

Industrial Systems Inventory and Best Practices

Self-Assessment Guide



Focus on Energy works with eligible Wisconsin residents and businesses to install cost effective energy efficiency and renewable energy projects. Focus information, resources and financial incentives help to implement projects that otherwise would not be completed, or to complete projects sooner than scheduled. Its efforts help Wisconsin residents and businesses manage rising energy costs, promote in-state economic development, protect our environment and control the state's growing demand for electricity and natural gas.

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Introduction

The purpose of this guide is to assist manufacturers to improve their operations and reduce their costs by evaluating how they use energy and increasing their energy efficiency on common systems. The assistance will be provided through the following process:

1. Complete and return the General Information form. This form gives us the information we need to determine your energy use per product sales or facility square foot. If you feel that any information requested is proprietary just leave it blank and go on to the next sections.
2. Complete and return the Utility Release form. This form gives us permission to contact your utility representative to get your energy use history.
3. Complete and return **each system section that applies to your facility**. If the information is not readily available or easily estimated you may leave that information blank.
4. We will use the information you provide to:
 - a. identify specific energy efficiency opportunities at your facility; and
 - b. determine how your facility's energy use and efficiency stacks up against that of other similar businesses.
5. After we receive your information, we will contact you via telephone within 2 weeks to discuss our findings with you and to develop a plan of attack for implementing the most promising opportunities and improving your energy efficiency.

REMEMBER

If you have questions, please call 608-277-2946

Fax your completed assessment to 608-277-2947

General Information

Company Name: _____

Address: _____
(street) (city) (zip)

Contact : _____
(name) (title)

_____ (phone) _____ (fax) _____ (e-mail)

Baseline Information

Number of Employees: _____ Primary SIC Code _____ Annual Sales(optional)\$ _____

Annual Electric Bill(\$): _____ Peak Demand(kW): _____ Annual Gas Bill(\$): _____

Has there been a previous energy survey conducted at your facility? No _____ Yes _____

If yes, what year was it conducted? _____ Have you implemented any of the recommendations? _____

Facility Space & Operating Hours

Area	Sq. Foot	Hours / Day	Days / Week	Weeks / Year
Manufacturing				
Office				
Warehouse				
Other ()				
Other ()				

Product Data: (optional - can help to understand energy cost per sales \$)

Product	Approximate % of Annual Sales

Utility Release Form

_____ authorizes the release of energy use and billing information for each building meter to the Wisconsin Focus on Energy Commercial Program Manager. This authorization is for energy usage and bill amounts covering a minimum two-year period to present. It is the responsibility of the utility(ies) named below to identify any confidential data provided to the Wisconsin Focus on Energy Commercial Program Manager which cannot be released under open records law and defend any challenge to the designation.

<i>BUILDING NAME/ADDRESS</i>	<i>UTILITY SUPPLIER/PHONE</i>	<i>ACCOUNT NUMBER</i>
	ELECTRIC SUPPLIER:	
	GAS SUPPLIER:	
	WATER SUPPLIER:	

<i>BUILDING NAME/ADDRESS</i>	<i>UTILITY SUPPLIER/PHONE</i>	<i>ACCOUNT NUMBER</i>
	ELECTRIC SUPPLIER:	
	GAS SUPPLIER:	
	WATER SUPPLIER:	

I CERTIFY THAT AS AN OFFICIAL OF THE ABOVE NAMED ENTITY, I HAVE THE AUTHORITY TO SIGN THIS FORM.

SIGNATURE OF AUTHORIZED OFFICIAL

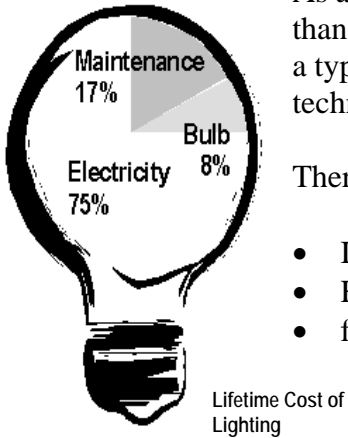
DATE

PRINTED NAME

TITLE

Lighting

As a nation, we spend about one-quarter of our electricity budget on lighting, or more than \$37 billion annually. On a smaller scale, electricity accounts for 75% of the costs of a typical light bulb over its lifetime. Yet much of this expense is unnecessary. Recent technologies can help cut lighting costs 30% to 60%.



