METAL FINISHERS

GUIDE TO REDUCING ENERGY COSTS

A PUBLICATION OF THE
ENERGY CENTER OF WISCONSIN

ENERGY CENTER
OF WISCONSIN
We show you how

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Metal Finisher's Guide to Reducing Energy Costs

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Introduction

You can increase profits of metal finishing through proven, low-risk methods of reducing energy costs. By applying the techniques offered in this guide, typically you can expect to cut your energy costs by 20 percent. Reducing costs is more immediately beneficial than simply increasing production because excess product must then be sold for there to be a benefit. Because of this, well-managed, profitable facilities tend to control their energy costs as a first step before addressing production levels and sales. This guide will help you emulate those facilities.

How to use this guide

This guide provides step-by-step instructions on how to improve the efficiency and reduce the costs of metal finishing. First we provide an Action Step Checklist to help you organize and track the actions you take in your facility.

Next we provide a series of 13 possible actions you can take to improve the efficiency of your operations. Each action summarizes what you need to do and provides references for further assistance and technical details. Review all the actions to determine which are economical and feasible for your facility.

Before performing an action, you should always consider these options:

- I have the time and expertise to carry out this step.
- I will find someone else within my company with time and expertise to carry out this step.
- I will obtain assistance outside our company with the expertise to carry out this step.

For further information see the frequently asked questions at the end of this guide. Questions address where energy is used, how to read an energy bill, and where to get more information.

The Energy Center of Wisconsin has produced a supplemental *Metal Finisher's Technical Reference* for those wanting technical background on optimizing the systems described in this guide. Contact ECW at 608.238.4601 for a copy.

Action Checklist

Table 1: List of Actions

Actions	Who's Responsible	Date Started	Date Finished	Notes
1. Determine if Cutting Energy Cost is Worthwhile for Your Business				
2. Determine the Financial Return Needed for You to Invest Capitol				
3. Optimize Ventilation Exhaust Air				
4. Optimize Steam Generation and Distribution System				
5. Minimize Cost of Winter Space Heating				
6. Minimize Heat Loss in Heated Process Tanks				
7. Use Lowest Cost Source to Heat Process Tanks				
8. Agitate Tank Fluids Using Lowest Cost Method				
9. Minimize Heating Cost in Drying Stations				
10. Optimize Facility Lighting				
11 Optimize Compressed Air Generation, Distribution, and Use				
12 Minimize Losses in Electric Power Supply System				
13 Optimize The Metal Finishing Process				

Action 1

Is cutting energy cost worthwhile for my facility?

Before taking action to cut costs you should determine the financial impact of a 20 percent cut in energy costs, as is typical for facilities employing the techniques in this guide. You'll calculate your total cost reduction as well as your savings per production unit. This information will help you decide if the time and effort necessary to bring about cost reductions is a good investment. If the answer is yes, the remainder of this guide will help you complete the task.

Table 2: Annual facility impact worksheet

Amount paid for electricity in the previous 12 months:	$ __________
Amount paid for natural gas in the previous 12 months:	$ __________
Amount paid for propane and other fuels in the previous 12 months:	$ __________
Total facility energy cost per year (add all above amounts):	$ __________
Multiply the above total by 0.20:	$ __________ We can expect to save this amount each year if we applied the best practice techniques in this guide.

Table 3: Annual production unit impact worksheet

Name of our facility’s unit of production:	____________	
Typical number of units produced per year:	____________	
Annual facility operating budget:	$ ________	
Divide annual operating budget by number of production units:	$ ________	(total cost per unit)
Divide total annual energy cost (see above) by number of units produced per year:	$ ________	(energy cost per unit)
Divide energy cost per unit by total cost per unit; multiply result by 100:	_________ %	(percent of unit production cost attributed to energy)
Multiply above percent by 0.20 (example: 15 % x 0.20 = 3 %):	_________ %	(cost reduction per unit if energy efficiency measures are taken)
Current profit margin per unit:	_________ %	
Given our profit margin and this opportunity to reduce unit costs, we make the following business recommendation:	❑ This financial benefit is **not worth pursuing** in our facility.	
	❑ This financial benefit is **worth _____ hours per week** to pursue a 20 percent facility energy cost reduction.	

