Motor Planning Kit

Version 2.1

Strategies, Tools, and Resources for Developing a Comprehensive Motor Management Plan

Motor Decisions Matter℠

Developed by the Motor Decisions Matter campaign

Motor Planning Kit

This Motor Planning Kit will assist you in developing a motor management plan — an effective tool for dramatically improving productivity and increasing reliability while minimizing downtime, reducing operating costs, and conserving energy. With a proactive motor management plan in place, you will be better prepared to make effective and thoughtful decisions in advance of motor failure.

Inside this booklet you will find information about the tools and templates you can use to design and implement a motor plan. For more information, please visit the Motor Decisions Matter (MDM) website, www.motorsmatter.org. A list of MDM campaign sponsors who can help with your motor planning process is available on the site.

Start today, because managing a plan is easier than managing a crisis.

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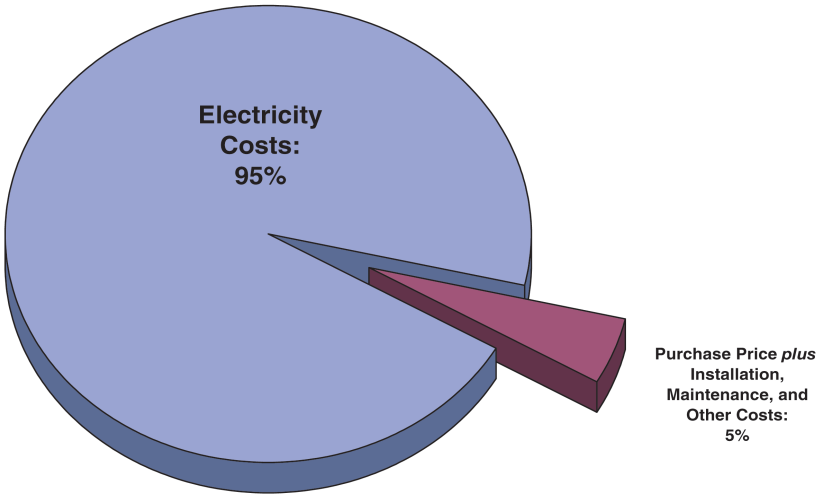
Motor Decisions Matter periodically publishes a compilation of motor planning resources. The information contained within this planning kit was reviewed by MDM sponsors. MDM believes the information to be reliable at the time it was provided, but MDM performs no independent verification of such information. Neither MDM nor CEE is responsible for any inaccuracies contained herein. This is not a comprehensive list of resources. For the most up-to-date list of resources, please refer to the "Motor Planning Kit" section of the Motor Decisions Matter website, www.motorsmatter.org.

I. Introduction to Motor Management

1.1 Motor Planning Makes $ense

Most motor decisions are made at the time of motor failure, when the clock is ticking and downtime costs are mounting. There is little time for analyzing options or interviewing service centers. As a result, decisions to repair or replace a motor are based on availability or short-term economics, not evaluation and planning. Typically, when motors fail, the highest priority is to return the equipment to service—not to optimize motor performance. The costs associated with this type of hasty decision-making can be high, resulting in elevated operational costs, poor equipment performance, and unreliable service.

Figure A: Sample Lifetime Motor Operating Costs[1]



The alternative to first-cost, panicked decision-making is to implement a sound motor management plan. Having a motor plan in place *before* motor failure ensures that your decisions will be both quick and cost-effective. A motor management plan can also reduce your energy costs for years to come.

Powering motors costs more than you think. Surprisingly, the electricity used to power a motor represents approximately 95 percent of its total lifetime operating costs. The combined costs of purchasing, installing, and maintaining a motor account for the remaining 5 percent (see **Figure A**).[1] Considering that a commercial building or manufacturing plant may have tens, hundreds, or even thousands of motors operating within the facility, managing motor energy costs is good business.

Figure B (next page) is a simple illustration that is intended give you a general idea of annual energy costs of the older motors in your facility. Costs of newer motors meeting federal minimum efficiency standards (EPAct 1992) may be somewhat less, but are still significant. Even a relatively small motor (50 hp and under) will consume thousands of dollars worth of energy per year.

Your actual motor costs will likely be different from those shown in Figure B.[2] For example, the calculations in Figure B assume a 100 percent load factor, while your motor may operate at a different load. The formula below can provide a closer approximation.

$$\text{Annual Energy Cost} = \frac{(\text{hp})(\text{load factor})(0.746)(\text{annual hrs. operation})(\text{electricity rate})}{\text{motor efficiency}}$$

Check the motor's nameplate for efficiency information. If no efficiency information is available, check with the motor manufacturer for the efficiency value. If you are still unable to determine motor efficiency, use the Pre-EPAct 1992 Default Motor Efficiency Table available in MotorMaster+ and in the *1-2-3 Approach to Motor Management*, software tools which are discussed later in this planning kit.

The electricity rate used in this calculation should be your aggregate cost of power. The aggregate (or total) cost of power may include energy charges, demand charges, and core charges. In addition, rates may vary

[1] The pie chart is based on a hypothetical 100 hp motor that is 94.5% efficient (EPAct 1992 minimum for 1800 rpm, TEFC). It assumes that the motor has an 18-year lifespan and runs 6,300 hours per year with a $0.075 per kWh electricity rate. Purchase price, installation, maintenance, and other costs are estimated at 5 percent of the motor's total lifetime operating costs. Your actual cost percentages will vary with factors such as motor size, efficiency, cost of electricity, and run time.

[2] The pre-EPAct 1992 default efficiencies in Figure B are taken from MotorMaster+, a software tool developed by Washington State University and funded by the U.S. Department of Energy. The calculation assumes 1800 rpm, totally enclosed fan-cooled (TEFC) motors and an electricity cost of $0.075 per kWh.

by type and size of organization and region of the country. Below are two approaches to determine your aggregate energy costs:

1. Check with your local electric utility account representative to make sure that the electric utility rate you are using for this formula closely matches your true cost of power.

2. Calculate your aggregate cost of power by dividing the grand total cost of electricity by the number of kilowatt-hours (kWh) consumed in a standard billing period. This information should be clearly printed on your monthly utility bill.

For example: From the simplified electric bill in **Figure C**, the aggregate

$$\frac{1{,}534.08}{(27{,}600+14{,}000)} = \frac{1{,}534.08}{(41{,}600)} = \$0.03688 \text{ per kWh}$$

cost of power is:
Becoming familiar with your electric bill not only helps you calculate your annual motor energy costs; it may also help you identify other savings opportunities, such as diverting some of your on-peak kW to off-peak times.

Figure C: Sample Electric Bill

On-Peak kWh	27,600	$634.80
On-Peak Demand kW	407	$307.00
Off-Peak kWh	14,000	$266.00
Off-Peak Demand kW	311	$126.60
Power Factor	0.84	$155.00
		$1,489.40
Taxes	3%	$44.68
Please Remit (Total)		$1,534.08

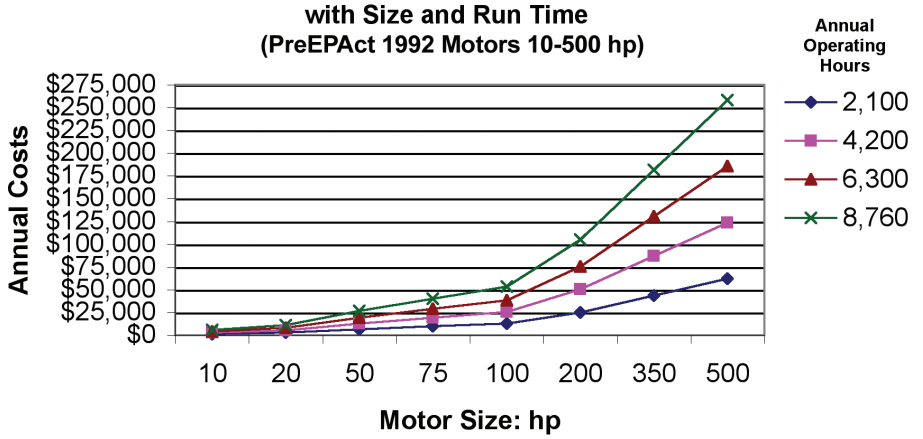
Premium-efficiency motors can help minimize your motor operating costs. Because many motors operate 40-80 hours per week (or more), even small increases in efficiency can yield substantial energy and dollar savings. In 2001, the National Electrical Manufacturers Association (NEMA), the Consortium for Energy Efficiency (CEE), and other stakeholders developed and adopted the NEMA Premium® specification.