There are several types of lighting:

- Incandescent lamp (standard lightbulb)
- Halogen lamp
- fluorescent (choose one below)
 - Compact fluorescent
 - T5 fluorescent
 - T8 fluorescent
 - T12 fluorescent
 - High performance T5, or T8
- high-intensity discharge (choose: mercury vapor, metal halide, or high-pressure sodium)
- low-pressure sodium.
- LED

In addition to specific lamps, there are a variety of control devices, including occupancy sensors and dimmers, which can reduce the cost of lighting.

Please fill out your readily available or easily estimated lighting data below, as the example shows:

Example:

Area: Office	Type: T8 fluorescent	Wattage: 32	5 fixtures	4 Bulbs	Sensors?: Yes <input type="radio"/> No <input checked="" type="radio"/>	Lighting Adequate: Yes <input checked="" type="radio"/> No <input type="radio"/>
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*Area	Lighting Type (choose from above)	Bulb Wattage	# fixtures per area	# of Bulbs per fixture	Occupancy Sensors?		Is Lighting Level Adequate?	
					Yes	No	Yes	No
					Yes	No	Yes	No
					Yes	No	Yes	No
					Yes	No	Yes	No
					Yes	No	Yes	No
					Yes	No	Yes	No
					Yes	No	Yes	No
					Yes	No	Yes	No

* Be sure to consider all lighted areas such as manufacturing space, warehouse space, offices, office lobby, bathrooms, storage rooms, locker rooms, break rooms, basement space, and exterior spaces (e.g. parking).

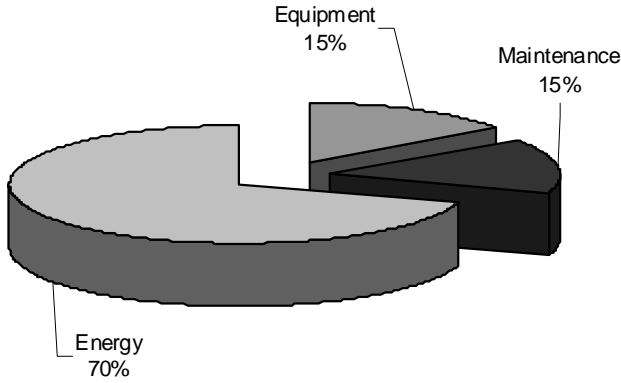
***Best Practices for
Lighting Systems***

(circle one)

- Yes* *No* Have you established lighting level standards for your facility?
- Yes* *No* Do you regularly verify lighting levels with a light meter?
- Yes* *No* Do you evaluate the economics of four-foot T-8 for all existing and new lighting applications?
- Yes* *No* Do you use 800 series lamps for T-8 fluorescent lighting?
- Yes* *No* Are occupancy sensors or other controls used in areas where the lighting is frequently left on without the space being used?
- Yes* *No* Do you shut off unnecessary lighting during a production process shutdown?
- Yes* *No* When upgrading lighting, do you maximize task lighting and minimize ambient lighting?
- Yes* *No* Is night lighting off during bright daylight hours?
- Yes* *No* Are L.E.D. lamps used in exit signs and signal lighting?
- Yes* *No* Do you use incandescent lights only for low run time specialty applications?
- Yes* *No* Is redundant safety lighting controlled so that it automatically goes off when the main lighting is working?
- Yes* *No* Do you avoid using lighting technology conversion lamps in your facility?
- Yes* *No* Have you evaluated areas that receive daylight during the day for installation of dimming controls?
- Yes* *No* Are facility security or cleaning personnel asked to identify opportunities for lighting control improvements?

For more information on lighting visit the U.S. Department of Energy's Office of Energy Efficiency & Renewable Energy website:
<http://www1.eere.energy.gov/buildings/commercial/lighting.html>

Compressed Air



Energy is by far the largest cost for compressed air over the operating life of a compressed air system. Some ways to improve system efficiency include:

- Routinely find & repair leaks
- Reduce system pressure
- Use compressors to match output and demand
- Maintain traps to remove condensate

Compressor types: Centrifugal, Axial flow, Reciprocating, Rotary screw, Rotary vane, Scroll, Diaphragm

Compressor control types: start/stop, load/unload, inlet modulation, auto-dual, variable displacement, variable speed.