Action 2

Determine the Financial Return Needed for Your Facility to Invest Capital

Although many energy efficiency measures have little or no cost, certain facility improvements will require a significant capital layout for labor and materials. In such cases it is necessary that you know up-front what financial return is required in your facility to compete for capital. You should not invest time pursuing opportunities that do not make good business sense for your company.

Most companies have at the very least a guideline rule that directs capital improvements. For example your company may require a three-year simple payback, a 35 percent rate of return, or other financial expectation for any proposed facility improvements.

Below you may wish to summarize your facility's guidelines for investing capital in cost reduction improvements:

____
____
____

Capital investment guidelines are generally based on the total financial benefits resulting from proposed improvements. These benefits may include reduced energy and maintenance costs, reduction in raw materials, scrap reduction, increased production rate, and reduced downtime.

Less tangible benefits may also result from facility improvements. Quantify these benefits whenever possible or use them to serve as tiebreakers when funding competition is close. These benefits may include worker safety, improved worker comfort, verification of code compliance, improved equipment reliability, reduced environmental emissions, and extended equipment life.

Action 3

Optimize Ventilation Exhaust Air

Ventilation is required for employee safety and comfort. When you optimize ventilation, you minimize the ventilation requirements, increase the capture effectiveness of ventilation equipment, and ensure proper—but not excessive—ventilation is maintained. If you use space heating, minimizing the amount of exhaust air not only reduces fan energy requirements but also cuts the cost of heating make-up outdoor air. Each 1000 CFM of ventilation requires about one kilowatt of electric load. For winter heating in Wisconsin each unnecessary CFM of ventilation in a round-the-clock operation costs about a dollar per year.

To optimize your plant ventilation systems:

1. Create a list of all ventilated workstations.
2. For each workstation determine the ventilation requirement according to regulations and your facility's standards.
3. For each ventilation point have the actual ventilation rate measured by a qualified ventilation service company.
4. For each ventilation point determine required ventilation rate from the American National Standards Institute (ANSI) standards (see your local contractor or the technical supplement to this guide).
5. Pursue these actions as appropriate:
    - If you have identified excessive ventilation reduce exhaust airflows by improving ventilation hood and baffle design. If airflow reduction is more than 20 percent of rated ventilation fan capacity, reduce fan speed and rebalance the system.
    - You can reduce fan speed by changing pulley wheel sizes in belt-driven systems, installing a variable-speed drive on direct-drive fans, installing an adjustable speed coupling on direct-drive systems, and replacing the existing motor with a lower-speed or multiple-speed motor. Replacing the entire fan/motor assembly is also an option. Remember that whenever you reduce total ventilation airflow or adjust one or more ventilation hoods, you must rebalance the system.
    - If ventilation requirements at a workstation vary, then vary the ventilation rate to match the need. You can shut down the ventilation when unnecessary or vary the ventilation rate to match changing needs.
    - To reduce the amount of ventilation needed: cover idle tanks, improve hood and baffle designs, and identify mist suppressant options. Hire a firm that specializes in this if you do not have the expertise available.

Note:
Hard chromium (and some decorative chromium) plating ventilation systems are subject to new stack tests if the ventilation system is modified. In Wisconsin contact your regional Department of Natural Resources representative, or call Renee Lesjack Bashel at the Department of Commerce Small business Clean Air Assistance Program at 608.264.6153 for more information.

Ventilation Resources

Table 4: Ventilation Resources

ANSI Z9.1 American National Standards Institute 1819 L Street, NW Washington, DC 20036 202.293.8020 www.ansi.org	***Basic Design of a Plating Exhaust System*** By Bruce E. Menkel. www.indvent.org/articles.html
Electroplating Engineering Handbook 1984. Edited by Lawrence J. Durney. Published by Van Nostrand Reinhold, New York, New York, USA. ISBN 0-442-22002-2, Library of Congress card number 84-3548.	***Industrial & Engineering Chemistry*, Vol 27** By A. K. Doolittle.
***Industrial Ventilation, A Manual of Recommended Practices*, 23rd Ed.** Publication 2092 of the American Conference of Governmental Industrial Hygienists. 1330 Kemper Meadow Dr., Suite 600 Cincinnati, OH 45240 513.742.2020 www.acgih.org	

Variable Frequency Drives Case Study
A description of the installation of variable frequency drives on the ventilation fans in the Lockheed Martin Armament Systems metal plating plant is available from the U.S. Department of Energy Motor Challenge program. The project saved $68,000 annually (38%) and provided a payback of just under 1.5 years. View the case study at www.oit.doe.gov/bestpractices/explore_library/docs/mc-cs01.shtml
or request it from the Motor Challenge Information Clearinghouse at 800.862.2086.