NEMA Premium® is the most efficient motor designation in the marketplace today. Motors meeting this designation are approximately 1-4 percentage points more efficient than motors meeting EPAct 1992 standards, depending on size and enclosure type. While NEMA Premium® motors are available from most U.S. manufacturers, not all motors that meet or exceed the NEMA Premium efficiency levels are labeled with the NEMA Premium® brand. For this reason, it is always important to check a motor's nameplate efficiency when calculating life-cycle costs.

Figure D (next page) is a generalized example of the annual energy cost savings your company might potentially achieve by replacing older, inefficient motors with NEMA Premium®.[3] Your actual savings with NEMA Premium® motors will vary. As illustrated in the chart, larger motors and longer operating hours increase the potential for savings.

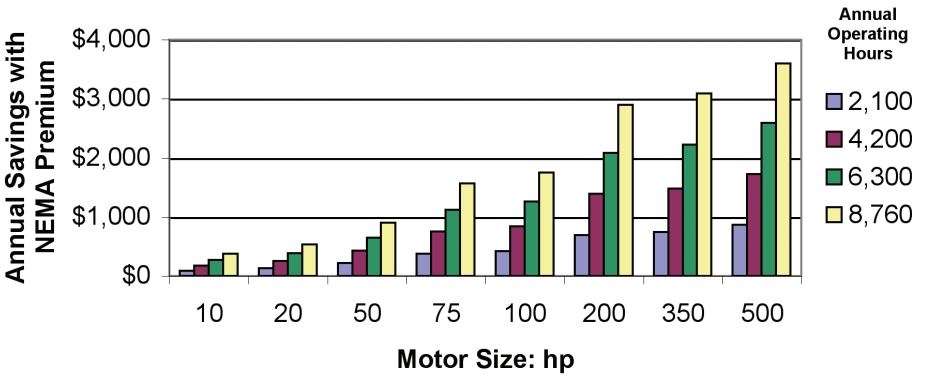
For example: a facility has an old 75 hp motor running 6,300 hours annually. The current model is 91.61 percent efficient. Replacing this model with a 95.4 percent efficient NEMA Premium® motor can save more than $1,100 annually. Over a 10-year period, this amounts to more than $11,000. If the facility had ten of these motors, the savings would quickly add up.

Figure B: Motor Energy Costs Increase with Size and Run Time (PreEPAct 1992 Motors 10-500 hp)



[3] Using annual energy cost formula given on page 1; plotting pre-EPAct 1992 costs against NEMA Premium. Pre-EPAct 1992 default efficiencies for each horsepower are taken from MotorMaster+. Nominal NEMA Premium efficiencies for each horsepower are used. The calculation assumes 1800 rpm, totally enclosed fan-cooled (TEFC) motors and an electricity cost of $0.075 per kWh.

Figure D: Premium Motors Reduce Energy Costs (NEMA Premium vs. Pre-EPAct 1992 Default Efficiency Motors)



Remember, this chart and others in this document are representations only; it is important to base your decision-making on individualized calculations for your motors. A number of free software tools are available to help you calculate whether a NEMA Premium® motor is right for one or many of your operations. Some of these tools are discussed later in this planning kit.

In addition to energy savings, NEMA Premium® motors have other valuable benefits. Their higher quality materials and cooler operating temperatures help to reduce maintenance costs, and manufacturers often offer longer warranties for NEMA Premium® models. Talk with your motor sales and service center about other non-energy benefits of NEMA Premium® motors.

The environmental benefits of the NEMA Premium® motor program are considerable. The U.S. Department of Energy estimates that the program could save over 5,800 gigawatt-hours of electricity and prevent the release of nearly 80 million metric tons of carbon into the atmosphere over a 10-year period. That would be the equivalent of keeping 16 million cars off the road.

Refer to **Sidebar A** (next page) to learn more about how to improve your organization's bottom line through energy-efficiency investments.

1.2 Overview of Motor Management

As you can see, you have the opportunity to make a real difference to your company's operations—and its profits—by proactively managing your motor inventory. The motor management planning process gives you the opportunity to evaluate the decisions and actions that are required when motor failure occurs.

The following section discusses each aspect of motor planning in greater detail. Remember that a key aspect of motor planning is to communicate your new policies and commitment throughout your organization.

As you read further, keep in mind that motor planning:

- is strategic for your company
- helps capture savings opportunities that might otherwise be overlooked
- enables managers and plant personnel to react quickly and effectively to motor failure
- ensures motor availability for critical processes
- decreases downtime while reducing energy costs

Refer to **Figure E** (next page) to see how motor planning expands your options from standard repair practices and replacement equipment to best-practice repairs and NEMA Premium® motors. To learn more about each option, view the interactive version of this chart on the MotorUp website at http://motoruponline.com/motorep.htm.

Before moving forward, you may want to take a quick look at a few of your own motors to assess the opportunities in your facility. Motor Decisions Matter's *1-2-3 Approach to Motor Management* was designed to help you estimate annual operating costs and to calculate potential savings. The greatest

SIDEBAR A: Considering a Corporate Energy Management Policy

Motor management is only one of many opportunities for you to improve your company's energy efficiency. Optimizing motor-driven systems (such as fan, pump, and compressed air systems), lighting, HVAC, industrial processes, and office electronics can present large opportunities for savings through efficiency investments.

Companies interested in pursuing multiple opportunities often develop a corporate energy management policy. This type of comprehensive energy planning involves a commitment to saving energy throughout the company; performance assessments; goal setting; creation and implementation of an action plan; evaluation of progress; and recognition of achievements.

Successful corporate energy management programs incorporate commitment that starts at the top. The CEO and other top-level corporate officers formally support the company's dedication to implementing the strategy and encourage managers to head energy management teams. The energy manager and/or management team identify the areas in which the greatest potential energy reductions can be achieved, as well as the lowest-cost energy reductions (which are the easiest for the company to make in the short term).

A corporate energy policy can not only improve your company's bottom line; it can also have a positive impact on your corporate image as an environmentally-conscious member of your community.

