

Energy Efficiency Fact Sheet: Overview of Energy Efficiency Techniques and Resources for Massachusetts Industries

Introduction

As energy costs rise, more companies are searching for ways to reduce their energy consumption in order to decrease their dependence on fossil fuels and stay competitive. This fact sheet will assist facility energy managers in developing energy management strategies for their companies and identifying techniques and funding sources for increasing the energy efficiency of their manufacturing operations. It also includes a wide variety of resources and tools to assist in these efforts.



Getting Started – Developing an Energy Management Strategy



The importance of energy performance and its impact on the bottom line is becoming more apparent to companies in Massachusetts. This awareness has resulted in companies initiating formal energy management programs. Both the U.S. Department of Energy (DOE) and U.S. Environmental Protection Agency (EPA) have developed resources to assist companies in this effort. One of DOE's resources is an approach known as [Corporate Energy Management](#) (CEM), which refers to sets of actions that move accountability for energy outcomes to upper levels of the firm. CEM programs are designed to involve many areas of business activity, such as accounting, marketing, and others that were not traditionally concerned with energy. DOE has also developed a 6-step [Action Plan](#) that facilities can use in implementing their energy management program. The joint EPA/DOE ENERGY STAR® program offers a proven [energy management strategy](#) that helps in measuring current energy performance, setting goals, tracking savings, and rewarding improvements. This program includes tools to help you assess your [energy management program](#) and [facility energy program](#). There are additional [tools and training](#) for assessing plant energy efficiency and performing financial evaluations.

Identifying and Evaluating Energy Efficiency Opportunities

A good tool for conducting an *initial* screen of potential energy saving opportunities is DOE's [Quick Plant Energy Profiler](#) (QuickPEP), which is run online at DOE's website. Another potentially useful DOE screening tool is the [Energy Use and Loss Footprints](#) they have developed for a number of manufacturing industries that map the flow of energy supply, demand, and losses in manufacturing facilities. Immediate opportunities to improve energy efficiency and lower energy consumption can be found by assessing energy losses. DOE also offers a number of [software tools](#) for evaluating energy saving opportunities, and the [Massachusetts Energy Efficiency Partnership](#) (MAEEP) conducts trainings on these tools.

Conducting a comprehensive energy audit is a proven next step for determining the best energy measures for a facility. Utility programs (see page 4) often subsidize gas and electric audits. Contact your gas and electric utility account representatives for detailed information on your provider's programs (municipal utilities may vary). DOE offers assistance in conducting *more thorough* audits to complement the utility audit through its [Save Energy Now program](#) and through the [Industrial Assessment Center](#) (IAC) located at UMass Amherst.

OTA Energy Conservation Services

Energy is increasingly an important cost factor for Massachusetts businesses. To help industries lower these costs, OTA provides on-site assistance and sponsors workshops on energy efficiency, energy conservation, and renewable energy. For more information on OTA's energy services please call 617-626-1060 or visit OTA's website: <http://www.mass.gov/eea/ota>

The [Massachusetts Department of Energy Resources](#) (DOER) has information on other energy resources, including energy procurement, fuel prices, conservation, and renewables. The [Northeast CHP Application Center](#) at UMass provides assessments and detailed information on combined heat and power. There are also a variety of publications to assist you in assessing energy efficiency opportunities.

Examples of Industrial Energy Efficiency Measures

A number of examples of energy efficiency measures for a variety of plant energy systems are provided below. Information on these and other industrial energy efficiency techniques, including case studies, technical publications, and tip sheets, can be found at the DOE [BestPractices](#) website.

Steam Systems (Generation, Distribution, Condensate Return)

- Optimize boiler efficiency
- Benchmark the fuel cost of steam generation
- Upgrade boiler equipment/controls
- Maintain/replace steam traps
- Preheat combustion air with economizer
- Consider steam turbine drives for rotating equipment
- Insulate steam and condensate lines
- Use low grade waste steam to power absorption chillers
- Install removable insulation on valves and fittings
- Replace pressure-reducing valves with backpressure turbogenerators (i.e., install CHP)



Compressed Air Systems

- Determine the cost of compressed air for your plant
- Analyze your compressed air system (air quality, quantity, pressure, etc.)
- Eliminate inappropriate uses of compressed air
- Minimize compressed air leaks
- Remove condensate with minimal air loss
- Consider alternative strategies for low-pressure end uses (e.g., use of fans or blowers)

Motors

- Install variable frequency drives (VFDs)
- Eliminate voltage unbalance
- Replace V-Belts with cogged or synchronous belt drives
- Avoid nuisance tripping with premium efficiency motors
- Evaluate motor efficiency to estimate energy savings
- Extend your motor's operating life with a predictive and preventive maintenance program
- Consider NEMA premium efficiency motors when buying new motors and when specifying motor-driven equipment

Lighting

- Convert to high-intensity discharge (HID) lamps when high levels of light are required over large areas – e.g., in production areas, warehouses, and outdoor applications such as roadways, parking lots, and pathways
- Low-pressure sodium lamps are an efficient alternative for outdoor applications where color rendition is not important
- Use daylighting (natural light) when possible
- Replace incandescent bulbs with compact fluorescents
- Replace T-12 fluorescent lights with T-8 or T-5 lights
- Use dimmer switches and occupancy sensors
- Use energy efficient LED exit signs

Note: An electronic version of this fact sheet is available on OTA's website:

http://www.mass.gov/Eoeea/docs/eea/ota/resource_conservation/energy_efficiency_final.pdf

Examples of Industrial Energy Efficiency Measures (cont.)