<u>**Fan & Motor Resources**</u>

Table 5: Fan and Motor Resources

Business Purchasing Guide on Adjustable Speed Drives Pacific Gas & Electric Company. Discusses the types, advantages, and disadvantages of ASDs. www.pge.com/customer_services/business/energy/smart/pdf/asd_motors.pdf	***Correct Sizing of Motors*** Pacific Gas & Electric Company. www.pge.com/customer_services/business/energy/smart/pdf/sizing.pdf
Efficiency Opportunities with Adjustable Speed Drives Pacific Gas & Electric Company. www.pge.com/pec/inftoc/speedriv.pdf	***Energy Efficient Motors (3-Phase)*** Energy Answers 2000, vol. 7, no. 15**.** Wisconsin Public Service Corporation www.wpsc.wpsr.com/business/No15.pdf
Fan System Efficiency-Make It Better Energy Center of Wisconsin. 608.238.4601 www.ecw.org/products/pdf/303-1.pdf	***Fan System Optimization Checklist*** Energy Center of Wisconsin. 608.238.4601 www.ecw.org/products/pdf/fancheck.pdf
Industrial Applications of Fans and Blowers Pacific Gas & Electric Company. Smarter Business Guide. www.pge.com/customer_services/business/energy/smart/pdf/ind_fan_blowers.pdf	***Power Transmission Handbook*** Power Transmission Distributors Association, Rosemont, IL, 1997. ASDs and other power transmission issues. 847.825.2000 www.ptda.org
Replacing V-Belts*.* U.S. Department of Energy. MotorMaster Motor tip sheet #3 800.862.2086 www.oit.doe.gov/bestpractices/explore_library/pdfs/motor3.pdf	***Understanding Variable Speed Drives*** Allen-Bradley. www.ab.com/drives/techpapers/knowvfd.htm

Motor Challenge Program, U.S. Department of Energy
This program provides on-line and printed material on the advantages of energy efficient motors, how to interpret ratings, how to calculate when energy efficient motors make sense financially, and how to optimize motor-driven systems. The free *MotorMaster* software compares specific motors, calculates savings, and keeps maintenance records. Fact sheets including *Replacing an Oversized and Under-loaded Electric Motor* are also available. These resources are available through the Office of Industrial Technology, Best Practices web site.

www.oit.doe.gov/bestpractices/
800.862.2086.

Other resources

Table 6: Other resources

EEM-TRP Assessment Report: Volume 1, Metal Finishing The Energy, Environment, and Manufacturing Technology Reinvestment Project, June 20, 1996. Reports on energy savings in five midwestern metal-finishing plants. Energy and Environment Center Industrial Technology Institute Ann Arbor, Michigan 48106.	***Evaluation of the Impact of Selected Process Conditions on Hexavalent Chromium Emissions from Hard Chromium Plating Tanks*** Metal Finishing Association of Southern California. National Association of Metal Finishers 112-J Elden St., Suite 202 Herndon VA, 20170-4809 703.709.8299
Industrial Heat-Recovery Systems Pacific Gas & Electric Company's SmarterEnergy Business Purchasing Guide. www.pge.com/customer_services/business/energy/smart/pdf/ind_heat_recover.pdf	***Metal Finisher's Technical Reference*** Energy Center of Wisconsin. 608.238.4601

Action 4

Optimize Steam Generation and Distribution Systems

Steam systems include generation, distribution, end-use, and condensate return. Cost-saving measures for steam systems are often overlooked despite their large financial benefits.

