

## Compressed Air

- Listen for and locate air leaks in compressed air lines and equipment fittings. Repair the loudest leaks first. Repairing air leaks reduce the system's electrical usage by 15 to 40%.
- Assure the compressed air system does not run when plant is not in use (i.e., overnight or on the weekends). Use smaller air compressors dedicated to serve minimal after-hour needs. These actions can save up to 20% of a system's electricity usage.
- Do not use compressed air for cleaning purposes. Use blowers or hand sweeping, which can save up to 10% of compressed air system usage.
- Use the load-unload valve controls to moderate compressor output capacity. Adjusting controls can reduce compressed air system energy use by about 10%.
- Reduce the discharge pressure to the minimum required by the system.
- Install air storage strategically to minimize system horsepower requirements and improve delivery of air. This measure can reduce the system's electricity usage by 15 to 35%.
- Install variable speed drives on compressors. Savings are approximately 10%.
- Make sure multiple compressors are sequenced using automatic sequencing controls. Shutoff timers should be used on all air compressors. Installing microprocessor controls on compressor systems can yield savings in the 2% to 4% range.
- Ensure the compressor is on a regular maintenance schedule. Regular maintenance can yield savings as high as 30% in reduced energy use.

## Motors and Drives

- Eliminate bypass loops and other unnecessary flows. This produces a systems savings of 10 to 20%.
- Install premium or high efficiency motors. This measure saves up to 3% of energy use.
- Install timers, level sensors, material sensors or other controls for automatic operation and/or to shut off equipment as required.
- Install variable speed drives. Replace generator sets and eddy current drives with solid-state variable speed drives.
- Replace oversized motors with properly sized energy efficient motors. Motors consume the least amount of energy when they operate at their highest efficiency.
- Replace throttle controls with a solid-state variable system drive control and fan discharges with inlet vane controls. These measures can save as much 50% of system energy.
- Install parallel systems for highly variable loads. This can save as much as 30% savings in energy use.
- Conduct regular maintenance checks. Plugging leaks and maintaining system balances can yield up to 30% of systems energy savings. Process Cooling and Refrigeration Systems
- Cycle evaporator and condenser fans.
- Consolidate loads with similar suction requirements.
- Eliminate heat losses from leaks and improper defrosting. This action can reduce refrigeration system energy use by 10 to 20%.

## Process Cooling and Refrigeration Systems

- Freeze products in batches rather than continuously. This measure can reduce freezing process energy use by up to 20%.
- Consider load shifting during periods of high-energy use and/or using thermal storage during periods of low-energy use to reduce the total energy demand.
- Set the system to operate at lower head pressures. (Minimize the lift.)
- Perform scheduled maintenance on refrigeration units. Regular maintenance can yield savings as high as 30% in reduced energy use.
- Install high efficiency evaporator and condenser fan motors. Energy savings estimates range from about 3% to 9% per refrigeration system.
- Energy-efficient defrost systems improve the operation of the defrost cycle. Demand controls, which initiate defrosting in a variety of ways, can save 1 to 6% of refrigeration system energy use.
- Invest in mechanical subcooling — an effective method of cooling liquid refrigerant below saturation pressure in order to increase system capacity and improve efficiency. Energy savings can be achieved up to 25%.
- Installing variable speed drives in place of constant speed drives can reduce cooling system energy use by 30% to 50%, depending on load profile.
- Add evaporator capacity to reduce evaporator approach temperature and raise suction pressure.
- Install a thermosyphon cooling system to cool the compressor oil.
- Install additional condensing capacity to reduce discharge pressure. Reducing condenser pressure by 10 psi can decrease refrigeration system energy use per ton of refrigeration by about 6%.
- Insulate cooler/freezer area.

## Process Heating

- Clean heat transfer surfaces frequently of indirectly heated systems, such as steam coils, radiant tubes and electrical elements. This measure can save between 5 and 15% of energy use.
- Maintain minimum required free oxygen in combustion products from burners for fuel-fired process heating equipment and eliminate or minimize air leakage. These actions can result in 5 to 25% energy savings in heat generation.
- Preheat combustion air and preheat and/or dry the charge load. Cascade heat from exhaust gases to the lower temperature equipment for savings of 10 to 25% of current use and as much as 3% of a facility's total energy use.
- Develop procedures for regular operation, calibration and maintenance of sensors and controllers. Regular maintenance can result in energy savings of as much as 10%.
- Set appropriate operating temperatures for part load operations to avoid long "soak" or overheating. This action can save up to 10% of current energy use.
- Optimize heat transfer by selecting burners and design furnaces that allow use of high convection or radiation. Also replace indirectly heated systems such as radiant tubes. Energy savings potential is up to 25% of current use.
- Use adequate and optimum insulation for process heating equipment and conduct regular repair and maintenance of insulation. These measures can save between 2 and 15% of current energy use.

