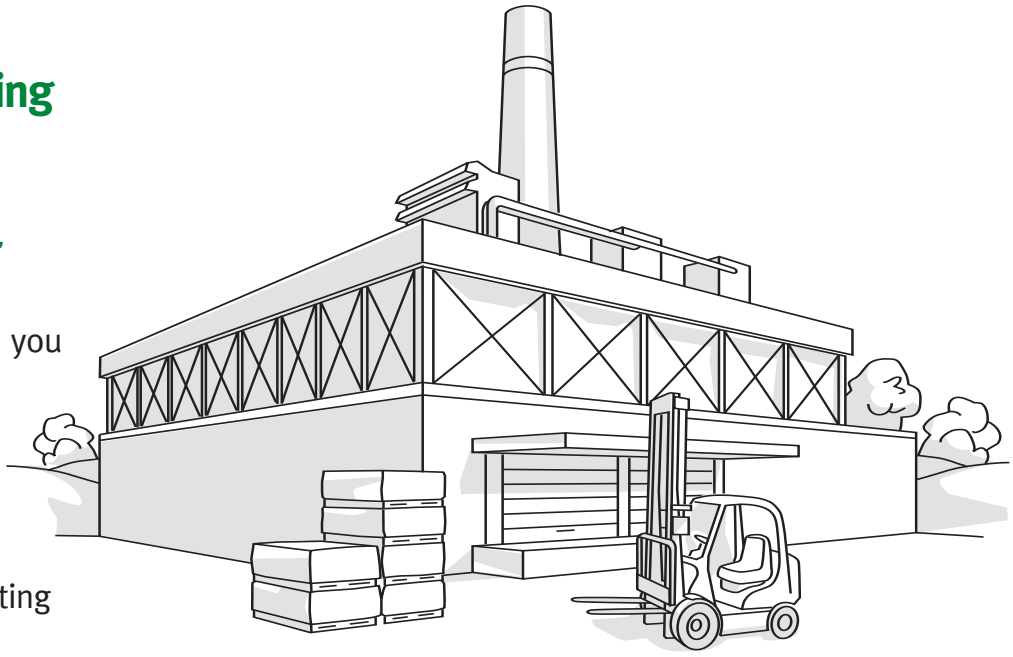
Reduce Energy Use in Industrial Facilities

- **Motors**
- **Heating & Cooling**
- **Lighting**
- **Compressed Air**



This document will help you to identify cost-saving opportunities in your industrial facility and to develop a plan to reduce your energy consumption and operating costs.

In most industrial facilities, there are many opportunities for energy savings. Some energy efficiency improvements can be made with little or no investment, while others require a larger initial investment but can pay for themselves quickly. Energy use often accounts for the majority of the cost of industrial equipment over its lifetime, so it is usually cost-effective to invest in efficient equipment. Efficiency projects can provide additional benefits, including improved work environment, increased productivity, and reduced maintenance costs.

The benefits of energy efficiency improvements depend on a number of facility-specific factors. Efficiency Vermont can help you identify and implement the most cost-effective approach to energy use in your facility. Together, we can work to improve your company's bottom line through increased energy efficiency.

Motors

When purchasing continuous-duty 3-phase motors of at least one horsepower, choose National Electrical Manufacturers Association (NEMA) Premium® efficient motors. Electricity savings relative to a baseline motor usually provide a simple payback of less than two years, depending on motor size, type, and runtime. Also, purchasing new premium efficient motors is often more cost-effective than rewinding older, less efficient motors. To reduce downtime when replacement motors are needed, notify your motor vendor in advance that you intend to purchase NEMA Premium® motors.

Heating and Cooling

Design, controls, operation, and maintenance are all important factors in the performance and efficiency of heating, ventilation, and air conditioning (HVAC) and process heating and cooling systems. Optimizing these systems can result in significant savings of both electricity and fuel.

Efficiency Ratings

When purchasing new heating and cooling equipment, ask your vendor for equipment with high efficiency ratings, and contact Efficiency Vermont for information on energy savings. The efficiency of refrigerant-based cooling systems is rated by energy efficiency ratio (EER) and seasonal energy efficiency ratio (SEER). Chillers are rated by coefficient of performance (COP) and integrated part-load value (IPLV). Furnaces and boilers are rated by annual fuel utilization efficiency (AFUE).

System Optimization

Use controls to improve the performance and efficiency of heating and cooling systems. In a simple HVAC system, use programmable thermostats to schedule operation to correspond with your business hours. Simple payback for thermostat installation is often less than one year. Optimize operation of complex, multi-component systems using an energy management system. In a large system, commissioning of new equipment is recommended to ensure that it is operating as designed.

