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Energy Savings Tips for Small Businesses: Small and Medium Manufacturers

In the U.S., industries spend over $100 billion annually to power their manufacturing plants. As a manufacturer, you understand that energy management is a top priority in the success and sustainability of your business. Therefore it's important to seek out new ways to reduce energy in your daily usage, whether it's by optimizing current energy use or embedding energy awareness in your company's culture. Energy savings matter. This section will be a resource to help guide you through additional savings energy-saving strategies that include the following:

- How to profile your plant's energy use
- Manufacturing-specific tips to save energy and money
- Additional links and resources for your plant and business.

Profiling Your Energy Use

Energy is used throughout industrial facilities. Fuels heat materials in furnaces or generate hot water and steam in boilers. Steam dries, heats, or separates product flows. Electricity powers motor systems for air conditioning, lighting, and appliances. Motor systems pump fluids and compress gases or air and move them around. Compressed air drives machinery. ENERGY STAR research has demonstrated that all these systems offer considerable potential for energy-efficiency improvement and energy cost reductions, for nearly all facilities. If you reduce your energy cost per product, then you can use savings to grow market share.

Despite the diversity in energy end uses, in most plants just a few pieces of equipment consume the majority of fuel or electricity. Each plant's energy use distribution is unique, but contains overall patterns. Motor systems use the greatest amount of electricity in most industrial facilities, followed by process heating and cooling, building HVAC, and lighting. Process heating, boiler fuel, and combined

heat and power (CHP), and/or cogeneration processes typically dominate fuel use. Energy savings are dollars that you would have to pay your utility. Why not save them for your business priorities?

The ENERGY STAR publication, *Managing Your Energy: An ENERGY STAR Guide for Identifying Energy Savings in Manufacturing Plants* is an excellent resource for energy savings. This guide contains easy-to-use information that identifies multiple opportunities for plants to increase efficiency and cut costs.

If you'd like a resource for instructing employees, tour the *ENERGY STAR animated manufacturing plant*. This interactive tool shows where you can save energy in industrial buildings and manufacturing plants—to raise awareness among staff and workers on the benefits and best-practices of energy use in a manufacturing facility while highlighting the environmental benefits of responsible production.

Tips for Energy Saving at Your Manufacturing Plant

This section serves as a sample of cost-effective, manufacturing-specific tips and strategies that can help you reduce energy consumption (based on the ENERGY STAR). Strategies in this section address hot water and steam, compressed air, motors, and basic manufacturing practices. The information in this appendix is intended to help energy and plant managers achieve energy reductions while maintaining product quality.

Motor Systems

Manage Motor Systems. Motors are found in your process equipment, HVAC systems, air compressors, and other systems. The following steps are suggested for managing your motor systems:

- Make sure you first locate and identify all motors in the facility
- Document conditions and specifications of each motor to provide a current systems inventory
- Assess the needs and the actual use of the motor systems to determine if motors are properly sized for the equipment being served and how the motor is being operated.
- Collect information on potential repairs and upgrades to the motor systems, including the economic costs and benefits of implementing repairs and upgrades, to enable the energy-efficiency improvement decision-making process
- If upgrades are pursued, monitor the performance of the upgraded motor systems to determine actual costs savings.
- For equipment that runs at different speeds, consider installing Adjustable-Speed Drives (ASD) or Variable-Speed Drives (VSD) to better match speed to load requirements for motor operations, and therefore ensure that motor energy use is optimized to a given application. Energy savings may vary from 7% to as high as 60%.

Create a Motor Management Plan. A motor management plan is another essential part of a plant's energy management strategy. It helps to support long-term motor system energy savings and to ensure that motor failures are handled quickly and cost effectively. The National Electrical Manufacturers

Association (NEMA) and other organizations have created the Motor Decisions Matter (MDM) campaign to help industrial and commercial customers evaluate their motor repair and replacement options, promote cost-effective applications of NEMA Premium motors as well as "best practice" repair, and support the development of motor management plans before motors fail. The national campaign suggests the following actions for a sound motor management plan (MDM 2007):

- Prepare for motor failure by creating a spares inventory
- Develop a purchasing specification
- Develop a repair specification
- Develop and implement a predictive and preventive maintenance program
- Develop guidelines for proactive replace/repair decisions.

For more information, download the *Motor Decisions Matter Motor Planning Kit* as a guide to assist in your motor management plan. This planning kit aims to increase productivity and reliability while minimizing motor downtime, reducing operating costs, and conserving energy.