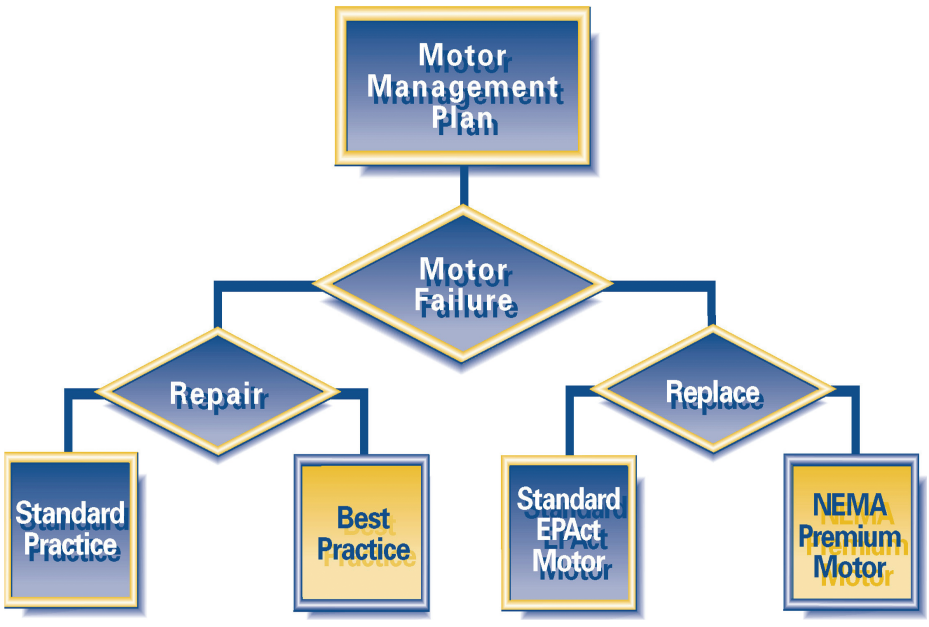
The U.S. Environmental Protection Agency's ENERGY STAR® program website (www.energystar.gov) contains Guidelines for Energy Management, along with many other valuable energy management resources.

The Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) website (www.eere.energy.gov/industry) has additional important information about developing a successful corporate energy management strategy (See **Section IV** for details).

opportunities are frequently found in older motors, motors with long run times, or motors that represent many other similar motors.

An initial analysis can help determine the motor management strategies that are appropriate for your facility. There are many tools available to help determine the cost effectiveness of repairing a motor or replacing, immediately or upon failure, with an EPAct 1992 or NEMA Premium® motor (see **Section IV: Tools and Resources**, for details).

Figure E: Motor Decision Tree



II. The Building Blocks of Effective Motor Management

Motor management plans can be simple or complex. More comprehensive plans take additional time and resources to develop, but offer greater savings opportunities. The important thing is to create a strategy that works for your organization.

Successful motor management programs are based on a few fundamental principles. These principles can be used like building blocks to create a plan that suits the company's needs. Many organizations phase in selected parts of a comprehensive plan over time. Others implement a more wide-ranging plan all at once.

The basic steps include:

1. Creation of a motor survey and tracking program.
2. Development of guidelines for proactive repair/replace decisions.
3. Preparation for motor failure by creating a spares inventory.
4. Development of a purchasing specification.
5. Development of a repair specification.
6. Development and implementation of a predictive and preventive maintenance program.

This section contains guidance for moving forward with each step; tools and resources are discussed in **Section IV**. Talk with your motor sales and service provider, energy-efficiency organization, and/or utility to decide which steps are right for you. Working together to develop a plan will help you accomplish your stated goals while conforming to your company's organizational structure and financial guidelines.

Throughout the planning process, it is important to discuss whether NEMA Premium® motors are cost-effective replacements for certain individual motors or groups of similar motors. Many utilities and energy-efficiency organizations now offer rebates for NEMA Premium® motors and technical assistance with motor management services. An extensive listing of these programs is available in the CEE 2004 *National Summary of Energy-Efficiency Programs for Motors and Drives* (see **Section 4.6: System Optimization and Corporate Energy Management Resources**).

2.1 Motor Survey and Tracking Program

Motors represent an important asset for your company. To manage them effectively, it is important to understand where, what, and how many there are. Therefore, many companies' first motor management step is to conduct a motor survey. The survey might be based on nameplate data, or it might include actual measured data.[4] It may also include motor history information. If there are many motors within your facility, you may want to begin with those running critical applications, with the longest run times, the highest failure rates, or that are the oldest.

Motor survey: There are several software programs and/or spreadsheets specifically designed to build a motor survey and to help you make sensible motor decisions. MotorMaster+ 4.0, created by Washington State University through a grant from the U.S. Department of Energy, is a comprehensive program that allows you to create and manage your motor database. It also contains manufacturers' information for more than 20,000 AC motors, including nameplate data, list price, repair costs, and other information. The MotorMaster+ 4.0 software is available free of charge online at www.eere.energy.gov/industry/bestpractices/software.html. It can also be ordered from the DOE's Office of Energy Efficiency and Renewable Energy (EERE) Information Center (formerly the OIT Clearinghouse), at 877-337-3463. Refer to **Sidebar B** (next page) to see how Walt Disney World has saved energy and money using MotorMaster+.

Other resources are also available. The *Motor Survey How-To Guide* is available from Advanced Energy at 800-869-8001 or online at www.advancedenergy.org/motors_and_drives/knowledge_library. This document provides step-by-step instructions for planning

[4] When there are uncertainties about the actual load, it is beneficial to take actual load measurement readings. Data from the Xenergy study, *United States Industrial Motor Systems Market Opportunities Assessment* (prepared for the U.S. DOE's Office of Industrial Technologies and Oak Ridge National Laboratory), indicate that a large percentage of motors operate at load levels below 40 percent (p.79). Your motor service provider can help with these measurements.

your inventory, collecting data, understanding life-cycle costing analysis, and creating policies for purchasing, repair, and replacement that are tailored to your operation. In addition, electric utilities, motor sales and service providers, motor suppliers, state energy-efficiency programs, and independent energy consultants offer inventory and management services.

Motor tracking: Motor tracking helps to identify recurring problems with specific motors or previously unrecognized application considerations, in order to avoid some common pitfalls.

Consider the following example. A motor is repaired and returned to inventory, then installed sometime later in a different application in a different part of the plant. If the motor then fails again, it may be sent out again for repairs, returned to inventory, and reinstalled without anyone recognizing the need to assess the motor more carefully. Keeping track of operational data means that the motor's history will be readily available if a failure occurs, and will allow facility managers to make more informed decisions.

For motor tracking, your survey should include **operational data**, such as:

- where the motor is located
- motor application
- when the motor was placed in service
- when the motor was last repaired
- who last repaired the motor
- how many times the motor has been repaired and/or rewound (and why)
- motor loading and operating hours (evaluate need for spares; compare root cause failure analysis history)

Because motor tracking alone will not prevent repetition of a prior application error, it is often beneficial to ask your motor service provider to perform root cause failure analysis (RCFA). RCFA is a method of determining why chronic failures occur, and making modifications to prevent future failures. Detailed information surrounding the failure and the motor's operating conditions is collected and analyzed. From the findings, preventive recommendations for the future can be made. For example, a motor modification such as additional shaft seals could keep water spray from getting into the motor.

SIDEBAR B: Disney World Benefits from Motor Planning

According to the Department of Energy's BestPractices program, the Reedy Creek Improvement District sends chilled water to Walt Disney World facilities and has over 20,000 horsepower worth of motors. Using DOE's MotorMaster+ (MM+) software, the University of Florida Energy Extension Service surveyed 120 motors at the North Service Area Chiller Plant, ranging from 25 to 700 hp.

Applications included all aspects of water pumping—chilled, condensed, hot, and municipal water — as well as compressors and cooling tower fans. Using data from MM+, the University of Florida identified areas where motor system upgrades would reduce energy usage.

The motor survey resulted in the replacement of seven critical motors at the chiller plant and one at the Magic Kingdom totaling 1,425 hp. Energy savings exceeded 300,000 kWh per year and 60 kW in demand, worth approximately $30,000 annually.

2.2 Proactive-Decision Making

When it comes to motor planning, proactive decision-making means thinking about motor replacement decisions before failure occurs. By planning proactively, you can calculate the most cost-effective replacement for your motor, and your decisions are based on economics, not motor availability.