<i>Please fill in</i>	Primary Compressor	Backup Compressor No. 1	Backup Compressor No. 2
Manufacturer			
Type (choose from above)			
Control type (choose from above)			
Age			
Size (hp)			
Pressure Range	() to ()	() to ()	() to ()
% Time Loaded			
% Time Idled			
% Capacity*			
Automatically Sequenced?	Not Applicable	Yes No	Yes No
Blowdown?	Yes No	Yes No	Yes No
Storage Tank?	Yes No	Yes No	Yes No
Pressure furthest from compressor			
Recover waste heat?	Yes No	Yes No	Yes No

* If your compressors do not have a % Capacity Gauge, simply write "NA"

Please fill out the readily available or easily estimated compressed air use data below, as the example shows:

Example:

Use Point: Grinder	Gauge Pressure: 90	Design Pressure: 80	Use Factor: 50%	Design Flow: ??	Required Dew Point: 40 F
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Use Point	Actual Gauge Pressure	*Design Pressure (PSI)	Avg. Use Factor (%)	*Design Flow (CFM)	Required Dew Point

* See equipment nameplate for this information

**Best Practices for
Compressed Air Systems**

(circle one)

Yes	No	Is there a posted diagram of the compressed air system including all of its components and their performance specifications?
Yes	No	Is there metering that quantifies electrical use, compressed air pressure throughout the distribution system, and volume of compressed air produced.
Yes	No	Is the system under control (After any system change, is system control is re-established)?
Yes	No	Is a schedule established for identifying and correcting leaks, inappropriate uses, and restrictions?
Yes	No	Is the entire compressed air system physically inspected to identify opportunities to improve the performance and reduce the operational cost?
Yes	No	Are system improvements quantified and reported to management?
Yes	No	Is system performance monitored to pursue continuous improvement?

For more information on compressed air visit the website for the Compressed Air Challenge (http://www.compressedairchallenge.org/library/index.html#Best_Practices)

Heating & Cooling

Millions of Americans work in facilities with mechanical heating, ventilation, and air-conditioning (HVAC) systems; these systems are designed to provide air at comfortable temperature and humidity levels, free of harmful concentrations of air pollutants. Cooling may use as much as a third of the electricity consumed by a typical building. Heating systems may also use electricity, but the majority use natural gas or coal as the primary fuel, to produce either heated air directly or steam which in turn heats air through heat exchange devices.

Heating & Cooling Data (only readily available or easily estimated)

Area	*Type of Heating	Is Heating Adequate?		Chiller Tonnage	Chiller Manfctr	Is Cooling Adequate?		Daytime Temp (F)	Evening Temp (F)	Programmable Thermostat?		Ceiling Height?	Ceiling Fans?		Comments
		Yes	No			Yes	No			Yes	No		Yes	No	
Office		Yes	No			Yes	No			Yes	No		Yes	No	
Manufacturing		Yes	No			Yes	No			Yes	No		Yes	No	
Warehouse		Yes	No			Yes	No			Yes	No		Yes	No	
Other ()		Yes	No			Yes	No			Yes	No		Yes	No	
Other ()		Yes	No			Yes	No			Yes	No		Yes	No	

* Type of heating (electric, steam, hot water, infrared, gas-fired make-up air, rooftop forced air)

For each make-up air unit (MAU), please provide the following information:

MAU	Burner BTU	Rated Flow (CFM)
1		
2		
3		

Ventilation

While heating and air-conditioning are straightforward operations, the more complex processes involved in ventilation are the most important in determining the quality, condition, and cost of indoor air.

There are five basic types of ventilation systems: dilution and removal by general exhaust; local exhaust; makeup (or replacement) air; HVAC (primarily for comfort); and recirculation systems. These processes typically include bringing in outdoor air, conditioning and mixing the outdoor air with some portion of indoor air, distributing this mixed air throughout the facility, and exhausting some portion of the indoor air outside.

Please fill out the readily available or easily estimated ventilation data below, as the example shows:

Example:

Purpose: CO ² Removal	Intake or Exhaust?	Operating Hours: 75%	Ventilation Adequate? Yes No	Load: Constant or Variable	Control: Manual or Automatic	Fan Diameter 48	Motor Size 5
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Vent Fan	*Purpose	Intake or Exhaust?	Operating Hrs as % of Facility Hrs	Is Ventilation Adequate?	Load Profile	Control	Fan Dia (inches)	Motor Size (hp)
1		Int. Exh.		Yes No	Constant or Variable	Manual or Automatic		
2		Int. Exh.		Yes No	Constant or Variable	Manual or Automatic		
3		Int. Exh.		Yes No	Constant or Variable	Manual or Automatic		
4		Int. Exh.		Yes No	Constant or Variable	Manual or Automatic		
5		Int. Exh.		Yes No	Constant or Variable	Manual or Automatic		

*Purpose for ventilation (VOC's; CO₂; Smoke; Particulates; Comfort; Other)

- Is building pressure *positive* or *negative* ? (circle one) (Hint: Air rushes out through doors for positively pressurized buildings and air rushes in through doors for negatively pressurized buildings.)
- Do you have an energy recovery system on ventilation exhaust? No _____ Yes _____
- Does your facility have spray booths? No _____ Yes _____