During cooler weather, significant electricity savings can be achieved by using outside air for free cooling. Opportunities for free cooling may include use of dual-enthalpy economizers on HVAC equipment, economizers in refrigeration systems, and seasonal tower-only cooling in chilled water systems. Consult with an engineer to ensure proper system design.

Electricity Savings with VARIABLE FREQUENCY DRIVES

With a variable frequency drive (VFD), motor speed can be adjusted to match load requirements. Unlike constant-speed motor starters, which operate the motor at full speed at all times, a VFD adjusts motor speed according to operator input or automatic controls. This can result in significant energy savings as well as improved operation in many applications. Contact Efficiency Vermont for information on savings potential and financial incentives.

VFD APPLICATIONS INCLUDE:

Pumps: Many types of pumps consume significantly less electricity when their rotational speed is reduced. If demand varies or if reduced flow rates are required in closed-loop systems, VFDs can optimize system operation and reduce electricity use.

Fan Motors: Ventilation and cooling fans are usually designed for peak load conditions, which may occur only a few hours each year. By adjusting fan speed for the required air volume, a VFD reduces electricity use while maintaining process conditions and comfort levels. Cooling tower fans and combustion air fans are also good candidates for VFDs. Running a fan with a VFD at 50% flow can reduce its electricity consumption by as much as 87%, depending on the application.

See that insulation of chilled and hot water storage and distribution systems is sufficient and well-maintained. Regularly maintain steam traps and repair any steam leaks. Minimize pressure losses and save pumping energy with proper pipe sizing and layout.

To maximize combustion efficiency, adjust your boiler's air-fuel ratio as part of regular boiler maintenance or install a burner control system for automatic adjustment. Consider other opportunities to improve boiler efficiency, such as installing a heat exchanger to use boiler exhaust to preheat incoming air or water.

Building-Pressure Balance

Proper balancing of building pressure can improve HVAC efficiency. The volume of air exhausted in industrial processes is often greater than the volume of ventilation supply air. This causes negative pressure in the building and increases air infiltration through the building envelope, making it difficult to maintain desired indoor air temperatures. To eliminate this problem, maintain proper exhaust and ventilation levels.

Heat Recovery

Look for opportunities to use energy recovery devices to capture and reuse waste heat from exhausted air, industrial processes, and air compressors. Plans should be reviewed by an engineer to ensure proper application and design.

Lighting

Lighting accounts for nearly 10% of the electricity consumed by the average industrial facility. Through good design, selection of high-performance lighting technologies, and use of automated controls, many facilities can reduce energy and maintenance costs for lighting by 25% or more. Contact Efficiency Vermont for help determining the savings potential for your facility.

Lighting Design

In industrial facilities, lighting is often arranged to provide a consistent light level throughout the building. This can waste electricity by over-lighting some spaces while under-lighting critical task areas, which can impact quality and productivity. Optimize lighting and energy use by planning your lighting layout carefully, using a combination of overhead and task lighting.

Efficient Lighting

It is often cost-effective to retrofit existing lighting in industrial facilities with newer, more efficient lighting technologies. Upgrade linear fluorescent lighting from T12 to High-Performance T8 to reduce electricity costs by approximately 40%. Replace high-bay metal halide or high-pressure sodium lighting with fluorescent T5 high-output lighting to reduce electricity costs by 45%, improve light quality, and eliminate the warm-up time required by metal halide and high-pressure sodium lights. Replace incandescent light bulbs with long-lasting compact fluorescent light bulbs (CFLs) to reduce electricity costs by as much as 75%. Efficient lighting generates less heat than standard lighting, so lighting retrofits can further lower energy use by reducing the cooling load in air-conditioned or refrigerated spaces.

Lighting Controls

Install occupancy sensors to automatically turn lights on and off in intermittently used spaces, such as warehouses and conference rooms. In areas with natural light, it may be cost-effective to install photoelectric sensors and dimming ballasts to automatically adjust lighting levels in response to available daylight.