Proactive decision making will help you minimize unscheduled downtime and improve overall profitability. The cost of replacing or repairing a failed motor can be insignificant compared to the downtime costs incurred. These include:

- idle workers
- reduced productivity
- disrupted schedule
- late delivery; angry customers
- overtime pay for mechanics
- priority shipping charges
- spoiled product cleanup and disposal
- damage to driven equipment from seizure

SIDEBAR C: Lumber Company Reaps Energy and Downtime Savings with Motor Management[5]

Alder Creek Lumber, a stand-alone sawmill in northern Oregon, is a successful niche provider to the high-end building sector. The company realized, however, that it needed to upgrade its facility — including its aging fleet of motors — to maintain its competitive edge. Using EM2, a software tool developed by the Northwest Energy Efficiency Alliance, a field consultant for the Alliance and an Alder Creek project manager created a database and analyzed the company's 175 motors, ranging from 3-200 hp.

The project manager used the data analysis to convince his managers that motor replacement could be more cost-effective than rewinding in some instances, particularly because of the age and inefficiency of the old motors.

The efficiency of the first old, 200 hp motor to be replaced had fallen to 82 percent. The new, premium-efficiency model had a 96 percent efficiency rating; installing the new motor resulted in energy savings close to 15 percent—or over $8,300 annually — giving a payback of less than twelve months. Employment of the premium-efficiency motor also cut manufacturing downtime, resulting in greater product volume. Additionally, use of the new motor reduced electricity peaks to a lower level, flattening operating energy demands. Increases in revenue with decreases in load mean a stronger bottom line.

The project manager also used a current logger to record motor amp draw over time, and created motor load profiles to determine if motor sizing was appropriate.

He then used the EM2 software to identify downsizing opportunities — such as the replacement of a 20 hp motor with a 15 hp motor. Oversizing is common in older mills, and results in inefficient energy consumption. Replacement of an oversized motor with one of the correct horsepower is a quick and easy way to reduce energy usage.

The motor analysis project's multiple positive outcomes resulted in Alder Creek Lumber's specification of premium-efficiency motors to replace failed motors, at decreased hp when appropriate. Their plan will continue the company's trend toward energy and bottom-line savings through motor management.

[5] Abbreviated version of "Motor Management Success: A Niche Company's Answer to Electric Motor Efficiency." By Electric Motor Management (EMM) of the Northwest Energy Efficiency Alliance. Full version available on www.motorsmatter.org/kit/Alder_Creek.pdf and at www.nwalliance.org/research/evaluationreports.aspx under "Electric Motor Management."

Consider the three sample decision-making strategies outlined here. Rather than three discrete strategies, consider these approaches as points on a continuum from general decision guidelines to application-specific approaches.

Remember that, whichever strategy you choose, an important aspect of making decisions about motors is communicating your action plan with others in your facility. See **Sidebar D** (next page) for an example of how software tools like the *1-2-3 Approach to Motor Management* can help make it easy for your facility employees to understand your repair/replacement decisions.

STRATEGY A: Develop a Set of General Decision Rules

One way to approach motor management is to develop a written set of general criteria that will be applied in all repair/replacement decisions. The advantage of this approach is that the rules are relatively easy to explain and implement. Caution is warranted, however, because this approach does not consider motor characteristics and operating factors on a case-by-case basis and could leave additional savings opportunities on the table. If you decide on this approach, you might want to discuss these decision rules with your motor service professional before adoption.

Examples of decision rules:

- Replace all failed motors under a specified horsepower and repair all failed motors above a predetermined horsepower, i.e., a horsepower breakpoint.
- Replace all motors that operate more than a predetermined number of hours with NEMA Premium motors when the calculated payback meets a specified set of criteria.
- Replace a failed motor when the repair cost exceeds a predetermined percentage of the new motor; for example, 60 percent. (Note: Check with your motor distributor or service provider for replacement availability.)

- Require all repairs to follow best practice repair guidelines. (Note: See the EASA/AEMT study, *The Effect of Repairing/Rewinding on Motor Efficiency*, available online at www.easa.com under "Industry Info.")

- Stock replacements for all critical motors. (Note: This might be done in-house or in conjunction with your motor service provider or motor vendor.)

STRATEGY B: Develop Specific Repair/Replacement Decisions for Individual Motors

For some applications, it is beneficial to incorporate more specific application information into the decision-making process. Parameters that might influence your repair/replace decision include motor loading, duty cycle, matching equipment type, enclosure type, and torque requirements.

Some companies choose to focus on the most important motors in the facility, such as the largest and most critical application motors. Critical motors may also include those that offer the greatest opportunities for savings, such as the most intensively-used motors. This method can be particularly useful for facilities with limited funding for process optimization.

SIDEBAR D: Convey Repair/Replace Decisions with Motor Tags

Facility managers and personnel need clear communication about motor decisions to ensure smooth operations. This is often accomplished by placing identifiable tags on individual motors or groups of similar motors. Tags provide important information about the motor and about actions to take upon failure. One way of generating these tags is to use Motor Decisions Matter's free, online motor repair/replacement calculation tool, the *1-2-3 Approach to Motor Management.* Learn more about the *1-2-3 Approach* in **Section IV**.

STRATEGY C: Develop a Comprehensive Motor Inventory

The most comprehensive approach to motor planning expands the narrow framework of Strategy B to understand and optimize all of the organization's motors. This approach requires evaluation of each motor or motor type in the facility (see **Section 2.3: Spare Motor Inventory** for more information on a spare motor inventory), development of an appropriate repair/replace response for each application, and implementation of an inventory management plan to ensure that when motors fail, the most cost-effective motor solution is available immediately.

Because the process of building a comprehensive motor inventory can be time consuming, you may want to start with your most critical motors, and gradually make your management plan more comprehensive.

Alternatively, some organizations decide to outsource their inventory development. A number of consultants, motor suppliers, and motor service centers offer this service. Check with your local motor service professional about the availability of motor management services in your area.

2.3 Spare Motor Inventory

Once you understand your replacement requirements, maintaining a spares inventory will guarantee that the motor you have selected will be available when you need it. This minimizes downtime and provides peace of mind. Motor sales and service providers are stepping up efforts to work with customers in this area. Customized programs might include stocking, storage, maintenance, and/or tracking agreements. Talk with your local motor sales and service center about establishing a spares inventory for your critical motors.

2.4 Motor Purchasing Policy

An important component of any motor management plan, a motor purchasing policy accomplishes several key objectives.

A purchasing policy:
- streamlines the purchasing process
- demonstrates management support for decisions based on life-cycle costing rather than first cost alone
- ensures consistent procurement
- helps to ensure that the most appropriate, cost-effective motor is chosen for each application

To be effective, the policy must be widely disseminated to those who regularly make motor-related decisions and must be clearly supported by management. Several sample policies are available. The National Electrical Manufacturers Association's *General Specification for Consultants, Industrial and Municipal: NEMA Premium Efficiency Electric Motors (600 Volts or Less)* covers many design criteria as well as material and mechanical considerations. The condensed version is available free of charge at www.nema.org under "Standards."

2.5 Motor Repair Policy

Motor repair quality is an important consideration when analyzing the costs associated with repair/replacement decisions. While some repair practices can result in decreased motor efficiency, "best-practice" repair services can maintain the efficiency of your motors. Efficiency is important to your bottom line, so it makes sense to ensure that you are receiving the highest quality motor services available.

Developing a relationship with your motor service provider is an excellent way to guarantee receiving the best repair/replacement advice and service.

While developing your motor plan, you may find that it makes sense for your company to implement a motor repair policy. See **Section 4.6: Motor Repair Resources.**

In addition to requiring "best-practice" repair services, you might look for a motor service provider that has a formal quality assurance program in place, such as ISO 9000 or EASA-Q. These standards provide a good indication that the service center is familiar with and can provide these premium services.