1. Assign this task to someone who understands the basics of steam systems.
2. Create a written steam and condensate management plan.
3. Hire a service to routinely measure boiler combustion efficiency and take their recommended actions to optimize the fuel-air ratio for maximum efficiency.
4. Hire a service to determine the optimum boiler blow-down rate and establish a method for you to maintain this.
5. Map all steam lines in your facility describing pressure, flow, and end use.
6. Ensure that proper pipe insulation is in place throughout the distribution and return system.
7. Generate and distribute steam in your facility at the lowest possible pressure.
8. Ensure that all new steam and condensate piping size is designed, not estimated.
9. Ensure that the end-use heat exchangers are clean and working as intended.
10. Design end-use heat exchangers for maximum economic heat transfer.
11. Establish and execute a routine steam trap inspection and repair program.
12. Maximize the amount of condensate returned to the boiler.
13. Recover flash steam and use for lower temperature steam needs.

Steam System Resources

Table 7: Steam System Resources

Boiler Systems Guide Pacific Gas and Electric Company, Smarter Energy. Www.pge.com/customer_services/business/energy/smart/html/boiler_guide.html	***CIBO Energy Efficiency Handbook*** Council of Industrial Boiler Owners, 1997.
Energy Efficient Operations and Maintenance Strategies for Industrial Gas Boilers Pacific Gas and Electric Company, 1997. www.pge.com/customer_services/other/pec/inftoc/gasboilr.pdf	***Metal Finisher's Technical Reference*** Energy Center of Wisconsin. 608.238.4601

Metal Finishing EEM-TRP Assessment Report, Volume 1, 1996. The Energy, Environment, and Manufacturing Technology Reinvestment Project, Energy and Environment Center, Industrial Technology Institute, Ann Arbor, MI.	***Steam Trap Performance Assessment—Advanced Technologies For Evaluating The Performance Of Steam Traps*** **Federal Energy Management Program. July 1999.** **www.eren.doe.gov/femp/prodtech/steamtrap1.html**
Steam Best Practices U.S. Department of Energy. Fact sheets, software, and technical assistance, including: Improving Steam Systems Sourcebook Lists of Commercial Technical References, Tools, and Training Courses Financing Resources Case Studies Tip Sheets (many describe how to implement action steps identified above) Cost-Sharing Opportunities for Energy Use Improvement Business Impacts of Steam Efficiency paper Technical Papers, Guidelines, and Handbooks Software www.oit.doe.gov/steam steamline@energy.wsu.edu 800.862.2086	

Action 5

Minimize Cost of Winter Space Heating

1. Identify and evaluate sources of waste heat (cooling towers, refrigeration condensers, compressed-air cooling water) that could be used for space heating in winter and switched back to external discharge in summer.
2. Identify areas of your facility that regularly get large volumes of cold air (mechanic bays, loading docks, garage doors). Ask your equipment supplier to evaluate the benefit of installing infrared heating in these areas.
3. If any part of your facility relies on electric space heaters consider replacing them with heaters powered by natural gas, propane, steam, or waste heat. These generally have lower operating costs than electric heaters, which can make replacement economically favorable.
4. If parts of your facility are regularly unoccupied, evaluate using setback thermostats to reduce the space temperature when unoccupied. This is possible for all types of heating systems including steam: when a thermostat turns off the fan, steam supply to unit heaters is shut off as well.
5. When high ceiling areas are occupied in winter use ceiling fans to bring down warm air.

Space heating resources

Table 8: Space heating resources

Energy Answers: Low-Intensity Infrared Space Heating Wisconsin Public Service Corporation. Www.wpsc.wpsr.com/business/No8.pdf	***Guide to Reducing Energy Use in Commercial HVAC Systems*** Pacific Gas & Electric Company's Smarter Energy Business Purchasing Guide. www.pge.com/customer_services/business/energy/smart/pdf/phvac.pdf
Metal Finisher's Technical Reference Energy Center of Wisconsin. 608.238.4601	

Action 6

Minimize Heat Loss in Process Tanks

You can reduce energy costs by minimizing heat loss through the walls and open tops of heated process tanks:

1. Cover tanks whenever possible with a rigid or floating cover.
2. Consider using automated covers if frequent opening is required.
3. Insulate tanks with at least one inch of insulation.
4. Perform maintenance to minimize scale buildup on heating elements.