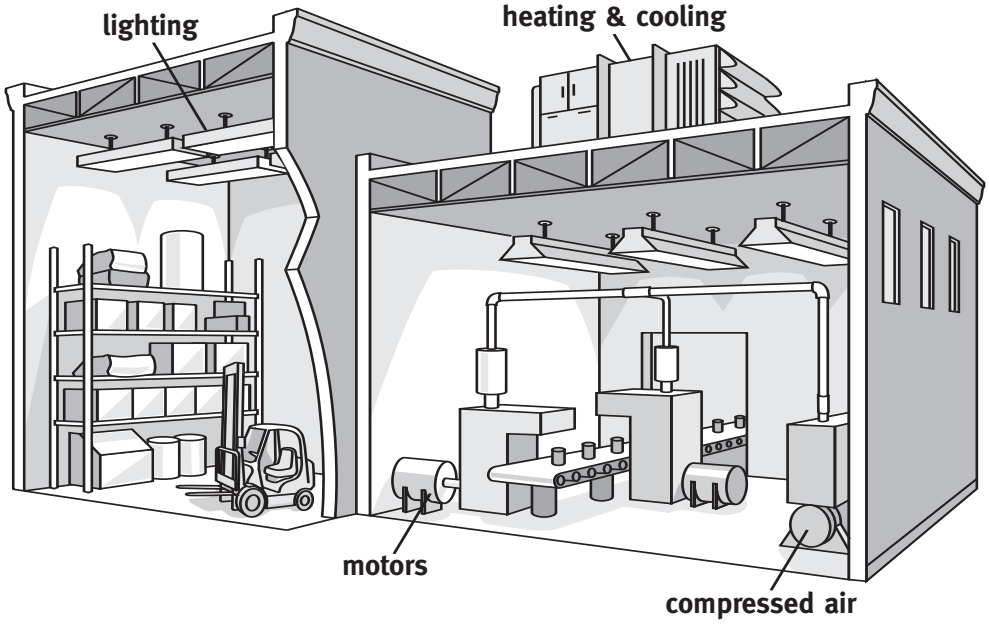
Wire lighting circuits to allow flexibility by including separate controls for different areas. In larger facilities, consider installation of an automated lighting control panel.

Understanding Your **POWER FACTOR**

Power factor is a measure of how effectively electrical power is being used. This is calculated as the ratio of real power (kilowatts) to total power (kilovolt-amperes). Depending on your electric utility and rate category, your utility may charge a penalty if your average power factor is below a certain level. This penalty can add thousands of dollars to your electric bills every year.

Low power factor can be corrected with the installation of capacitor banks in your facility. This correction can substantially reduce electricity costs and often results in a simple payback of less than one year.

If there is a power factor charge on your electric bills, contact either your electric utility or an engineer or electrician who has experience in power factor correction. Efficiency Vermont does not offer financial incentives for power factor correction, but can answer questions or review proposals.



Compressed Air

Opportunities for electricity savings exist in almost every compressed air system. Air compressors are very energy-intensive and account for 10% of electricity use in the average industrial facility. For the best and most cost-effective performance, optimize your entire compressed air system — both the supply and demand sides. Your compressor vendor and Efficiency Vermont can help you evaluate energy savings opportunities in your facility.

Leak Repair and Maintenance

In some facilities, air leaks waste as much as 30% of an air compressor's output. Hoses, couplings, fittings, regulators, and quick disconnects are particularly prone to leakage. Incorporate leak repair and prevention into your facility's regular maintenance program. The costs for repair and ongoing maintenance are low, usually paying for themselves in a matter of months. In addition to immediate electricity savings, the reduction in compressed air demand resulting from leak repair may eliminate the need to purchase an additional compressor, even when production volumes increase.

Appropriate Compressed Air Uses

Compressed air is frequently used for applications in which other methods would be more cost-effective, such as open or unregulated blowoff, cooling, vacuum generation, and diaphragm pumps. Use efficient nozzles or low-pressure blowers where blowoff is required, electric fans for cooling, and electric-driven vacuum or liquid pumps rather than compressed air-driven equipment. Eliminating inappropriate applications can result in a payback of less than one year.

System Pressure Setting

The pressure setting on a compressor has a significant impact on electricity consumption. For every 2 psi (pounds per square inch) reduction in air pressure, air compressor electricity consumption is reduced by about 1%. For the most cost-effective operation, set your compressor outlet pressure only as high as necessary to meet the maximum end-use pressure required in the facility, taking into account the pressure drop in your distribution system.

Efficient Compressors and Controls

Electricity costs typically make up 75% of the total cost of owning an air compressor over its lifetime, so it is usually cost-effective to invest in efficient equipment. It also can be more cost-effective to purchase a new, efficient compressor than to rebuild older equipment.

Consider compressors with efficient part-load controls, such as variable speed controls, especially when demand for compressed air varies widely. In plants with multiple compressors, use sequencing controls to automatically operate the most efficient combination of compressors to meet the air load and pressure requirements.

When purchasing a refrigerated air dryer, consider cycling models. Cycling dryers are most efficient when compressed air demand varies over time because their electricity use is proportional to the airflow out of the compressor. For specialized applications requiring a low dew point, contact Efficiency Vermont for information on efficiency options for desiccant air dryers.

System Optimization

Reducing pressure drop in your compressed air system allows you to save electricity by turning down the compressor pressure setting. Use low-pressure-drop filters, and consider opportunities to reduce pressure drop in the distribution piping such as minimizing sharp bends and elbows, increasing pipe diameter, and using a closed-loop header layout.