2.6 Predictive and Preventive Maintenance Program

In order to anticipate and prevent motor failures, your facility should implement a maintenance program that incorporates both predictive and preventive measures as part of its motor management plan. It is important to include both types of measures: preventive measures keep motors in good operating condition, reducing the risk of unexpected motor failure. Predictive measures help to determine which motor-related components may eventually lead to failure, giving facility managers the opportunity to reconfigure, repair, or replace the components before failure occurs. The combination of preventive and predictive measures provides many benefits to your company.

Preventive Maintenance[6]

There are five factors that are often responsible for motor failure: heat, dirt, moisture, vibrations, and voltage irregularities. Maintenance programs that focus on negating motor exposure to these factors can successfully reduce the rate of motor failure.

Heat: Undersizing; incorrect starting torque characteristics; high ambient temperature; and poorly ventilated motors (plugged up, dirty, or in cramped locations) can all cause motors to overheat. Correct motor selection and placement, essential to a variety of motor operating characteristics, is especially important to prevent overheating.

Dirt: Debris in a plant or outdoor work area (such as a construction project) can damage a motor's mechanical and electrical components, and contributes to motors overheating. Many motor manufacturers make models that are designed to keep dirt and other potentially harmful materials out of motors; talk with your motor sales and service center to see if these motors or other modifications such as debris shields or bearing isolators are appropriate for some of your operations. Of course, keeping the plant or work area as clean as possible can also go a long way towards reducing debris buildup in motors.

Moisture: Moisture is corrosive to the motor's mechanical and electrical components, and is particularly harmful to motors that are used irregularly. Using forced ventilation or mechanical dehumidification may help to reduce these effects in damp motor running environments. Idle motors can be protected with internal space or winding heaters.

Vibration: Various failing or malfunctioning components of the motor or its load may be responsible for vibration. Vibration gradually destroys the motor's bearings. If severe, mechanical components may develop cracks or fractures.

Voltage irregularities: Fluctuations beyond the motor's specified capabilities—undervoltage, overvoltage, unbalanced voltage, voltage transients, and other equipment's harmonics—can cause windings to overheat. In three-phase motors, this overheating can occur even with relatively small variations in voltage. Voltage should be checked frequently, and corrected if there is a problem.

Predictive Maintenance[7]

There are a number of ways to predict failure, including use of monitoring equipment to assess the impact of the above-mentioned factors on motor "health." Your facility might consider infrared thermal imaging that can be used to identify overheating wiring and bearings, vibration sensors that can identify vibration and bearing problems, and electrical analyzers that can identify power supply problems. Including motor operating characteristics in your motor inventory can give you a baseline data set for your motor population. By regularly measuring operating characteristics, you can detect changes that may indicate a problem, and schedule the motor system for maintenance. This is a "preemptive strike" against motor failure.

Identifying a problem with your motor before failure occurs means that you can have it reconditioned at a far lower cost than a post-failure rewind and/or extensive mechanical restoration.

[6] Derived from the *Maintenance Solutions* article, "Motor Maintenance Matters." James Piper, July 2003.
[7] Derived from *Guide to Energy-Efficient Commercial Equipment*, 2nd edition. Published by the American Council for an Energy-Efficient Economy (ACEEE); available at www.aceee.org.

III. Additional Motor System Management Considerations

Implementing an effective motor management plan for your existing motors can help your company realize significant energy and bottom-line savings and productivity increases.

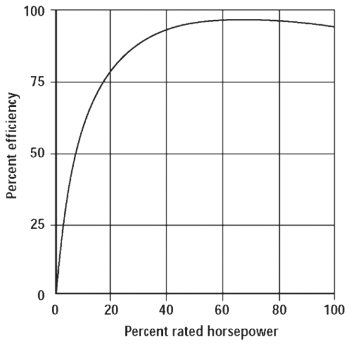
You should also be aware that you can achieve additional and often greater savings opportunities by optimizing the motor's compatibility with its motor-driven system (through proper selection and use of devices such as adjustable-speed drives, when applicable) and by optimizing the motor-driven system as a whole.

3.1 Optimizing Motor Compatibility with Load, System, and Operating Conditions

Proper motor selection saves you time and money. The common practice of oversizing motors results in inefficiency. Motor efficiency drops off sharply below about 40 percent of rated load and motors operating in this range run far below their nameplate efficiency. As a rule of thumb, it is best to select a motor that will operate with a load factor between 60 percent and 85 percent (see **Figure F**).

Additionally, it is important to know which design and enclosure type of motor you need. The most commonly used NEMA design types are A, B, C, D, and E. These letters indicate the shape of the motor's torque-speed curve. NEMA Premium® covers only designs A and B. Make sure when you are specifying a new or replacement motor that you understand your application and include the correct design designation. Different enclosure types work best in different operating environments, so you might also discuss motor enclosure types with your motor sales and service provider. In addition to the common open drip-proof (ODP) and totally enclosed fan-cooled (TEFC) enclosure types, there are various types of special-duty motors for a range of operating conditions.

Figure F: Typical Efficiency vs. Load Curve for Polyphase Induction Motors[8]



Correcting adverse operating conditions like large voltage variations, voltage unbalance, and improper alignment can also help you optimize equipment performance.

For more information about this topic, please refer to **Section 4.2: Motor Selection Resources.**

[8] Chart from *Understanding Energy Efficient Motors* (p.4, Figure 2). Electrical Apparatus Service Association. Available at www.easa.com under "Industry Info."

3.2 Adjustable-Speed Drives

Some applications do not require motors to operate at full speed all the time. An adjustable-speed drive ("drive" or "ASD") is a device that controls the input voltage and frequency to the motor, resulting in the ability to change the motor's speed. Because of their substantial energy-saving benefits, drives present an excellent opportunity in appropriate applications. For example, in some variable-load applications, **motor system savings from drive installation can exceed 50 percent**.

The Department of Energy estimates that drives could be cost-effectively used with motors that account for 18 to 25 percent of total manufacturing motor system energy.[9]

Additionally, installation of drives can prolong motor life and decrease maintenance costs by decreasing wear on the motor. Sometimes, ASDs are installed to improve process control.

For this text, we use the terms "drive" and "ASD" generically to encompass a wide range of drive technologies, including variable-speed drives (VSDs) and variable-frequency drives (VFDs).

[9] *United States Industrial Motor Systems Market Opportunities Assessment Executive Summary*. By Xenergy, prepared for the U.S. DOE Office of Energy Efficiency and Renewable Energy and Oak Ridge National Laboratory. December 1998.

If you have tried installing ASDs in the past with little success, please note that drive technology and application knowledge have matured and many of the early technical problems have been overcome. In addition, drive prices have generally come down. Additionally, many utilities and energy-efficiency organizations offer ASD rebates or other technical assistance (see *National Summary of Energy-Efficiency Programs for Motors and Drives* in **Section 4.5: Adjustable-Speed Drive Resources.**

It is important to carefully match a drive to the motor and application it controls. There are a number of applications in which drives are cost effective. For example, motors running centrifugal load, variable-speed, variable-torque applications such as pumps, fans, and compressors are great candidates. These common applications are often found in the pumps and fans used for heating, ventilating, and air conditioning (HVAC) systems.

Applications that currently use restricting devices such as throttling valves, inlet guide vanes, and discharge dampers may be better served by using ASDs. Running the motor at full speed and controlling the flow through use of these restricting devices is analogous to pressing the accelerator pedal in your car to the floor and controlling your speed with the brake. This is not an efficient way to operate. A drive might be a better alternative.

There may also be other applications throughout your facility that would benefit from the installation of ASDs, so be sure to explore your full array of options.

