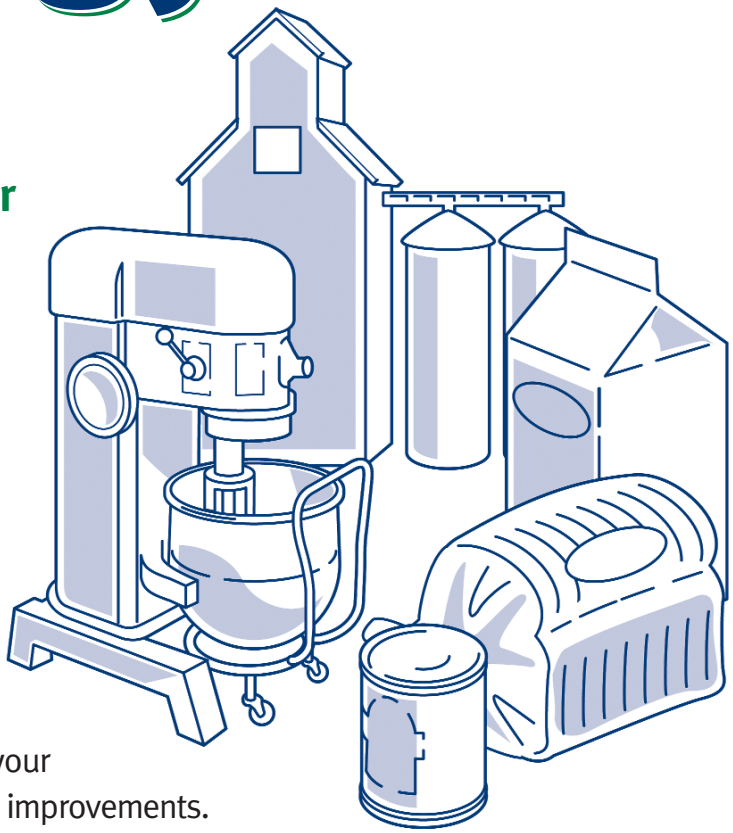
Reduce Food Processing Energy Use

- Refrigeration
- Compressed Air
- Motors
- Lighting
- Process Heat



This publication will help you identify the cost-saving opportunities in your food processing facility and guide you in undertaking a program to improve your bottom line through energy-efficient improvements.

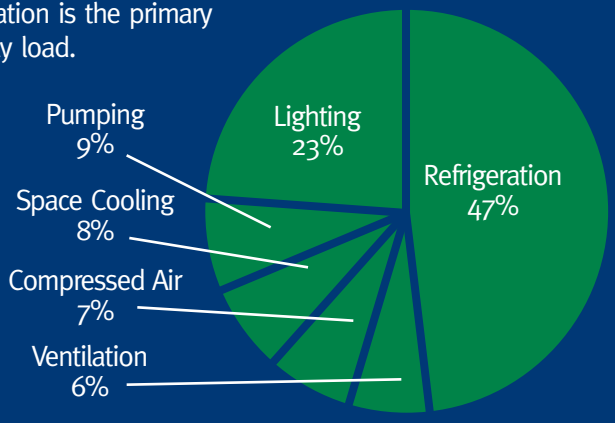
Vermont food processing facilities are critical to Vermont's economic future and way of life. The high energy costs associated with food processing present both challenges and opportunities. One plant recently undertook a three-year efficiency upgrade that is lowering annual electricity costs by $44,000. The plant owner's investment of $43,000, with a $13,000 contribution from Efficiency Vermont, is paying off in lower operating costs, increased equipment performance and a better bottom line with a 147% internal rate of return.

What food processing equipment uses the most energy?

Food Processing for Human Consumption

ELECTRICITY USE

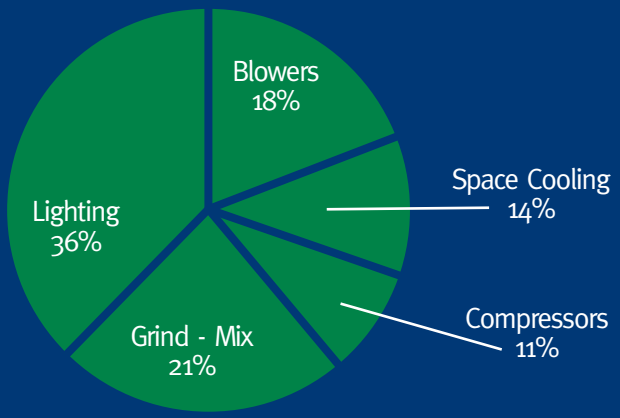
Refrigeration is the primary electricity load.