Compressed Air

Compressed air is one of the least energy efficient systems in an industrial plant because of the amount of energy required for compression and distribution. If compressed air is used, it should be at the minimum quantity for the shortest possible time, and it should be constantly monitored and reweighed against alternatives. Inadequate maintenance can lower compression efficiency and increase air leakage or pressure variability, and can lead to increased operating temperatures, poor moisture control, and excessive contamination of compressed air system components. Consider the following maintenance suggestions to reduce these problems and save energy:

- **Blocked pipeline filters increase pressure drop.** Keep the compressor and intercooling surfaces clean and foul-free by inspecting and periodically cleaning filters. Use filters with just a 1 pound per square inch (psi) pressure drop. The payback period for filter cleaning is usually under two years. Fixing improperly operating filters will also prevent contaminants from entering into tools, which causes them to wear out prematurely.
- **Monitor motor cooling.** Poor motor cooling can increase motor temperature and wind resistance, shortening motor life and increasing energy consumption. Keep motors and compressors properly lubricated and cleaned. Sample and analyze compressor lubricant every 1,000 hours and ensure that it is at the proper level. In addition to energy savings, this maintenance can help avoid system corrosion and degradation.
- **Monitor compressed air use.** As with maintenance, proper monitoring of compressed air systems can save energy and money. Proper monitoring includes the following:
  - ✓ Pressure gauges on each receiver or main branch line, and differential gauges across dryers and filters

- ✓ Temperature gauges across the compressor and its cooling system to detect fouling and blockages
- ✓ Flow meters to measure the quantity of air used
- ✓ Dew point temperature gauges to monitor air dryer effectiveness
- ✓ Kilowatt-hour meters and hours-run meters on the compressor drive.

- **Reduce leaks in pipes and equipment.** Air leaks can be a significant source of wasted energy. A typical plant that has not been well maintained could have a leak rate from 20% to 50% of total compressed air production capacity. Leak repair and maintenance can reduce this number to less than 10%. Overall, fixing leaks in a compressed air system is projected to reduce annual energy consumption by 20%.

  A simple way to detect large leaks is to apply soapy water to suspect areas, or to use a bag to monitor the velocity of the air filling the bag, although this may be time consuming. In the "bag test," a plastic bag is put up to the leak and used to monitor the velocity of the air filling the bag. The best way to detect leaks is to use an ultrasonic acoustic detector, which can recognize the high-frequency hissing sounds associated with air leaks. After identifying them, leaks should be tracked, repaired, and verified.
- **Turn off unnecessary compressed air.** Equipment that is no longer using compressed air should have the air turned off completely. This can be done using a simple solenoid valve. Check compressed air distribution systems when equipment has been reconfigured to ensure no air is flowing to unused equipment or obsolete parts of the compressed air distribution system.
- **Reduce pressure.** Try to use the lowest possible pressure level to operate the system.

Steam Systems

The most important industrial applications for steam are process heating, drying, concentrating, steam cracking, distillation, and driving machinery such as compressors. Whatever the use or the source of the steam, efficiency improvements in steam generation, distribution, and end use are possible.

Boiler Energy Efficiency Measures

The boiler energy-efficiency measures presented below focus primarily on improved process control, reduced heat loss, and improved heat recovery. When new boiler systems are needed, they should be designed and installed in a custom configuration that meets that particular plant's needs. Often, pre-designed boilers cannot be fine-tuned to meet the unique steam generation and distribution system requirements of a specific plant in the most efficient manner:

- **Get a boiler tune-up.** When too much excess air is used to burn fuel, energy is wasted because excessive heat is transferred to the air rather than to the steam. Air slightly in excess of the ideal fuel-to-air ratio will cause the boiler to run inefficiently. A boiler tune-up will help ensure your boiler has the right fuel-to-air ratio.