Conversely, there are applications where drives need to be approached with caution. For example, the insulation system in many older motors will not function well if connected to today's drives. Lifting applications such as hoists, cranes, and elevators should be referred to knowledgeable specialists or the drive and equipment manufacturers. Only motors used on wide speed range applications, those operated above the motor's base speed, or other special applications need be inverter-duty. The need for line filters or reactors should be evaluated for any motor used on a drive.

Remember that sometimes drives are installed for purposes other than energy efficiency, such as process control. While drives are not normally installed on constant-load applications, the process control aspects may make it worthwhile to consider a drive.

It is also important to talk with your motor service provider to determine whether a drive might be suitable for your specific applications. NEMA's *Application Guide for AC Adjustable Speed Drive Systems* addresses a variety of drive application and selection considerations (see **Section 4.5: Adjustable-Speed Drive Resources**).

3.3 Motor-Driven System Optimization

Examining and optimizing your facility's motor-driven systems can take your energy management savings to the next level. Often, the savings and productivity increases your facility can achieve by optimizing the system as a whole can be greater than the combined savings of upgrading individual system components.

There are many organizations and resources that provide technical and/or financial assistance for those interested in examining and optimizing their motor-driven systems. The DOE provides many excellent resources, including tip sheets, case studies, technical publications, software, and a training and event calendar. DOE software such as the Pumping System Assessment Tool (PSAT), Steam System Assessment tool (SSAT), and Fan System Assessment Tool (FSAT) are useful for assessing these system opportunities within your facility (www.eere.energy.gov/industry/bestpractices/software.html).

Other informative technical resources and training opportunities can be found at the websites of the Compressed Air Challenge (for compressed air systems; www.compressedairchallenge.org) and the Hydraulic Institute (for pump systems; www.pumps.org).

Section 4.6: System Optimization and Corporate Energy Management Resources provides a list of some available resources.

Remember:

Motor management can mean substantial energy savings as well as profitability and productivity improvements for your business. Optimizing a facility's systems can mean even greater savings.

For companies interested in pursuing multiple energy-saving opportunities, implementing a corporate energy management strategy may help maximize savings.

See **Section 4.6: System Optimization and Corporate Energy Management Resources** for helpful tools and programs.

IV. Tools and Resources

4.1 General Resources[10]

Organizations:

Copper Development Association Inc. (CDA)
CDA is a trade association representing the copper and brass industries in the USA, and is affiliated with an international network of copper centers in 23 countries. CDA offers a free CD-ROM on energy-efficient motors (and transformers), including video and text segments on life-cycle cost analysis, how the energy-efficient motors are made, and how they are different from standard products. CDA also offers a host of case histories and technical papers, most of which can be viewed or downloaded from their website at www.copper.org.

Electrical Apparatus Service Association (EASA)
EASA is an international trade organization of over 2,150 electromechanical sales and service firms in 50 countries. On its website, www.easa.com, search for motor sales and service centers in your area under "Find A Member," or check out the "Seminars" section for comprehensive, skill-oriented technical and management seminars. The site also contains other useful materials and links under "Industry Info" (references interspersed throughout this section).

Motor Decisions Matter (MDM)
Motor Decisions Matter is a national campaign encouraging the use of sound motor management and planning as a tool to cut industry's energy costs and increase productivity. The campaign is sponsored by a consortium of motor industry manufacturers and service centers, trade associations, electric utilities and government agencies. The website, www.motorsmatter.org, has a number of publications, case studies, fact sheets, a list of campaign sponsors, and links to the resources listed on the following pages, as well as other websites.

U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE): BestPractices Industrial Systems
Sponsored by the EERE, the BestPractices Industrial Systems website, www.eere.energy.gov/industry/bestpractices/, offers a wide array of resources, including motor tip sheets, motor efficiency case studies, technical publications, software, and a training and event calendar. Information about optimizing compressed air, steam, pumping, HVAC and other industrial systems is also available (see **Section 4.6: System Optimization and Corporate Energy Management Resources** for details). Information can be downloaded from the website or can be obtained by calling the EERE Information Center at 877-337-3463.

U.S. DOE EERE: Information Resources Catalog
The EERE Information Resources Catalog provides access to hundreds of information products on industrial technologies, including motors and adjustable-speed drives. Brochures, success stories, technical "roadmaps," and tip sheets are available, among many other materials. Search by program area or product category, alphabetically or by keyword. Most of the documents listed in the catalog can be viewed, downloaded, or ordered from the EERE Information Center from the website, www.eere.energy.gov/industry/resources/, or at 877-337-3463.

[10] For the most up-to-date list of resources, please refer to the "Motor Planning Kit" section of the Motor Decisions Matter website, www.motorsmatter.org.

Software:

1-2-3 Approach to Motor Management
An innovative software tool, the *1-2-3 Approach* demonstrates how industrial and commercial facility managers can reduce downtime and save energy by proactively managing their motor fleets. It is easy to use and provides information quickly.

The *1-2-3 Approach*, developed by MDM sponsors, is a good starting point for small to medium-sized companies that might not have the resources to develop a motor management plan. Using a limited amount of customer input, the tool calculates annual motor operating costs and presents financial data for future decisions based on life-cycle costing. In this way, the *1-2-3 Approach* user can make an informed decision on the cost effectiveness of repairing a motor or replacing immediately or upon failure, with an EPAct 1992 (current federal minimum efficiency standard) or NEMA Premium® motor, and plan accordingly. It is available free of charge online at www.motorsmatter.org (one-time registration required; all contact information is confidential).

MotorMaster+ 4.0
Created by Washington State University through a grant from the U.S. Department of Energy, MotorMaster+ 4.0 is a comprehensive program that allows users to create and manage their motor database. It also contains manufacturer's information for more than 20,000 AC motors, including nameplate data, list price, repair costs, and other information. The MotorMaster+ 4.0 software is available free of charge and may be downloaded from the BestPractices website, www.eere.energy.gov/industry/bestpractices/software.html. It can also be obtained by calling the EERE Information Center at 877-337-3463.

Canadian Motor Selection Tool (CanMOST)
CanMOST, the Canadian equivalent of MotorMaster, was developed for Natural Resources Canada by the Washington State University Extension Energy Program as part of the International Motor Selection and Savings Analysis (IMSSA) project. It is a software program that analyzes and compares the efficiency of three-phase electric motors. CanMOST is available at www.oee.nrcan.gc.ca/industrial/equipment/products/; go to "Industrial: Facilities and Equipment" from the home page.

4.2 Motor Selection Resources

NEMA Premium®
The member organizations of the National Electrical Manufacturers Association (NEMA) established NEMA Premium® as a common specification and label for premium-efficiency motors. NEMA's goal is to provide highly energy-efficient products that meet the needs and applications of users and original equipment manufacturers, based on a consensus definition of "premium efficiency" and use of the NEMA Premium® logo for premium products. The energy specification tables for NEMA Premium® motors are available on NEMA's website, www.nema.org.

Many electric utilities use NEMA Premium® as a qualifying specification for their premium motor rebate programs (see **Section 4.7: Region-Specific Information and Motor Planning Assistance** for the *National Summary of Energy-Efficiency Programs for Motors and Drives*).

Literature:

Buying an Energy-Efficient Electric Motor
(U.S. Department of Energy, 1996)
This 8-page fact sheet explains how to obtain efficient motors at the lowest prices, and how to avoid common problems. This document is pre-NEMA Premium®. It is available at www.eere.energy.gov/industry/bestpractices/motors.html.

Efficient Motors: Selection and Application Considerations
(Consortium for Energy Efficiency, 1999)
This brochure provides a brief guide to understanding and selecting motors. It is available on CEE's website at www.cee1.org/ind/motrs/motr-broch.pdf.