Heated Process Tank Resources

Table 9: Heated Process Tank Resources

Considerations for Total Pollution Control: Energy Conservation & Process Control Utilizing Covered Tanks By Kenneth C. Hankinson. KCH Services, Inc. 828.245.9836 contact@kchservices.com.	***Electroplating Engineering Handbook*** 1984. Edited by Lawrence J. Durney. Published by Van Nostrand Reinhold, New York, New York, USA. ISBN 0-442-22002-2, Library of Congress card number 84-3548.
Evaluation of the Impact of Selected Process Conditions on Hexavalent Chromium Emissions from Hard Chromium Plating Tanks Metal Finishing Association of Southern California, Pacific Environmental Services, Inc., February 10, 1993. Reprint available from MFASC, 5000 Van Nuys Blvd., Sherman Oaks, CA 91403.	***Metal Finisher's Technical Reference*** Energy Center of Wisconsin. 608.238.4601
Piping Insulation-Economics and Profits By F. L. Rubin. In *Practical Considerations in Piping Analysis*, ASME Symposium, vol. 69, 1982, pp. 27-46.	

Action 7

Use Lowest Cost Source to Heat Process Tanks

It's about two times more costly to heat tanks with electricity than to use steam generated with a fossil fuel. The disadvantage of fossil fuel heating is that it requires a greater up-front investment in equipment.

If your facility has simultaneous tank heating and tank cooling needs, an industrial heat pump may be another option to reduce operating costs—the up-front investment for the equipment is large, but the operating cost is extremely low.

For these options you will need to determine the economic benefits for your operation:

1. For all new tank installations compare the life-cycle economics of installing a steam heating source versus electric heating.
2. If you have tanks requiring cooling and tanks requiring heating in the same general area, retain an industrial heat pump supplier or consultant to evaluate using a heat pump for heating.

Action 8

Agitate Tank Fluids Using Lowest Cost Method

Metal finishing tank fluids are typically agitated with compressed air. Compressed air is the highest cost utility in an industrial plant, five times more expensive than electricity to produce the same work. Replacing compressed air agitation with either "blower air" agitation or circulation pumping will significantly reduce the cost of agitating tank liquids.

1. Identify all sources requiring tank agitation in your facility.
2. Quantify compressed air load currently being dedicated to tank agitation.
3. Identify the regulated air pressure that is used for tank agitation.
4. Contact suppliers or consultants to evaluate practicality, cost, and annual savings from using a high-pressure blower in place of compressed air for tank agitation.
5. Contact suppliers or consultants to evaluate practicality, cost, and annual savings from replacing the existing system with liquid pump agitation.
6. Compare economics of all options and pursue the best one for your facility.

Action 9

Minimize Heating Cost in Drying Stations

Drying stations remove moisture from parts as they exit the plating line. You can reduce costs in three areas: reduce the amount of heat used to dry each part; insulate walls of the drying station to prevent heat from escaping; and use the lowest cost energy source to provide the heat.

1. Ensure parts do not stay in the station longer than necessary to dry.
2. Set the temperature of the drying station to the lowest temperature that still dries the parts at a rate acceptable to production.
3. If the wall of the heating station is too warm to touch (over 120° F), insulate it to minimize heat loss.
4. Modify flow of operation to ensure parts arrive at the drying station as warm as possible.
5. Use a blower (not compressed air) to blow off surface moisture prior to heat drying.

Drying Station Resources

Table 10: Drying Station Resources

Infrared Drying New Industrial Technology Fact Sheet. Energy Center of Wisconsin. (608) 238-4601 industrial@ecw.org www.ecw.org/products/commindu.html	***Metal Finishing: A Small-Business Guide*** Electric Power Research Institute. Final Report 1997, TR-106676-V6, 4491, prepared by Resource Dynamics Corporation. Discusses new electrotechnologies for the metal finishing industry.

Action 10

Optimize Facility Lighting

You can reduce lighting costs by using more efficient lighting technologies and by reducing unnecessary lighting.

1. If your fluorescent lights do not have electronic ballasts and T-8 (1 inch diameter) bulbs, contact a lighting supplier or consultant to evaluate the economics of replacing your lighting system with a newer, more efficient system.
2. Identify periods when lighting remains on when not needed for production or safety. Quantify the number of fixtures and number of hours of unnecessary lighting. Contact a lighting supplier or consultant to evaluate the economics of installing automatic switching controls, which can turn lighting off when an area is unoccupied.
3. Identify any outdoor lighting that is on during the day and install a photosensor to control this lighting.
4. If you have any mercury vapor high bay or outdoor lights, contact a lighting supplier or consultant to evaluate the economics of installing metal halide fixtures with the same light output.