Animal Feed Production

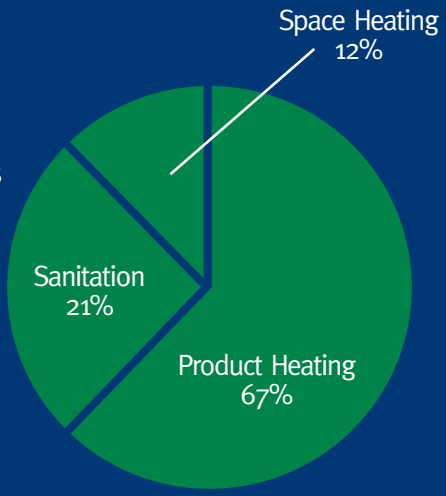
ELECTRICITY USE

Lighting, grinders, and fans are the highest contributors to electricity load.



Fossil Fuel Use

Product heating accounts for the largest fossil fuel use.



Reduce Refrigeration Costs

See how a Vermont facility is
REDUCING REFRIGERATION COSTS

Conditions:

- Plant uses an ammonia refrigeration system.
- Operation runs 6,000 hours per year.
- Compressor is 100 hp.
- Average compressor load is 70%.

Improvement: Optimize process refrigeration condensing controls by reducing the pressure on the evaporative condenser that serves the compressor. Automatic controls reduce the condensing pressure setpoint from 150 psi to 125 psi when outdoor conditions are cool enough. Although the 15 hp fan in the evaporative condenser will use more energy, the compressor will compensate by using 10% less energy.

Benefits: Plant electric bills are reduced by $2,200 per year.

Costs and Savings

Annual electricity savings	26,000 kWh
Electricity cost savings	$2,200
Installation cost	$10,000
Incentive from Efficiency Vermont	$2,500
Net customer cost	$7,500
Payback period	3.4 years

1. Optimize head pressure controls

Refrigeration compressors run more efficiently at a reduced condensing pressure and temperature. To lower the condensing temperature, the fans in the cooling tower or evaporative condenser need to use more energy. When condensing temperatures and pressures are decreased, a small liquid pump (sometimes called an LPA) may be required for adequate operating pressure. The end result is lower head pressure (from 12 to 40 psi), reduced power consumption (up to 35% reduction), and higher overall compressor efficiency. Using an LPA to pump refrigeration is significantly more efficient than using head pressure from the compressor to do the same work.

2. Control air purge

Most new ammonia refrigeration systems have automatic air purge equipment. These systems eliminate air in the lines when a system is taken down for service or additional equipment is brought on line. For older equipment, it can be cost-effective to install an ammonia air purge, which will improve compressor performance and can save up to 15% on refrigeration costs. The presence of air in a refrigeration system increases the condensing pressure, resulting in increased power requirements. For every 10 psi increase in condensing pressure, there is approximately a 6% increase in power consumption by the compressors. For a typical air purge retrofit installation, the payback is reached in one year.

3. Install a refrigerant gas heat recovery system

The heat rejected from a refrigeration compressor can be recovered and reused cost-effectively. Use it to heat the food product, to heat the water used for sanitation, or to provide space heating. This will save fossil fuel and reduce overall production costs.

4. Reconfigure the entire refrigeration system

Installing a two-stage rack refrigeration system during major equipment replacement, system upgrade or expansion will enable compressors to better match actual load. If you are building a new central refrigeration plant, a two-stage system typically will reduce both energy use and maintenance costs over the lifetime of the equipment.

Compressed Air

The average facility uses 10% of its electricity for compressed air. Compressed air improvements generate better performance at lower cost and usually pay for themselves in less than two years. The two most cost-effective improvements for compressed air systems are leak repair and replacement of inefficient equipment. You also can reduce energy use by selecting energy-efficient compressors and dryers, and by installing air storage in conjunction with part load controls.

1. Repair leaks

If your facility has high leakage rates, you may be able to eliminate the need for a new compressor by fixing existing leaks and reducing inappropriate uses of air. Even if you need to install a new compressor immediately, it makes sense to institute a leak detection and correction program. This will reduce overall air demand and energy use of the compressor. New efficient compressors will ramp down energy use in response to the reduced demand.

2. Replace equipment

New high-performance compressors improve air output, reduce energy use, and increase system reliability. Efficient compressors contain integrated controls to gauge the correct amount of air required and regulate the loading and unloading of the compressor. These compressors can save 20% to 25% of the energy consumed by older compressors. Properly sized compressors also can reduce purchase and operating costs.

3. Make system improvements

You can reduce the amount of air wasted in your facility by reducing piping angles and connections, upgrading dryers, and installing condensation drains. By adding storage capacity, you can reduce compressor operation time, potentially reducing the compressor's impact on peak demand.

Variable Speed Drives

With a variable speed drive (VSD) you can automatically adjust motor speeds to match the actual workload of your operations instead of running motors continuously at full speed. This speed control results in improved operations and reduced energy consumption in many applications. A VSD connected to a motor larger than 10 hp can reduce annual electrical consumption of that motor by 30% to 40%.