Replacing an Oversized and Underloaded Electric Motor
(U.S. Department of Energy)
This 6-page fact sheet includes a discussion of how MotorMaster software can be used to conduct motor replacement analyses. It is available at www.eere.energy.gov/industry/bestpractices/motors.html.

4.3 Motor Repair Resources

Programs:

EASA-Q
EASA-Q is a custom-tailored guideline for motor service centers to implement the ISO 9000 series of quality management system standards. It is available through the Electrical Apparatus Service Association (EASA): 314-993-2220 or email easainfo@easa.com.

ISO 9000
The ISO 9000 family of international quality management standards and guidelines has earned a global reputation as the basis for establishing quality management systems. For more information, see the International Standards Organization's website: www.iso.ch.

Proven Excellence Verification (PEV)
A service center certification program that includes independent on-site assessment as well as before-and-after repair testing in a nationally accredited motor laboratory. It is available through Advanced Energy, 800-869-8001, or online at www.advancedenergy.org/motors_and_drives/consulting/repair_shop_selection.html.

Literature:

A Guide to AC Motor Repair and Replacement (EASA)
Available on EASA's website: www.easa.com, under "Industry Info." For more information contact EASA at 314-993-2220, or email easainfo@easa.com.

Guidelines for Maintaining Motor Efficiency During Rebuilding (EASA Tech Note No. 16)
Available on EASA's website: www.easa.com, under "Industry Info." For more information contact EASA at 314-993-2220, or email easainfo@easa.com.

Motor Repair Tech Brief and Model Repair Specifications for Low Voltage Induction Motors
(U.S. Department of Energy, 2000)
Available through DOE's EERE Information Center, 877-337-3463, or online at www.eere.energy.gov/industry/bestpractices/techpubs_motors.html.

Recommended Practices for the Repair of Rotating Electrical Apparatus (ANSI/EASA AR 100)
EASA-established guidelines for motor repair service centers, discussing in detail expected practices that motor service centers should follow. Available on EASA's website: www.easa.com, under "Industry Info." For more information, contact EASA at 314-993-2220, or email at easainfo@easa.com.

Service Center Evaluation Guide
(U.S. Department of Energy, 2001)
This guide provides useful information to customers on service center quality. It is available through the EERE Information Center, 877-337-3463, or online at www.eere.energy.gov/industry/bestpractices/techpubs_motors.html.

The Effect of Repair/Rewinding on Motor Efficiency: EASA/AEMT Rewind Study and Good Practice Guide to Maintain Motor Efficiency
The main purposes of this study were to determine the impact of repair/rewinding on the induction motor efficiency and to identify procedures that degrade, maintain, or even improve the efficiency of rewound motors. Available on EASA's website: www.easa.com, under "Industry Info." For more information, contact EASA at 314-993-2220, or email at easainfo@easa.com.

4.4 Motor Evaluation and Planning Resources

Horsepower Bulletin (Advanced Energy, 2001)
This 8-page bulletin outlines a policy for cost-effective management of motor purchases and repairs. The information is based on feedback from industrial customers, electric utilities, motor suppliers and service centers as well as test results from more than 100 new and repaired motors for measured efficiency. Available through DOE's EERE Information Center, 877-337-3463, or through Advanced Energy, 800-869-8001. Also available online at www.eere.energy.gov/industry/resources and www.advancedenergy.org.

Motor Survey How-To Guide (Advanced Energy)
Provides industrial and commercial facility managers with a method to identifying motors in a single facility or on a company-wide basis. The guide helps explain how to gather necessary data, including motor load and nameplate information. A form for documenting this information is provided. This resource is available from Advanced Energy at 800-869-8001, or online at www.advancedenergy.org/industrial/publications.

4.5 Adjustable-Speed Drive Resources

Application Guide for AC Adjustable Speed Drive Systems (National Electrical Manufacturers Association, 2001)
This guide is available free of charge on NEMA's website, www.nema.org, under "Standards." This guide is intended to assist users in the proper selection and application of AC adjustable-speed drive systems.

National Summary of Energy-Efficiency Programs for Motors and Drives (Consortium for Energy Efficiency, 2004)
This comprehensive document contains detailed information about programs that provide rebates and/or other assistance to businesses for NEMA Premium® motors and/or adjustable-speed drives. Search by state, region, or organization. Organizations administering the programs include energy-efficiency organizations and utilities that operate on a statewide or regional scale. The Summary includes programs in California, Hawaii, the Northwest, British Columbia, Texas, the Midwest, and the Northeast

Visit www.motorsmatter.org to download a PDF of the National Summary.

Variable Frequency Drives: Technical Data Sheet (Wisconsin's Focus on Energy program, 2004)
This piece on drives details benefits of using drives and some common applications for which drives work well. It also gives a brief technical overview of how drives function, along with examples of potential savings. It is available at www.focusonenergy.com/data/common/dmsFilesStaging/B_GC_MKFS_BPVariablefrequencydrives.pdf.

4.6 System Optimization and Corporate Energy Management Resources

Organizations and Programs:

Compressed Air Challenge (CAC)
This program is a voluntary collaboration of industrial users; manufacturers, distributors, and their associations; consultants; state research and development agencies; energy-efficiency organizations; and utilities. It provides technical resources and training for compressed air systems. Visit the CAC website at www.compressedairchallenge.org.

ENERGY STAR®
The U.S. Environmental Protection Agency's ENERGY STAR partnership offers a proven energy management strategy for businesses. ENERGY STAR Industry Focuses involve concentrated work with a single manufacturing industry to improve that industry's energy efficiency, create momentum for continued improvement, provide tools to enhance energy performance, and to provide a forum for resource- and idea-sharing. Current focuses are the auto, brewing, corn refining, cement, and pharmaceutical industries; more will be added in the future.

Among other excellent resources, the website contains *Guidelines for Energy Management*, also available as a PDF. These guidelines impart useful information about creating a successful energy management strategy, including how to: commit to saving energy throughout the company; assess performance; set goals; create and implement an action plan; evaluate progress; and recognize achievements. Visit the ENERGY STAR website at www.energystar.gov. You can find the *Guidelines* at www.energystar.gov/index.cfm?c=guidelines.guidelines_index.

Hydraulic Institute (HI)
The HI website directs pump users to manufacturers and suppliers, an online training course, pump diagrams and definitions, and various other pump resources. Visit the HI website at www.pumps.org.

U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE)
The EERE website contains valuable information about specific activities involved in implementing a corporate energy management plan. These include: tracking electricity bills; evaluating equipment operating practices and identifying biggest energy users; identifying low- or no-cost projects for saving energy; gaining the support of management; forming an energy management team; and developing an ongoing strategy for improvements. Learn more online at www.eere.energy.gov/.

U.S. DOE EERE BestPractices Program
The BestPractices program of the EERE Industrial Technologies Program (ITP) works with U.S. industry to identify plant-wide opportunities for energy savings and process efficiency. The BestPractices website, www.eere.energy.gov/industry/bestpractices/, contains credible, useful tools and information about opportunities for your business to explore energy-saving opportunities by partnering with the DOE.

Plant-Wide Assessments
The DOE and other organizations conduct plant-wide energy assessments to determine energy-saving and process optimization opportunities. The assessments highlight opportunities for best practices in energy management, including the adoption of new, energy-efficient technologies and process and equipment improvements. Read more about the DOE's plant-wide assessments online at www.eere.energy.gov/industry/bestpractices/conducting.html.

Software:

Fan System Assessment Tool (FSAT)
This DOE tool helps quantify the potential benefits of optimizing fan system configurations that serve industrial processes. FSAT is simple and quick, and requires only basic information about your fans and the motors that drive them. Available online at www.eere.energy.gov/industry/bestpractices/software.html.