If yes, please provide the following information

Booth	Booth Operating Hours	Exhaust Fan Operating Hours	Are Exhaust Fan & Spray Gun Linked?	Fan Dia (inches)	Motor Size (hp)
1			Yes No		
2			Yes No		
3			Yes No		

***Best Practices for
Ventilation Systems***

(circle one)

- | | | |
|------------|-----------|---|
| <i>Yes</i> | <i>No</i> | Has the source of each contaminant been determined & minimized? |
| <i>Yes</i> | <i>No</i> | Is exhaust automatically shut down when it isn't needed? |
| <i>Yes</i> | <i>No</i> | Is make-up air automatically controlled to keep neutral plant pressure? |
| <i>Yes</i> | <i>No</i> | Is process exhaust located as close to the contaminant source as possible? |
| <i>Yes</i> | <i>No</i> | Are contaminant intensive processes grouped together? |
| <i>Yes</i> | <i>No</i> | Is all economically usable waste heat recovered to warm winter make-up air? |
| <i>Yes</i> | <i>No</i> | Are direct fired air make-up units used during winter heating? |
| <i>Yes</i> | <i>No</i> | Is warm ceiling air de-stratified (for example w/ ceiling fans) during the winter heating season? |
| <i>Yes</i> | <i>No</i> | Are dust and scrap collection systems properly sized to meet the demand? |
| <i>Yes</i> | <i>No</i> | Is warm air from dust and scrap collection systems recovered? |

For more information on ventilation and air quality visit the U.S. Occupational Safety & Health Administration's web site on ventilation (www.osha.gov/dts/osta/otm/otm_iii/otm_iii_3.html#iii:3_1)

Steam Systems

Over 45% of all the fuel burned by U.S. manufacturers is consumed to raise steam. Steam is used to heat raw materials and treat semi-finished products. It is also a power source for equipment, as well as for building heat and electricity generation. Costs in the U.S. total approximately \$18 billion (1997 dollars) annually to feed steam boilers. A typical industrial facility can realize savings of 20% by improving their steam system. There are a variety of ways to improve the efficiency of your steam system. Some of them are:

- Insulating distribution and condensate lines
- Inspecting and repairing steam traps
- Recovering stack waste heat
- Covering heated liquid vessels
- Minimizing boiler blowdown
- Reconditioning burners

Please fill in Steam System Data (only readily available or easily estimated)

- For what do you use steam? a) space heating _____ b) manufacturing process(es)_____
- What is your primary boiler fuel? a) natural gas _____ b) coal _____ c) wood _____
- Is this fuel type used elsewhere in your facility? No _____ Yes _____
- Please specify the boiler's rated a) pressure _____ b) size _____ c) input Hp _____ d) output Hp _____
(See boiler nameplate for this information)
- What is the boiler's? a) stack temperature _____ b) operating pressure _____ c) cycles per hour _____
- Is boiler pressure reduced to meet process requirements? No _____ Yes _____
- Does the boiler have an economizer? No _____ Yes _____
If yes, is the economizer used for: a) feed water _____ b) makeup water _____ c) combustion air _____
- Do you have a scheduled steam trap maintenance program? No _____ Yes _____
If yes, a) how many traps? _____ b) how frequently? _____ c) when was last time? _____
- Approximately what percent of condensate is returned? (select only one)
0-25% _____ 25-50% _____ 50-75% _____ 75-100% _____
- Approximately what percent of your steam and condensate lines are insulated? (select only one)
0-25% _____ 25-50% _____ 50-75% _____ 75-100% _____
- Do you check regularly for steam leaks? No _____ Yes _____ If yes, when was last check? _____
- Is your steam system blowdown *manual*, *automatic*, or *continuous*? (circle one)
If blowdown is automatic a) how frequently? _____ b) for how long? _____

***Best Practices for
Steam Systems***

(circle one)

- | | | |
|------------|-----------|---|
| <i>Yes</i> | <i>No</i> | Is there a formal steam system management program in place? |
| <i>Yes</i> | <i>No</i> | Do all people working with steam understand its properties? |
| <i>Yes</i> | <i>No</i> | Is there a good description or diagram of the entire steam system? |
| <i>Yes</i> | <i>No</i> | Has the steam pressure generated been minimized? |
| <i>Yes</i> | <i>No</i> | Is the boiler efficiency optimized? |
| <i>Yes</i> | <i>No</i> | Can all steam related surfaces (e.g. pipes, boiler walls) be touched? |
| <i>Yes</i> | <i>No</i> | Is the distribution system actively and routinely maintained? |
| <i>Yes</i> | <i>No</i> | Is the maximize heat used prior to returning condensate? |
| <i>Yes</i> | <i>No</i> | Is all condensate returned? |
| <i>Yes</i> | <i>No</i> | Is flash steam used as an energy source? |