Lighting Resources

Table 11: Lighting Resources

Competing Technologies Vie for Eight-Foot Fluorescent Fixture Market: Evaluating the Alternatives by Robert Sardinsky and Barbara Heckendorn. E Source, 1999.	***Efficient Lighting Using Full-Size Fluorescent Lamps and Fixtures*** Pacific Gas and Electric Company, 1997. www.pge.com/pec/inftoc/factrost.html
EEM-TRP Assessment Report: Volume 1, Metal Finishing The Energy, Environment, and Manufacturing Technology Reinvestment Project, June 20, 1996. Energy and Environment Center Industrial Technology Institute Ann Arbor, Michigan 48106.	***IESNA Lighting Ready Reference*** Edited by J. Murdoch et al. Illuminating Engineering Society of North America, 1996.
Lighting Fundamentals, Lighting Upgrade Manual U.S. Environmental Protection Agency, Office of Air and Radiation, 1995. http://lightforum.com/general/fundamentals1.html	***Metal Finisher's Technical Reference*** Energy Center of Wisconsin. 608.238.4601
Performing a Lighting System Audit and The NLB Guide To Industrial Lighting National Lighting Bureau. Shows how to evaluate your lighting system needs if you are unable to hire a lighting professional to perform an audit. Global Engineering Documents 800.854.7179 global.ihs.com	

Lighting Information Organizations

Table 12: Lighting Information Organizations

Illuminating Engineering Society of North America 120 Wall Street, 17th Floor New York, NY 10005 212.248.5000 iesna@iesna.org www.iesna.org • IESNA is a professional organization that publishes reports covering lighting design and standard practices, lighting energy management, and lighting measurements testing and calculations.	**International Association of Lighting Management Companies** 431 E. Locust, Suite 300 Des Moines, IA 50309 515.243.2360 director@nalmco.org www.nalmco.org • NALMCO is a professional organization of lighting management and related companies. They promote professional lighting management techniques and the benefits of quality lighting, and foster the expansion of the lighting management industry. They offer training programs for certified lighting consultants and lighting technicians. NALMCO publishes *Lighting Management and Maintenance,* a collection of articles and information pertaining to current issues and technology facing the lighting industry today.
National Lighting Bureau 8811 Colesville Road, Suite G106 Silver Spring, MD 20910 301.587.9572 info@nlb.org www.nlb.org • NLB is a nonprofit organization that was founded to educate lighting decision-makers about the bottom-line benefits of specifying High-Benefit Lighting (energy efficient lighting that matches the requirements of the people, spaces, and tasks involved). NLB is sponsored by professional societies, trade associations, manufacturers, and federal government agencies	**National Lighting Product Information Program** Lighting Research Center 21 Union Street Troy, NY 12180-3352 518.687.7100 www.lrc.rpi.edu/NLPIP/Online/index.html • NLPIP is supported by government agencies and electric utilities and provides accurate and objective manufacturer-specific information on energy efficient lighting products.

Action 11

Optimize Compressed Air Generation, Distribution, and Use

Optimize ComCompressed air is usually the most expensive utility in an industrial facility. The cost-cutting approaches presented here can often reduce compressed air energy consumption by 30 percent.

1. Create a diagram of your entire compressed air system including specifications of all equipment and end uses.
2. Measure all the operating parameters of your current system operation including:
   - Pressures throughout the distribution system
   - Typical operation time and loading percent for all compressors
   - Estimate of “leak load” when the plant is shut down
   - The top five equipment pressures required in the plant
   - Typical distribution system air pressure fluctuation during a work day
   - Required “dryness” of compressed air produced (increased dryness increases cost)
   - Required “oil freeness” of compressed air produced (less oil carryover costs more)
3. Contact a compressed air system supplier or consultant to assess the current compressor control strategy. Controls should keep the distribution system pressure stable, minimize compressor “idle” time, “trim” compressed air production with the most efficient part-load compressor, and minimize wear and tear on the compressors.
4. Identify and eliminate unnecessary sources of pressure drop in the distribution system.
5. Identify and eliminate uses of compressed air that can easily be replaced with less expensive alternatives. These include floor sweeping, cabinet cooling, people cooling, tank agitation, parts drying, air nozzles left on when equipment is shut down, and air motors in nonexplosive areas.
6. Reduce compressed air system distribution pressure to as low as is reasonable. A one percent efficiency gain is made with every two PSI of pressure reduction at the compressor. Plant leaks are reduced by 1.5 percent for every two PSI reduction.
7. Identify compressed air uses that require pressures greater than most of the other equipment. Supply these loads with a separate small air compressor so the system pressure as a whole can be reduced.
8. Establish a formal compressed air maintenance program to ensure compressors, dryers, traps, etc. are operating as intended. Repair all leaks in your facility immediately.