Use zero-loss (level-actuated) condensate drains to remove unwanted moisture from the system without wasting compressed air.

Install sufficient storage capacity to optimize your compressed air system. Depending on the type of compressor control, additional storage capacity may improve the efficiency of part-load operation or reduce frequent cycling to meet brief surges in demand.

Hidden Cost of **TRANSFORMERS**

Transformers adjust the voltage of electricity delivered from the utility to the levels used in a facility. Most commercial and industrial transformers convert at least 95% of the electricity received into usable output power, but because they are in constant use, even a small efficiency improvement leads to significant savings over the life of the transformer, which can be as long as 40 years.

To optimize operating efficiency when choosing a new transformer, consider the load profile of your facility as well as the part-load efficiency and no-load losses of available models. In some facilities, it may be cost-effective to replace existing transformers with more efficient, properly sized models, particularly if the existing transformer is at least ten years old or does not meet the NEMA TP-1 standard. Contact Efficiency Vermont for information on energy savings and financial incentives.

How Four Vermont Businesses Are Reducing Energy Costs

NSA Industries, a sheet metal fabrication and precision machining company in Lyndonville, has been working with Efficiency Vermont since 2005 to improve operations and to reduce costs. As a result, the company is saving almost $80,000 per year. The company has seen payback periods ranging from one to four years for their investments in lighting and compressed air system retrofits, and a financial incentive from Efficiency Vermont helped NSA to purchase new manufacturing equipment that will reduce cycle time as well as electricity use.

Energy Savings Project	Annual Electricity Savings	Annual Cost Savings
Installation of new variable speed air compressors and improvements to compressed air systems	372,000 kWh	$39,000
Upgrade of lighting fixtures	325,000 kWh	$30,000
Upgrade of manufacturing process equipment	115,000 kWh	$9,000

Green Mountain Coffee Roasters, based in Waterbury, has worked with Efficiency Vermont since 2001 to reduce the company's operating costs and to support their corporate commitment to environmental responsibility. Efficiency Vermont has performed a site survey and provided technical support and financial incentives for projects involving compressed air and lighting. The simple payback period for completed projects has ranged from one to five years. In total, these efforts are saving the company more than $60,000 annually.

Energy Savings Project	Annual Electricity Savings	Annual Cost Savings
Installation of new variable speed air compressors	298,000 kWh	$30,000
Upgrade of lighting fixtures	237,000 kWh	$18,000
Improvements to compressed air system	131,000 kWh	$12,000
Installation of occupancy sensors to control lighting	22,000 kWh	$1,000

Pad Print Machinery *of* Vermont

Pad Print Machinery is a small industrial company in East Dorset that wholesales and customizes high-tech industrial printing equipment. Since beginning to work with Efficiency Vermont in 2006, they have received guidance in the selection of efficient lighting and air conditioning units, as well as financial incentives toward these equipment costs. By upgrading lighting fixtures and air conditioning units, Pad Print Machinery has reduced their annual electricity bills by approximately 10,000 kWh, or $950, which enabled the company to keep electric bills level during an expansion of their business.

Iroquois Manufacturing, a manufacturer of truck components, worked with Efficiency Vermont from 2005 to 2006 when adding a 19,000 square foot building to their facilities in Hinesburg. The new building has efficient lighting with automated controls, air sealing of the building envelope, and heat recovery on exhaust fans. By planning with energy consumption in mind and investing in efficient equipment, Iroquois has significantly reduced both electricity and gas costs. Due to the annual electricity savings of more than 31,000 kWh, operating costs are $2,300 lower than costs for a comparable facility.

Working with Efficiency Vermont to Develop Your Energy Action Plan

Efficiency Vermont can work with you and your vendors to determine the most cost-effective choices for your facility. Financial incentives may be available to help offset the cost of implementing improvements and purchasing efficient equipment. For more information, contact us before you begin implementation.

Our staff can work with you and your vendors to:

- Understand your electric utility bills and energy use;
- Identify and prioritize efficiency opportunities in your facility;
- Review vendor proposals and provide independent analysis of project benefits;
- Calculate energy savings, compare life-cycle costs, and analyze project cash flow;
- Determine eligibility for financial incentives.

Contact Efficiency Vermont if you:

- Plan to add or replace equipment;
- Plan to expand or renovate your facility;
- Are looking for opportunities to reduce energy consumption and operating costs in your facility.

Efficiency Vermont, Vermont's statewide energy efficiency utility, offers technical and financial assistance to help Vermont businesses and households reduce energy use in order to save money, strengthen the economy, and protect the environment.

Since 2000, Efficiency Vermont has partnered with over half of the state's electric utility customers to save more than 360 million kilowatt-hours of electricity and to cut Vermont's rate of electric load growth by approximately two-thirds.

Efficiency Vermont

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