Pump Systems

- Conduct an in-plant pumping system survey
- Maintain pumping systems effectively
- Match pumps to system requirements
- Optimize parallel pumping systems
- Consider fluid properties, determine end use requirements, and understand environmental conditions when designing pump systems
- Reduce pumping costs through optimum pipe sizing
- Select an energy-efficient centrifugal pump
- Conduct efficiency tests on priority pumps in the plant
- Trim or replace impellers on oversized pumps

Fan Systems

- Perform periodic maintenance on fan systems - check belts, bearings and motor condition; keep system clean; check for ductwork leaks
- Ensure proper fan sizing
- Design the system so that the inlet and outlet ducts are as straight as possible
- Consider VFDs to improve fan operating efficiency over a wide range of operating conditions
- Maintain proper belt tension and alignment
- Combining fans in series or in parallel can increase efficiency and reduce costs



General

- Install state-of-the-art energy management software
- Turn off equipment when not in use
- Computers – install power management software (available from Energy Star® and other vendors); use Energy Star®-rated equipment; turn computers off at night and when not being used

HVAC Systems (Laboratory and Physical Plant Applications)

- Utilize heat recovery (e.g., heat recovery wheels) to preheat incoming air
- Install programmable thermostats
- Optimize space temperatures by time of day and season
- Group equipment that has high heat production together – e.g., computer centers or lab areas should have separate, dedicated HVAC equipment.
- Consider replacing an old electric chiller with absorption cooling
- Utilize passive techniques such as overhangs, reflective windows, and a white roof to reduce cooling needs
- Consider chiller replacement when modifications are being done to the facility that will reduce cooling loads or when existing equipment is more than ten years old and a life-cycle cost analysis confirms that replacement is worthwhile
- Consider the use of alternative heating and/or cooling systems, such as ground-source heat pumps and solar thermal systems
- Improve air distribution efficiency through the use of: Variable-air-volume (VAV) systems; VAV diffusers; low-pressure-drop ducting design; low face-velocity air handlers; proper fan sizing; and displacement ventilation systems (reduce the need for ducting)

Process Heating

- Optimize burner air-to-fuel ratio
- Check heat transfer surfaces
- Install waste heat recovery system
- Preheat combustion air
- Reduce air infiltration in furnaces
- Use waste heat for external processes

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Utility Energy Efficiency Incentive Programs

Many electric and gas utilities provide funding to assist their customers in implementing energy efficiency projects, including conducting energy audits. Contact your account representative for detailed information on your provider's programs. If your energy supplier is a municipal utility, there may only be limited incentive programs available. Links to many municipal utilities are provided at the Massachusetts Municipal Wholesale Electric Company (MMWEC) [website](#).

Electric

- [Cape Light Compact](#)
- [Fitchburg Gas & Electric \(Unitil\)](#)
- [National Grid](#)
- [NSTAR](#)
- [Western Massachusetts Electric \(WMECO\)](#)

Natural Gas

- [Bay State Gas Company](#)
- [The Berkshire Gas Company](#)
- [Blackstone Gas Company](#)
- [Fitchburg Gas & Electric](#)
- [National Grid \(gas\)](#)
- [New England Gas Company](#)
- [NSTAR Gas Company](#)

Energy Efficiency for Buildings

ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping businesses to save money and protect the environment through energy efficient products and practices. ENERGY STAR offers a proven energy management strategy that helps in measuring current energy performance setting goals, tracking savings and rewarding improvements. EPA has an energy performance tool where an operator can enter energy information from the building and the tool will calculate the efficiency of that building. More information on ENERGY STAR is available on the program website at: <http://www.energystar.gov>. OTA's fact sheet "[Energy Saving Tips for Industrial and Commercial Buildings](#)" also provides useful guidance.

Other Resources

- [Alliance to Save Energy](#)
- [American Council for an Energy Efficient Economy \(ACEEE\)](#)
- [Best Practices Benchmarking for Energy Efficiency Programs](#)
- [Consortium for Energy Efficiency](#)
- [Energy Foundation](#)
- [E-Source](#)
- [Gas Networks](#)
- [Northeast Energy Efficiency Council](#)
- [Northeast Energy Efficiency Partnerships](#)

Relevant Publications

1. Rutgers Self-Assessment Workbook for Small Manufacturers –<http://iac.rutgers.edu/technicaldocs.php>
2. Wulfinghoff, Donald R., **Energy Efficiency Manual**, Energy Institute Press, 1999.
3. Mull, Thomas E., **Practical Guide to Energy Management for Facilities Engineers and Plant Managers**, ASME Press, 2001.

The Office of Technical Assistance and Technology (OTA) has developed a series of fact sheets on Resource Conservation practices and issues. To see the other fact sheets please visit: <http://www.mass.gov/eea/ota>. OTA is a non-regulatory office within the [Executive Office of Energy and Environmental Affairs \(EEA\)](#) that provides a range of non-regulatory assistance services to help businesses cut costs, improve chemical use and energy efficiency, and reduce environmental impact in Massachusetts. For further information about energy efficiency and renewable energy, or about OTA's technical assistance services, contact:

Office of Technical Assistance and Technology, 100 Cambridge St., Suite 900, Boston, MA 02114
Phone: (617) 626-1060 Fax: (617) 626-1095 Website: <http://www.mass.gov/eea/ota>