Energy savings from a VSD can be surprisingly high, because energy use is theoretically proportional to the cube of the motor speed. For example, in closed-circulation systems, using a VSD to reduce motor speed by 75% reduces motor energy use by about half. In open systems that require a lot of pressure, energy use is better aligned with motor speed.

SPECIFIC VSD APPLICATIONS INCLUDE:

Pumps: Process and cooling pumps that have throttling control or balance valves can be retrofitted with VSDs. This may reduce energy usage by 35% to 45% while maintaining optimal performance.

Fan Motors: Ventilation and cooling fans are often oversized for regular use. They are designed to handle worst-case conditions, which may occur only a few hours per year. By installing a VSD on these fans, it is possible to reduce fan speed and move the volume of air required. This lowers energy use while maintaining comfort for personnel.

Grinders and Mixers: Some dry and wet mixtures don't require the full speed of your mixer motor. Installing a VSD will reduce energy use without compromising the process. Startup during mixing requires the largest demand. Once mixing is under way, the VSD will reduce motor speed to match the need.

See how a Vermont facility is **REDUCING COOLING WATER PUMP COSTS**

Conditions:

- 15 hp cooling water pump running at constant speed.
- Serving a variable cooling load.

Improvement: Install a variable speed drive on the pump to reduce water flow and match cooling load demand.

Benefits: Plant electric bills are reduced by $1,500 per year.

Costs and Savings

Annual electricity savings	18,000 kWh
Electricity cost savings	$1,500
Installation cost	$5,250
Incentive from Efficiency Vermont	$1,300
Net customer cost	$3,950
Payback period	2.6 years

Motors

Motors are at the heart of manufacturing processes. When motors fail and production lines go down, an immediate replacement is critical. Reduce downtime by performing an inventory of motors, including spares. Work with your motor vendor to develop a plan to increase your stock of premium efficiency motors. You'll capture Efficiency Vermont financial incentives for your purchases.

When you replace motors, the range of savings will depend on motor size, runtime, and type. Some examples of savings for total-enclosed fan-cooled (TEFC) motors are listed here:

Efficiencies		Motor Size	Annual Electrical Savings*
Baseline	Premium		
90%	92%	10 hp	$70
92%	94%	30 hp	$280
94.5%	95.8%	100 hp	$525

*Savings based on a rate of $0.10 kWh.

Lighting

Recommended light levels for food processing vary from 30 footcandles (fc) to 100 fc, depending on the use of the space. Manufacturing facilities are often illuminated to provide a constant light level throughout the building. This wastes energy in overlit spaces and may result in under lighting of critical task areas, reducing productivity and affecting quality assurance. Lighting system upgrades can reduce overall lighting usage to 1.5 watts per square foot in some facilities. For a 10,000-square-foot facility using 15-year-old technology, this upgrade could result in annual electrical cost savings in the range of $2,500 to $5,000, depending on hours of operation.

See how a Vermont facility is **REDUCING LIGHTING COSTS**

Conditions:
- T12, 4 ft., 4 lamp magnetic ballast fluorescent lighting.
- Work area lighting.
- 6,300 hours of operation per year.

Improvement: Replace T12 lighting with Metal Halide pulse start (175 watt). This will offer more evenly distributed footcandle levels while reducing energy use, lighting, heat generation and associated cooling costs.

Benefits: Electric bills are reduced by $1,100 per year, with reduced maintenance costs and improved lighting.

Costs and Savings

Annual electricity savings	10,000 kWh
Electricity cost savings	$1,100
Installation cost	$7,500
Incentive from Efficiency Vermont	$2,300
Net customer cost	$5,200
Payback period	4.7 years

Develop Your Energy Action Plan

1. Review the measures described in this brochure with your refrigeration contractor, compressed air vendor, electrician or maintenance staff. Identify opportunities and obtain cost estimates. Contact Efficiency Vermont for financial incentives and energy savings estimates on these measures before you install them.
2. Determine if your plant has instituted a compressed air leak detection and abatement program. If not, sign up for our leak detection training. If you are planning on adding or replacing a compressor, contact Efficiency Vermont for incentives on the most efficient compressor options. We can work with you and your vendor to get the most efficient installation for your money.
3. Perform a plant-wide motor inventory. Plan for upgrading to efficient motors at the time of motor failure. Let your vendor know you want NEMA premium efficiency motors and ask for their help completing the Motor-Up rebate form. For motors that have varying loads, talk to your vendor about opportunities to use variable speed drives. Call Efficiency Vermont to ensure the drives qualify and to get your incentive contract before installation.
4. Call Efficiency Vermont:
   - Before you install measures (you must have a signed Efficiency Vermont contract to be eligible for incentives);
   - When planning improvements or upgrades to your refrigeration, compressed air, heating, lighting or processes;
   - For a contractor or vendor referral;
   - To obtain incentives and energy savings analysis for identified projects.

Efficiency Vermont
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