- Use improved materials, design and applications of load support such as fixtures, trays and baskets, to reduce nonproductive loads. These upgrades can save up to 25% of a system's energy usage.
- Use direct natural gas firing instead of indirect steam heating. This measure can save 33 to 45% of the energy used by a process heating system.
- Use direct electric heating (infrared, microwave or dielectric). This measure can reduce process heating energy use by up to 80%.

## Steam Equipment

- Insulate steam and condensate return lines and ensure proper boiler and pipe insulation. Insulation can typically reduce total facility energy consumption by 1% and help ensure proper steam pressure at plant equipment.
- Check and maintain steam traps. In systems with a regularly scheduled trap maintenance program, a facility can save 2% of its total energy use and 10 to 20% of the boiler's fuel use.
- Minimize your blowdown rate. This action substantially reduces energy loss and recoups water and chemical treatment costs. Check water chemistry and employ appropriate fuel-air mixtures.
- Implement boiler load management techniques. For example, operating on high fire settings or installing smaller boilers can save more than 7% of a typical facility's total energy use.
- Implement a boiler maintenance program. The program can include optimizing the air-to-fuel ratio, burner maintenance and tube cleaning, and can save about 2% of a facility's total energy use.
- Optimize excess air in the boiler to increase steam generation efficiency. Efficiency can be increased by 1% for each 15% reduction in excess air or 40°F reduction in stack gas temperature.
- Install a condensate return loop. Condensate return to the boiler is essential for energy efficiency. Direct contact condensation heat recovery can save 8 to 20% of a boiler's fuel use.
- Install an automatic blowdown control system. This action reduces your blowdown rate from 8 to 6%, which can save 2% of a facility's total energy use and tens of thousands of dollars in annual energy costs.

Reference:

[http://www.fyppower.org/ind/tools/energy\\_tips\\_results.html](http://www.fyppower.org/ind/tools/energy_tips_results.html)

## Heating, Ventilation & Air Conditioning (HVAC)

- Alter settings of heating and cooling systems seasonally to save 1 to 2% of cooling or heating costs for each degree the thermostat is raised or lowered. Ask staff and other occupants to find the temperature that is most comfortable and best meets other climate control requirements. You may find that some areas are warmer or cooler than they need to be.
- During the summer, set the thermostat to 78°F or higher when the workplace is occupied, and 85° F or off after business hours.
- During the winter, set the thermostat to 68°F when the work place is occupied and 63°F after business hours.
- Adjust workplace schedules to reduce energy use during the hours when there is most demand for electricity. If employees start work earlier or have lunch during the hottest hour of the day, a company can save on air conditioning, lighting and other electricity use during the hours of peak electricity demand.
- Prevent solar entry and air-conditioning loss during the summer. Use shades and blinds to keep the sun out. Close doors to the outside to keep in cooler air.
- Perform regular maintenance to keep heating, ventilation and air conditioning (HVAC) systems running more efficiently. Maintenance activities can save up to 30% of fan energy and up to 10% of space conditioning energy use.
- Install an energy-efficient attic fan or evaporative cooler. Attic fans or evaporative coolers help reduce or replace air conditioner use.
- Reduce air conditioning and heating hours by installing a time clock to turn off the system when the building is unoccupied.
- Perform regular maintenance on cooling equipment. Regularly clean condenser coils, change belts and filters and fix duct leaks. Also check for proper economizer operation and adequate refrigerant levels. Maintenance activities can save up to 30% of fan energy and up to 10% of space conditioning energy use.
- Add controls to the exhaust fan. These fans remove air you have already paid to cool. Ask your air conditioning contractor to install timers and switches to shut them off when they are not needed, such as when the building is unoccupied.
- Perform regular maintenance on heating equipment. Inspect and patch leaky heating ducts. Fix steam leaks. Clean blower coils and heat exchanger surfaces. Adjust belt drives, dampers, valves and linkages.
- Install an ENERGY STAR programmable thermostat to automate your HVAC system. An "old-fashioned" thermostat turns the HVAC on and off based on temperature, not whether the building is occupied, or whether you benefit from the cooling/heating.
- A programmable thermostat can optimize HVAC operation "24/7" based on your needs. For example, instead of heating or cooling all night, so you can enter a comfortable building in the morning, this "smart thermostat" can turn on the HVAC one hour before you arrive, based on your daily/hourly needs. The cost can be \$25 to \$150, and it could cut your HVAC costs about 30%. Add a locking cover to prevent tampering with thermostat settings.
- Upgrade air conditioning equipment by installing a variable-air-volume (VAV) system. A VAV system supplies only as much air as is needed to condition or ventilate a space. This is more efficient than supplying a constant volume of air at all times.
- Install an ENERGY STAR ceiling fan. By using ceiling fans, a facility can set the thermostat higher, because the air movement cools the room by up to 4°F.
- Install awnings, solar shade screens or sun-control window film. Install these on south-facing and west-facing windows to prevent heat loss during cooler months and heat entry during the hot summer months. This can save 5% to 10% on energy costs.