Compressed Air Resources

Table 13: Compressed Air Resources

Metal Finisher's Technical Reference Energy Center of Wisconsin. 608.238.4601	***National Compressed Air Challenge*** Fact sheets, case studies, a sourcebook, and workshops. Workshops include *Fundamentals of Compressed Air Systems* and *Advanced Compressed Air Systems*, one- and two-day sessions that teach how to enhance the performance of compressed air systems. 800.862.2086 www.knowpressure.org, pressed Air Generation, Distribution, and Use

Action 12

Minimize Losses in Electrical Power Supply System

If electrical conductors are undersized or their connections have air or corrosion gaps in them, some of the electricity is converted to heat and lost. In AC to DC power rectifiers, if the conversion process is not proceeding correctly they produce less DC electricity and more heat. The following new design and maintenance practices minimize these losses:

1. Have a thermal imaging inspection performed to identify high-temperature electrical conductors and electrical connections. Repair poor connections and upgrade undersized conductors.
2. Have measurements taken to determine the actual electrical transformation efficiency of your existing rectifiers. After identifying current replacement options, efficiency, and cost, evaluate the financial return for replacing rectifiers.
3. Conduct routine maintenance to insure existing rectifiers operate efficiently and operating temperatures are minimized.

<u>Power Supply Resources</u>

Table 14: Power Supply Resources

Electroplating Engineering Handbook Edited by Lawrence J. Durney. Published by Van Nostrand Reinhold, New York, New York, USA. 1984. ISBN 0-442-22002-2, Library of Congress card number 84-3548.	***Metal Finisher's Technical Reference*** Energy Center of Wisconsin. 608.238.4601
Selecting a Rectifier: Part I *Plating & Surface Finishing*, April 1981, p26.	***Selecting a Rectifier: Part II*** *Plating & Surface Finishing*, May 1981, p92.

Action 13

Optimize the Metal Finishing Process

Measures that assure maximum plating quality also save energy—when you allocate resources to ensure quality you also reduce operating costs.

1. Ensure conductors used for hanging parts are not undersized.
2. Take measures to minimize excess plating thickness or unnecessary application.
3. Ensure barrels are fully submersed in barrel plating tanks.
4. Optimize agitation performance.
5. Operate at the lowest temperature acceptable to the specific process solution.
6. Optimize conductive additives in DC processes.
7. Reduce or eliminate contaminants that reduce conductivity in process solutions.
8. Identify new processes that do the same job but at lower operating temperatures.

Metal Finishing Process Resources

Metal Finisher's Technical Reference
Energy Center of Wisconsin.
608.238.4601

Frequently Asked Questions

Where is Energy Used in Metal Finishing Plants?

The American Electroplating and Surface Finishers Society sponsored a research project in the late 1970's to determine where energy was used in the metal finishing industry. Twenty plants were surveyed—11 job shops and nine captive shops (part of larger manufacturers). The products, practices, and energy conservation attitudes of these plants varied widely. Although this study is old, it appears to be the best information available.

The average percentage of electrical energy consumption was computed for the entire group of plants and for two subgroups: Group I, which finished larger parts, and Group II, which finished smaller parts.