- **Control boiler processes.** Flue gas monitors maintain optimum flame temperature and monitor carbon monoxide (CO), oxygen, and smoke. A small 1% air infiltration will result in 20% higher oxygen readings. A higher CO or smoke content in the exhaust gas is a sign that there is insufficient air to complete fuel burning. Using a combination of CO and oxygen readings, it is possible to optimize the fuel/air mixture for high flame temperature (and thus the best energy efficiency) and lower air pollutant emissions.
- **Reduce flue gas quantities using visual inspection.** Often excessive flue gas results from leaks in the boiler and/or in the flue. These leaks can reduce the heat transferred to the steam and increase pumping requirements. However, such leaks are often easily repaired, saving 2% to 5% of the energy formerly used by the boiler.
- **Properly size boiler systems.** Designing the boiler system to operate at the proper steam pressure can save energy by reducing stack temperature, piping radiation losses, and leaks in steam traps. Costs and savings will depend heavily on the current boiler system utilization at individual plants.
- **Improve boiler insulation.** It is possible to use new insulation materials, such as ceramic fibers, that both insulate better and have a lower heat capacity (thus allowing for more rapid heating). Savings of 6% to 26% can be achieved if improved insulation is combined with improved heater circuit controls. Due to the lower heat capacity of new insulating materials, the steam output temperature will vary more quickly with variations in the heating element temperature.
- **Implement a boiler maintenance program.** A simple maintenance program to ensure that all boiler components are operating at peak performance can result in substantial savings. In the absence of a good maintenance system, burners and condensate return systems can become worn out.
- **Return condensate to the boiler.** Reusing hot condensate in boilers saves energy, reduces the need for treated boiler feed water, and reclaims water at up to 212F of sensible heat.

Steam Distribution System Energy Efficiency Measures

Steam and hot water distribution systems are often quite extensive and can be major sources of energy loss. Energy efficiency improvements to steam distribution systems primarily focus on reducing heat losses throughout the system and recovering useful heat from the system wherever feasible. The following measures are some of the most significant opportunities for saving energy in industrial steam distribution systems:

- **Improve distribution system insulation.** Using more insulating material or using the best insulation material for the application can save energy in steam systems. Crucial factors in choosing insulating material include low thermal conductivity, dimensional stability under temperature change, resistance to water absorption, and resistance to combustion.
- **Maintain distribution system insulation.** It is often found that after heat distribution systems have undergone some form of repair, the insulation is not replaced. Additionally, some types of insulation

can become brittle or rot over time. A regular inspection and maintenance system for insulation can save energy.

- **Improve steam traps.** Modern thermostatic element steam traps can reduce energy use while improving reliability. Their main efficiency advantages are that they open when the temperature is very close to that of saturated steam, purge non-condensable gases after each opening, and are open on startup to allow a fast steam system warm-up. These traps also have the advantage of being highly reliable and useable for a range of steam pressures.
- **Maintain and monitor steam traps.** A simple program of checking steam traps to ensure that they are operating properly can save significant amounts of energy for very little money. In the absence of such a program, it is common to find 15% to 20% of steam traps in a distribution system malfunctioning. Attaching automated monitors to steam traps in conjunction with a maintenance program can save even more energy without significantly adding costs.
- **Repair leaks.** As with steam traps, steam distribution piping networks often have leaks that can go undetected without a regular inspection and maintenance program. The U.S. DOE estimates that repairing leaks in an industrial steam distribution system will lead to energy savings of 5% to 10%.

Manufacturing Processes

Improving operating practices for energy efficiency is an excellent and simple source of no-cost savings opportunities. Try to practice the following as much as possible:

- Turn off idling equipment, machines, and systems
- Reduce startup and shutdown times for equipment, machines, and systems if possible
- Make sure systems are optimized and maintained for maximum productivity.

RESOURCES AND LINKS

- ENERGY STAR Small & Medium Manufacturer's Guide to Energy Management: www.energystar.gov/SmallManufacturers
- ENERGY STAR Industrial Energy Management Information Center: https://www.energystar.gov/buildings/facility-owners-and-managers/industrial-plants/industrial-energy-management-information-center
- ENERGY STAR Challenge for Industry: www.energystar.gov/industrychallenge
- ENERGY STAR Energy Treasure Hunt Guide: Simple Steps to Finding Energy Savings: http://www.energystar.gov/treasurehunt
- ENERGY STAR Industrial Plant Employee Awareness Posters: www.energystar.gov/plantposters
- ENERGY STAR Bring your Green to Work: Interactive Manufacturing Plant: www.energystar.gov/work
- ENERGY STAR Directory of Industrial Service and Product Providers: www.energystar.gov/ispp
- DOE Industrial Facility Tool Suite: http://www1.eere.energy.gov/manufacturing/tech_assistance/software_facilities.html
- DOE Industrial Assessment Centers: http://energy.gov/eere/amo/industrial-assessment-centers-iacs
- SBA Energy Efficiency for Small and Medium-Sized Manufacturers: http://www.sba.gov/content/energy-efficiency-small-and-medium-sized-manufacturers
- Motor Decisions Matter Motor Planning Kit: http://www.motorsmatter.org/tools/mpkv21.pdf