- Install high efficiency windows. Consider replacing single-pane windows with double-pane windows that are gas-filled with high performance glass (e.g., low emissivity or "low-e" glass). Choose ENERGY STAR windows, which can reduce your heating and cooling costs by up to 15%.
- Apply a heat-blocking, reflective coating to the roof. Reflective roofing, or a "cool roof," reflects more than 65% of the sun's energy and can emit more than 80% of the stored heat. Cool roofs stay 50°F to 60°F cooler during peak summer conditions and can reduce cooling costs up to 40%.
- Install reflective foil, acoustic or thermal insulation with a high R-value – the measure of resistance to heat flow. These insulations can save 60 to 90% of heat loss or gain, resulting in 18% overall energy savings.
- Install weather stripping to all doors and seal windows. "Weatherization" can save up to 50% of heating or cooling costs.
- Plant trees and shrubs in strategic areas. Plants insulate buildings from intense heat and protect space-cooling equipment from the effects of rapid exterior temperature changes. Plants provide cooling daytime temperatures and warming or moderating evening temperatures.
- Combine architectural features and shading so that a minimum of the building envelope is exposed to the sun.
- Practice efficient landscaping. This involves the use of light colored pavements and surrounding buildings and parking lots with trees to reduce the heat buildup in parked vehicles. These changes reduce temperature of air blowing against buildings by 6° to 9°F.
- Trees properly placed around buildings can reduce air conditioning needs by 30% and can save 20 to 50% in energy used for heating.
- Install a high efficiency packaged heating, ventilation and air conditioning (HVAC) system. These can use up to 40% less energy than systems that just meet minimum standards. Look for a high SEER (Seasonal Energy Efficiency Ratio) or, on larger units, EER (Energy Efficiency Ratio). You can purchase units with SEER above 12 or EER above 11. Specify high-efficiency air conditioning equipment when your system needs to be replaced, and save 25% to 35% on your investment annually.
- Consider installing an evaporative cooler, and save 25 to 35% on your investment annually. Evaporative coolers, which make use of the cooling effect of evaporating water, cost less to run than air conditioners and are most effective in low-humidity areas.
- Install an energy management system (EMS), and save 30 to 40% on your investment annually. An EMS is especially useful when your air conditioning system is too complex to control with time clocks or programmable thermostats. An EMS lets you choose different cooling temperatures for different zones, optimum equipment start and stop times and control strategies that keep building occupants comfortable while minimizing energy use.
- Consider installing adjustable speed drives (ASDs), and save 30 to 40% on your investment annually. Your air conditioning system has fans that move air throughout your building. You can reduce the cost of operating these fans by installing ASDs, which can change the speed of the fan motors to match the amount of air that is needed.
- When fan and pump motors need repair, consider replacing them with premium efficiency models, and save 35 to 45% on your investment annually.