Table 14: Percentage of Electrical Energy Used in End-Use

End-use	All Plants	Group I	Group II
Exhaust Fans	24.6	22.4	33.2
Electroplating and/or anodizing	23.9	29.5	1.3
Lighting	11.7	12.2	9.8
Hoists and Drives	5.0	5.9	1.4
Oven Heat	4.5	*	*
Filter Pumps	3.0	3.4	2.3
Electric Tank Heating	2.9	*	14.5
Waste Treatment Equipment	2.7	2.2	4.7
Air Agitation	2.7	2.7	2.3
Chillers	2.6	*	*
All Other Pumps	2.6	2.5	*
Grinding, Polishing, Buffing	2.4	3.0	*
Electrocleaning	2.4	2.9	*
Air-conditioning	2.3	*	10.6
Other uses	6.7	13.3	19.9

Table 15: Percentage of Heat Energy Used in End-Use

End-use	All Plants	Group I	Group II
Process Tank Heating	23.1	23.3	15.7
Boiler Losses	18.2	19.7	12.2
Space Heat	18.2	8.5	56.7
Cleaner Tank Heating	12.0	13.2	5.2
Rinse Tank Heating	10.0	11.2	5.8

Ovens and Dryers	7.0	8.7	0.3
Vapor Degreaser Heater and Stills	4.0	4.1	3.7
Waste Recovery Evaporators	3.8	4.7	*
Other Uses	3.7	6.1	0.4

* Included in "other uses"

For the average plant, exhaust fans, electroplating and/or anodizing, and lighting were the dominant electricity users. Efforts to conserve energy should be focused on these end-uses first. Plants that finish small parts should look at electric tank heating and air-conditioning instead of electroplating.

What Do All the Charges Mean on My Electric Bill?

Understanding how your electric utility charges you for electricity can provide you with clues on reducing your energy costs. Your utility considers two major components in charging for electricity: consumption (the *amount* of electricity you use) and demand (the *rate* at which you use electricity).

Consumption

Consumption is reflected on your electric bill as an *energy charge*, measured in kilowatt-hours (kWh) and reflects the total quantity of electricity you used during the billing period. To save money on energy charges you need to reduce the total amount of electricity you use.

Demand

Utilities must have enough generation and distribution capacity to supply their customers. A utility will generally charge more for electricity used during peak demand hours—during the day on weekdays. The maximum rate at which you use electricity shows up on your bill as a *demand charge*. It is measured in kilowatts (kW) and recorded by your meter in 15- or 30-minute intervals. The demand charge on your bill is based on your highest-demand interval and reflects the utility's cost of having electricity available to meet that demand. For example, two pumps that each use 25 kW and that run for two hours a day at the same time will incur a demand of 50 kW. If they run at different times, their demand is only 25 kW. Many utilities include an annual demand charge in their rates, which charges you each month for either your maximum demand during the current month plus the past 11 months or your maximum demand during the past summer months. This means that this component of your bill may be set at a maximum demand that was set in a single month.

To save money on demand charges and reduce the impact of the annual demand charge, you need to even out your power use by eliminating "spikes" wherever possible. Your electric utility account representatives may be able provide the 15-minute demand data recorded from your meter. You may see patterns in this data—a demand spike that occurs at the same time each week or month, or a demand peak tied to the weather or to a specific process. Once you know what is causing your demand spikes you can take action to reduce them.

Power Factor Charges

We usually think of electricity as being measured in kilowatts (usable power), but there is another component of the electricity supplied to your plant: reactive power, measured in kilovars. Some electrical devices require both components of electricity. A device that does not use reactive power efficiently requires the utility to supply more usable power in order to provide enough reactive power. Your utility may charge you more if you are not using reactive power efficiently—this is called a *power factor* charge. If your plant's power factor is low, ask your utility or energy consultant how to improve it.

More Information

City Light, Water and Cable website
Describes demand and energy charges and provides a calculation for determining load factor.
www.clwc.com/electric/bill.html

How to read your business energy bill
Wisconsin Electric Power Company. Explains three facets of your energy consumption: energy, on-peak demand, and customer demand charge.
www.wisconsinelectric.com/pages/cssbusintro.html

Understanding Your Electric Bill
Electric Power Research Institute. Contact your utility account representative for access to this document.

Your Utility Account Representative
Electric utilities have different pricing options from which their commercial and industrial customers can choose. Your utility account representative can explain how your electric use affects your bill and which pricing option will work best for your facility. Your account representative may also be able to provide you with information on how reduce your demand peaks and improve your power factor.

What Other Resources Exist for Metal Finishers?

Strategic Goals Program For The Metal Finishing Industry
www.strategicgoals.org
Contact Mindy Gampel at 202.260.2748

AES Research Project 46: Energy Conservation in Plating and Surface Finishing
Mazzeo, D.A. *Plating and Surface Finishing*, July 1979. Contact AESF at 800.334.2052.

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