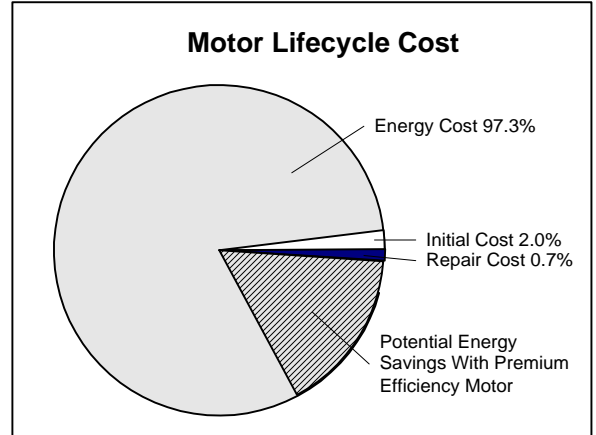
For more information on steam system operation and maintenance visit the web site for the U.S. Department of Energy's, Energy's Office of Energy Efficiency & Renewable Energy website:
<http://www1.eere.energy.gov/industry/bestpractices/steam.html>.

Motors

Motor-driven equipment accounts for well over half of the electricity consumed in the U.S. industrial sector. Motors are used for a variety of applications including pumps, fans, blowers, compressors, conveyors and production machinery. A motor-driven system consists of several components: the electrical power supply, motor controls, the electric motor itself, and a mechanical transmission system.

Each component of this system can be optimized for reliability and efficiency. One way to optimize your motor-driven system is to make sure the motor size matches the load requirements. Motors are often oversized because of uncertain load, allowance for load growth, rounding up to the next size, and availability.

Most electric motors are designed to run at 50% to 100% of rated horsepower load. Maximum efficiency is usually near 75% of rated load. Thus, a 10-horsepower (hp) motor has an acceptable load range of 5 to 10 hp; peak efficiency is at 7.5 hp. A motor's efficiency tends to decrease dramatically below about 50% load.



Please fill out the readily available or easily estimated ventilation data below, as the example shows:

Example	Use: pumping process water	Size: 20 hp	Efficiency: 90 %	Load: <u>Constant or Variable</u>	Drive type: direct	Adjustable?: <u>Yes No</u>
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Motor Number	Use	Size (hp)	Efficiency	Load ?	*Drive Type?	Adjustable Speed Drive
1						Yes No
2						Yes No
3						Yes No
4						Yes No
6						Yes No

*Drive types include direct and belt (v-shaped, cogged or synchronous).

Pump Data (for those motors that have a pumping function)

Motor Number	Fluid Temp.	Is Pump Throttled?	If yes, what is average % closed?	Operating Hrs (% of Facility Hrs)
		Yes No		
		Yes No		
		Yes No		

***Best Practices for
Motor Efficiency Programs***

(circle one)

- | | | |
|------------|-----------|---|
| <i>Yes</i> | <i>No</i> | Do you know how to calculate motor operation cost? |
| <i>Yes</i> | <i>No</i> | Do you know when to repair a failed motor verses buying a premium efficiency replacement motor? |
| <i>Yes</i> | <i>No</i> | Are premium efficiency motors specified for all new equipment purchased? |
| <i>Yes</i> | <i>No</i> | Does your company require a minimum motor efficiency when purchasing a new motor? |
| <i>Yes</i> | <i>No</i> | Do motor buyers know what makes a good motor rewind? |
| <i>Yes</i> | <i>No</i> | Is variable speed control evaluated for all loads that change? |
| <i>Yes</i> | <i>No</i> | Are all motors sized so they are loaded at 50% to 80% of full-load horsepower ? |
| <i>Yes</i> | <i>No</i> | Have cogged belts been evaluated for all V-belt transmission systems? |
| <i>Yes</i> | <i>No</i> | Is the shaft speed of centrifugal devices (fans and pumps) measured and optimized to meet process requirements? |
| <i>Yes</i> | <i>No</i> | Is motor lubrication and cooling fan airflow maintained on a schedule? |

For more information on motors visit the website for the U.S. Department of Energy's Office of Energy Efficiency & Renewable Energy website:
<http://www1.eere.energy.gov/industry/bestpractices/motors.html>