## Lighting

- Make sure you are getting the best possible light by cleaning fixtures and replacing any yellowed or hazy lenses and diffusers twice a year.
- Disconnect or remove lamps in multiple lamp fixtures. Use task lighting where needed. Use up to 50% less in lighting energy.
- Open blinds and shades. Turn off lights in unoccupied areas or in spaces with sufficient natural lighting.
- Turn off the lights when not needed. It is a myth that leaving them on uses less energy than turning them off. Turn off signage and other lights not necessary for security and safety.
- Adjust janitorial cleaning schedules to reduce total lighting and equipment energy use. Moving cleaning schedules to business hours can reduce overall energy costs.
- Use teamwork to reduce lighting loads. Cleaning staff can work in teams (instead of different areas simultaneously) to reduce lighting usage. This can save up to 20% in lighting energy.
- Buy fixtures that have a dimmer, which allow you to manually adjust the intensity of light in a room. Because most lights use less electricity at lower settings, you do not need to pay for more light than you need. Dimmers can be used with incandescent lights, including low-voltage systems, but only with new-screw-based dimmable fluorescent bulbs. Other fluorescent lights must have their own dimmable ballasts.
- Replace large, traditional decorative holiday lights with new miniature lights, which use about 70% less energy and last much longer than the larger bulbs. If you prefer the brilliance of the larger lights, switch to 5-Watt bulbs, which use about 30% less energy than 7- to 10-Watt bulbs.
- Install motion sensors outdoors. Use timers and sensors on outdoor lights to avoid leaving the lights on during nighttime hours.
- Replace incandescent light bulbs with compact fluorescent lamps (CFLs), wherever appropriate. CFLs use at least 66% less energy and last an average of 10 times longer.
- Convert T12s and magnetic ballasts to T8 lamps and electronic ballasts. T8 lamps produce more light per watt of energy input than T12s and can reduce energy use by 40%.
- Install occupancy sensors in the proper locations to automatically turn off lighting when no one is present, and back on when they return. Use sensors in rooms with high traffic (break rooms, restrooms, conference rooms) for reduced lighting costs of up to 40%. But don't install the sensor behind a coat rack, door or book case. It must be able to "see" the motion of occupant approaching an unlit area to turn on the light before, or as they enter.
- Retrofit hallway and security lighting. Convert hallway and non-public security lighting to energy saving 25-Watt T12 bulbs.
- Rewire restroom fans to operate when lights are turned on and turn off when the restroom is unoccupied.
- Install exit signs with Light Emitting Diodes (LED). A new LED exit sign fixture will save about 90% over an incandescent bulb's operating costs.
- Replace incandescent lights. T8 fluorescent lamps and matched electronic ballasts or compact fluorescent light bulbs (CFLs) can reduce electricity consumption by 50 to 75%.
- Replace red-signal traffic lights. Red-signal lights consume the most energy, followed by green-signal lights.
- Replace standard fluorescents. T8s and matched electronic ballasts provide an estimated savings of 35 to 45% of electricity operating costs.

- If your ceiling fan doesn't include lighting, purchase an ENERGY STAR qualified light kit. These kits come with either pin-based compact fluorescent lamps (CFLs) or screw-based CFLs.
- Certain compact fluorescent lamps (CFL) are designed to work in dimmable, three-way fixtures, as well as torchieres. Check the package to be sure you are buying the correct bulb.
- Install energy management system (EMS) technology to control lighting systems automatically. Energy savings can range from 10 to 15% of total lighting energy use.

## Office/Electronics Equipment

- To turn off computer scanners, printers and other devices that are plugged into a power strip, simply switch off the power strip after shutting down your computer.
- Install free software from the Environmental Protection Agency that put monitors in sleep mode when not in use. This can save \$0.085/kWh of power used by networks.
- Do not leave equipment in sleep mode overnight because it will continue to draw a small amount of power. Turn off all equipment every night — especially monitors and printers. Monitors usually consume twice the electricity as CPUs.
- Give nonessential energy users the day off. Unplug nonessential energy users, such as coffee makers, toasters and decorative features.
- Use "smart" power strips. Smart power strips sense the presence or absence of office workers and turn the attached equipment on or off accordingly.
- Use laptop computers. Laptops use up to 90% less energy than a desktop computer.
- Print with ink jet printers instead of laser printers. Ink jet printers cost less to maintain and use 90% less energy than laser printers.
- Choose electronic products and appliances without a built-in clock or timer. The displays only consume about a half Watt, but the power supply in the appliance is converting 120 volts of alternating current to low-voltage direct current for the clock or timer. This is very inefficient and consumes 20 to 100 Watts/hour per day. This is enough to run a compact fluorescent lamp (CFL) continuously for 10 hours.

## Refrigeration

- Turn off and recycle your second refrigerator. Many of these secondary units (usually older and less energy efficient) use as much as 40% more energy than a new model.
- Do not leave the walk-in refrigerator door open when loading it. Install a plastic strip curtain over the entrance and save up to \$20 per refrigerator each year.
- Check temperature settings of refrigerators. The most common recommended settings are between -14 degrees and -8 degrees Fahrenheit for freezers and between 35 degrees and 38 degrees Fahrenheit for refrigerators.
- Keep the refrigerator full. A full refrigerator retains cold better than an empty one. If the refrigerator is nearly empty, store water-filled containers inside. The mass of cold items will enable the refrigerator to recover more quickly after the door has been opened. On the other hand, don't overfill it, since that will interfere with the circulation of cold air inside.
- Regularly defrost manual-defrost models. Frost buildup increases the amount of energy needed to keep the motor running.
- Check door seals (also called the gasket) on the refrigerator. A broken seal is the same as leaving the door open. Replace the seal if it is torn or partially missing. To test it, close the door on a single sheet of paper and try to pull it out. If it slides out easily, the gasket needs to be replaced to prevent cold air from leaking out, or consider buying a new unit.

