSave supports the American agricultural sector with innovative energy efficiency and resource conservation programs. EnSave provides agricultural producers and food processors with cost effective ways to reduce operating costs while saving energy and reducing pollution.

EnSave's clients include state and federal energy and environmental agencies, investor owned utilities, and rural electric cooperatives. EnSave implements its programs by developing relationships with equipment manufacturers, local equipment dealers, and the local agricultural community. Ultimately, these programs promote economic investment in the rural economy and improve the quality of America's land, air, and water.

EnSave does not represent any equipment manufacturer, nor does EnSave represent any one equipment dealer. EnSave's goal is to help our clients save energy and reduce pollution on America's farms and food processing facilities. EnSave also wants to keep our clients safe, so please consult a licensed professional before installing any new or retrofit equipment.

If you would like information on how EnSave can work with you, please contact us at (800) 732-1399.



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