Pumping System Assessment Tool (PSAT)
This DOE tool helps industrial users assess the efficiency of pumping system operations. PSAT uses achievable pump performance data from Hydraulic Institute standards and motor performance data from the MotorMaster+ database to calculate potential energy and associated cost savings. Please note that the version of PSAT currently available does not incorporate NEMA Premium® efficiency levels into its calculations. Available online at www.eere.energy.gov/industry/bestpractices/software.html.

Steam System Assessment Tool (SSAT)
SSAT allows steam analysts to develop approximate models of real steam systems. Using these models, you can apply SSAT to quantify the magnitude—energy, cost, and emissions-savings—of key potential steam improvement opportunities. SSAT contains the key features of typical steam systems. Available online at www.eere.energy.gov/industry/bestpractices/software.html.

Many motor and drive manufacturers also provide energy analysis software.

Literature:

Determining Electric Motor Load and Efficiency
(U.S. Department of Energy)
This 16-page fact sheet discusses the necessity of properly loading a motor, and presents several load estimation techniques. Available online at www.eere.energy.gov; search by title.

***Energy-Efficient Motor Systems: A Handbook on Technology, Program, and Policy Opportunities* (2nd ed.)**
(American Council for an Energy-Efficient Economy, 2002)
This volume outlines a systems approach to motor efficiency, including information on high-efficiency motors, optimized controls, improved component sizing and repair, better transmission hardware, and more comprehensive monitoring and maintenance.

Energy Management for Motor Driven Systems
(U.S. Department of Energy, 1997)
Length: 100 pages
www.eere.energy.gov/industry/bestpractices/motors.html.
Order Number: DOE/MC-10021

Optimizing Your Motor Driven System
(U.S. Department of Energy, 1996)
This 8-page fact sheet highlights common ways of improving system efficiency and reliability. Available online at www.eere.energy.gov/industry/bestpractices/motors.html.

4.7 Region-Specific Information and Motor Planning Assistance

National (U.S. and Canada):

Motor Decisions Matter Sponsors
Any of the MDM campaign sponsors can provide information about motor planning. A list of MDM sponsors is available at www.motorsmatter.org/sponsors/index.html.

U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE)
The DOE's EERE Information Center provides easy access to motor planning resources and can field questions on DOE products and services, including those focused on technical questions about motor, steam, compressed air, and combined heat and power systems. Call 877-337-3463 or visit the Center online at www.eere.energy.gov/industry/resources.

Natural Resources Canada (NRCan)
NRCan is a federal government department specializing in the sustainable development and use of natural resources, energy, minerals and metals, forests, and earth sciences. NRCan provides environmental and energy-efficiency information and resources for Canadian businesses and consumers on its website, www.nrcan.gc.ca. Look under "Subject Listing" for an overview of resources.

Visit the NRCan Office of Energy Efficiency at www.oee.nrcan.ga.ca for helpful tools, services, and financial incentives.

Regional (U.S. and British Columbia):

National Summary of Energy-Efficiency Programs for Motors and Drives (Consortium for Energy Efficiency)
This comprehensive document contains detailed information about programs that provide rebates and/or other assistance to businesses for NEMA Premium® motors and/or adjustable-speed drives. Search by state, region, or organization. Organizations administering the programs include energy-efficiency organizations and utilities that operate on a statewide or regional scale. The Summary includes programs in California, Hawaii, the Northwest, British Columbia, Texas, the Midwest, and the Northeast

Visit www.motorsmatter.org to download a PDF of the most recent Summary.

Northeast Energy Efficiency Partnerships, Inc. (NEEP)
NEEP is a nonprofit regional organization. Its mission is to promote energy efficiency in homes, buildings and industry in the Northeast through regionally coordinated programs and policies that increase the use of energy-efficient products, services, and practices, and that help achieve a cleaner environment and a more reliable and affordable energy system.

NEEP is working with organizations in New England, New Jersey, and New York to offer incentives for premium efficiency motors as the standard for motors sold in the northeast region for commercial and industrial uses. Visit www.neep.org or www.motoruponline.com to learn more about NEEP's motor initiatives.

Midwest Energy Efficiency Alliance (MEEA)
MEEA is a collaborative network whose purpose is to advance energy efficiency in the Midwest in order to support sustainable economic development and environmental conservation. MEEA's programs focus on residential and commercial energy-efficiency projects. Learn more at MEEA's website, www.mwalliance.org.

Southwest Energy Efficiency Project (SWEEP)
SWEEP collaborates with utilities, state agencies, environmental groups, universities, and other energy efficiency specialists to promote electricity conservation in Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming.

The SWEEP website, www.swenergy.org, contains information on local, and utility policies and programs to advance energy efficiency. Many of these summaries, available under "Regional Policies & Programs," include links for further information. Examples of completed energy-efficiency projects are available under "Regional Case Studies."

Advanced Energy
Advanced Energy provides consulting services, training, and resources for motors and adjustable-speed drives to businesses in the Southeast. The organization also conducts testing and research through the Motor Resource Center, a partnership with the Washington University Extension Energy Program. Visit www.advancedenergy.org or www.motorresourcecenter.org to learn more about the resources available through Advanced Energy and the Motor Resource Center.

Northwest Energy Efficiency Alliance (Alliance)
The Alliance is a nonprofit corporation supported by electric utilities, public benefits administrators, state governments, public interest groups, and energy-efficiency industry representatives. These entities work together to make affordable, energy-efficient products and services available in the marketplace.

The Alliance's website, www.nwalliance.org, contains market research reports and case studies on motors and drives, and links to other motor resources. The Alliance is in the process of developing a new initiative for the industrial sector, which will incorporate motors as part of a larger energy-efficiency focus.

About Motor Decisions Matter

Motor Decisions Matter (MDM) is a national awareness campaign designed to promote the benefits of sound motor management to corporate and plant decision-makers. MDM sponsors — a collaborative of utilities, energy-efficiency organizations, government agencies, manufacturers, and trade associations — are working together to promote this common message to the market. Effective motor management can reduce costly downtime *and* save energy and money.

Motor Decisions Matter is managed and coordinated by the Consortium for Energy Efficiency.

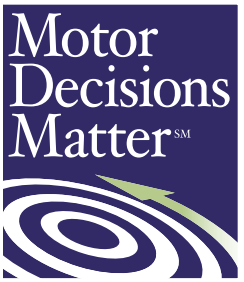
MDM provides a single, coordinated voice in the market, explaining the benefits of motor management and planning to a variety of stakeholders. MDM's goal is to increase the demand for premium-efficiency motors and quality motor repair services by highlighting the positive effects of good motor management on business performance.

The campaign encourages customers to work through local motor professionals and others to develop motor management plans. *Motor Decisions Matter* helps industrial and commercial customers use life-cycle costing methods to determine whether motors should be repaired or replaced *before they fail* and when to install premium-efficiency motors.

MDM was rolled out on June 25, 2001, and funded by sponsors for three years. MDM sponsors have extended the campaign for another three years, beginning in 2004.

In February 2004, MDM sponsors began distribution and promotion of the *1-2-3 Approach to Motor Management*, an innovative software tool that demonstrates how industrial and commercial facility managers can reduce downtime and save energy by proactively managing their motor fleets. The tool calculates the financial impact of common motor-related decisions.

For further information on Motor Decisions Matter, or to download the *1-2-3 Approach*, visit www.motorsmatter.org.



Motor Decisions Matter
98 North Washington Street
Suite 101
Boston, MA 02114
Phone: 617-589-3949
Fax: 617-589-3948

For additional copies, please call 617-589-3949.

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www.motorsmatter.org.

You can also request an information packet from the U.S. DOE's Office of Energy Efficiency and Renewable Energy (EERE) at 877-337-3463 or visit EERE online at:

www.eere.energy.gov/industry/resources.

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