- Install pulldown blinds on open dairy and produce cases. During nonoperating hours, these blinds keep refrigerated air from escaping.
- Buy an ENERGY STAR commercial solid door refrigerator and freezer. Compared to standard models, ENERGY STAR refrigerators and freezers can lead to energy savings of as much as 46% with a 1.3 year payback. Purchasers can expect to save \$140 annually per refrigerator and \$100 per freezer.
- Specify refrigerators with high efficiency evaporator fans. Energy savings range from 2 to 29% for reach-in freezers and refrigerators, display cases, ice machines, vending machines and beverage merchandisers.
- Install high efficiency condenser fan motors. System energy savings estimates are 3 to 5%.
- Use high efficiency compressor systems. Energy savings are estimated at 6% for ice machines, 9% for vending machines and beverage merchandisers and 12 to 16% for reach-in refrigerators and freezers.
- Install floating head pressure controls to allow compressor head pressures to vary with outdoor conditions. This retrofit saves energy and helps refrigeration equipment last longer. Savings range from 3 to 10%.
- Install liquid pressure amplifiers. LPAs (refrigerant pumps) raise liquid line pressure and increase system efficiency. Energy savings can be up to 20%.
- Use anti-sweat heater controls — but turn them off when not needed. These devices sense humidity conditions in a store. Energy savings range from 6% for grocery store display cases to 14% to 20% for reach-in freezers and refrigerators.
- Use energy-efficient defrost systems improve the operation of the defrost cycle. Demand controls measure frost accumulation and sense humidity and are more effective than using a simple timer clock to initiate defrosting. Energy savings estimates range from 1 to 6% of refrigeration system energy use.
- Install evaporative condensers, instead of air-cooled condensers, to expel heat. Evaporative condensers use a wetted filter that increases the ability to reject heat. Energy savings range from 3 to 9% for grocery store refrigeration systems.
- Install heat recovery systems to use heat removed from display cases to heat water. A 7.5 horsepower (hp) compressor can supply close to 100% of the hot water requirements in a medium-sized grocery store all year long.
- Install energy-efficient case lighting. T8 fluorescent lamps and electronic ballasts reduce lighting energy use and reduce the cooling load on the compressor. Energy savings potential is 10% for beverage merchandisers.
- Add doors to display cases. Glass doors on open multi-deck display cases can reduce compressor energy costs and cold air spillage. Savings are estimated to be as high as 50%.
- Perform scheduled maintenance on refrigeration units. Keep evaporator coils clean and free of ice buildup.
- Install lighting sensors in walk-in refrigerators. Install low temperature occupancy sensors or timed switches in walk-in coolers and freezers to control lighting. Not only does this save lighting energy, it reduces the load on the compressor. Save up to \$250/year.
- Refrigerators with anti-sweat heaters (which prevent condensation) consume 5 to 10% more energy. Look for models with an "energy saver" switch that lets you turn down — or off — the heaters.
- Purchase a freezer with manual defrost. This model consumes 40% less electricity than automatic defrost freezers.

## Pumping & Irrigation

- Practice energy-efficient irrigation, which also helps to conserve water. Adopt irrigation scheduling methods and deficit irrigation practices to conserve water.
- Investigate ways to irrigate crops in less time. Many existing pump and irrigation systems have the potential to deliver the water your crops need in 18 hours, instead of 24 hours.
- Reduce sprinkler discharge pressure. Lower discharge pressures, friction losses and pumping pressures using flow control and pressure regulators save as much as 25% of the electricity used.
- Test well pumps and improve the combined efficiency of the pump and motor or engine (overall pumping plant efficiency).
- Maintain filters and install appropriately sized pipes. Economical pipe sizing and maintenance of filters greatly improve the energy efficiency of pumping systems.
- Install simple pump timers. Timers allow farmers with automated tile drainage pumps to pump only during off-peak hours farmers.
- Install variable speed drives (VSD). Reduce the total dynamic head of pumps (power consumption) by installing variable speed drive controllers. Dairy farmers can install drive controllers in milking pumps.
- Install internal combustion engines. Internal combustion engines reduce irrigation pumping costs. Also use clean pumping technologies to mitigate potential pollution issues surrounding combustion.
- Use subsurface drip irrigation. Subsurface drip irrigation technologies save upwards of 25% in water pumping, fertilizer and herbicide costs.
- Use variable speed drives (VSD) for lift pumps. VSDs save energy in that the water lifted matches the water available with very little air entrained.