Demand-Side Management Technology Workshop: Motors and Variable Frequency Drives

Sponsored by

Basin Electric Power Cooperative

with Western Area Power Administration

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Bismarck, ND

BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

Western AREA POWER ADMINISTRATION

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Deploying a Motors Program to Your Customers

Katherine Johnson, Johnson Consulting Group

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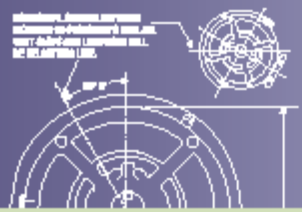

Do it today–because managing a plan is easier than managing a crisis.

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Trade Associations

Copper Development Association Inc.
Electrical Apparatus Service Association (EASA)
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Motor management lets you take charge of your bottom line.

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Web-based "How To" Guide

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Tips for Energy-Efficiency Programs

- **Post a link** to MDM on your website.
- **Include the MDM logo** in your marketing materials
- **Share motor management message**s through existing communications with your staff, contractors, and trade allies.
- **Provide regular and ongoing education** for your account managers, product design group, and other internal
- **Use MDM tools and materials** – they're FREE!
- **Develop an outreach strategy** to educate local trade allies about the financial benefits of motor management concepts.

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Empower Vendors

- Program staff or contracts educate vendors on the financial benefit of motor management
- Assist vendors in offering motor management services to customers;
- Ride along with vendors to perform on-site motor inventories for customers;
- Help vendors use software tools to present customers with the business case for proactive planning.
- Who's doing it:
  - NYSERDA Premium Efficiency Motors Program
  - National Grid Pilot Program

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Hire Contract Auditors

- Contractors are trained in the *1-2-3 Approach to Motor Management* and other MDM tools;
- Audits focus on opportunities for energy savings through lighting projects, motors, compressed air, and other sectors;
- Contractors with specific expertise in a non-motor area often hire motor vendors to ride along and enhance the value of service to the customer.
- Who's doing it:
  - National Grid Project Expediters (PEX)

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Educate Customers

- Program staff assesses the customer's current motor management practices compared to industry peers and best practice.
- Program staff analyzes the customer's motors list and develops a business case that highlights savings opportunities through motor management.
- Staff performs an on-site audit on motors of interest and holds discussions with plant management and operations team.
- Develop a customized motor management plan operations guide and a report that justifies the adoption of the guide.
- Who's doing it:
  - BC Hydro Power Smart

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Educate Vendors, Customers, and Trade Organizations

- Host regional seminars, workshops, and/or meetings;
- Invite largest customers, local vendors, and members of relevant trade associations such as building maintenance operators
- present information about how motor management affects each group's business; present information about your program and how to connect to it.
- Who's doing it:
  - Austin Energy

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Program Tracking and Evaluation

- Customer satisfaction
- Trade ally satisfaction
- Customer energy savings
- Net economic benefits
- Cost and benefits summary (including non-quantifiable benefits).

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Quantifying Non-Energy Benefits

- Non-Energy benefits include:
  - Increased plant efficiency
  - Worker productivity and safety,
  - Reduced carbon emissions because of the overall lower energy use.

Greenhouse Gas Equivalencies Calculator

U.S. ENVIRONMENTAL PROTECTION AGENCY

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Greenhouse Gas Equivalencies Calculator

UPDATED February 17, 2009. This calculator was updated to include the eGRID2007 Version 1.1 annual non-baseload CO_2 output emission rates (year 2005 data). See the revision history page for more details.

Did you ever wonder what reducing carbon dioxide (CO_2) emissions by 1 million metric tons means in everyday terms? The following equivalency calculator can help you understand just that.

For example, it can be difficult to visualize what a "metric ton of carbon dioxide" really is. This calculator will translate rather difficult to understand statements into more commonplace terms, such as "is equivalent to avoiding the carbon dioxide emissions of X number of cars annually."

Other Calculators

There are a number of other web-based calculators that can estimate greenhouse gas emission reductions for

- individuals and households
- waste, and
- transportation.

For basic information and details on greenhouse gas emissions, visit the Emissions section of EPA's climate change site.

This equivalency calculator may be useful in communicating your greenhouse gas reduction strategy, reduction targets, or other initiatives aimed at reducing GHG emissions.

Enter Your Data Below

There are two options for entering reduction data into this calculator.

http://www.epa.gov/cleanenergy/energy-resources/calculator.html

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Carbon Savings from 500,000 kWh

- Equal to 359 metric tons of CO_2
- Reductions are equivalent to one of the following;
  - CO_2 emissions from 40, 758 gallons of gasoline consumed
  - CO_2 emissions 835 from barrels of oil consumed
  - CO_2 emissions from the ***electricity*** use of 49.5 homes for one year
  - CO_2 emissions from the ***energy*** use of 32.7 homes for one year

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Overview of Motors/VFD Tools and Resources

Motor and VFD Case Studies

- ***Lumber/Wood Products:*** Alder Creek Lumber implemented a decision to purchase NEMA Premium motors. The first 200 HP motor replaced will save close to $8300 per year – a payback period of less than 12 months.
- ***Water/Wastewater:*** Officials running Frank L. VanLare wastewater treatment facility believe NEMA Premium motors help hold down energy costs and increase the systems reliability.
- ***Other Industries:*** In one small manufacturing area at Eastman Kodak's Kodak Park, replacing motors with NEMA Premium motors resulted in savings of 250,000 kWh annually (or about $17,250).

www.motorsmatter.org/case_studies/alpha_list.html

Examples of Motor Replacement Decisions

Demonstrations and Examples Using Motor Master

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Motor Master Software

- Introduction and Overview
- Examples using Motor Master Software

Motor Decisions Matter
www.motorsmatter.org

Estimated Annual Energy Savings with NEMA Premium® Motors[1]

TEFC · 1800 RPM · Full-load Operation · Nominal Efficiency[3]

Estimated Annual Energy Cost = (Hp x annual operating hours x cost of electricity x 0.746) / (efficiency)

Enter Appropriate Values for:

Annual Operating Hours : 8000 hrs per year

Cost of Electricity : 7 ¢ per kWh

Learn more about saving money through sound motor management. For additional tools and resources, visit www.motorsmatter.org.

Motor Size[2] (hp)	Estimated Annual Operating Costs		Estimated Annual Energy Savings	Estimated Annual Operating Costs		Estimated Annual Energy Savings	Estimated Annual Operating Costs		Estimated Annual Energy Savings
	Pre-EPAct Motors	EPAct Motors	Pre-EPAct → EPAct	EPAct Motors	NEMA Prem Motors	EPAct → NEMA Prem	Pre-EPAct Motors	NEMA Prem Motors	Pre-EPAct → NEMA Prem
1	$545	$506	**$38**	$506	$489	**$18**	$545	$489	**$56**
1.5	$792	$746	**$46**	$746	$724	**$22**	$792	$724	**$68**
2	$1,034	$995	**$39**	$995	$966	**$29**	$1,034	$966	**$68**
3	$1,540	$1,432	**$107**	$1,432	$1,400	**$32**	$1,540	$1,400	**$139**
5	$2,508	$2,387	**$120**	$2,387	$2,334	**$53**	$2,508	$2,334	**$174**
7.5	$3,665	$3,501	**$164**	$3,501	$3,417	**$84**	$3,665	$3,417	**$248**
10	$4,875	$4,668	**$207**	$4,668	$4,556	**$112**	$4,875	$4,556	**$319**
15	$7,236	$6,886	**$350**	$6,886	$6,782	**$104**	$7,236	$6,782	**$454**
20	$9,441	$9,182	**$259**	$9,182	$8,984	**$197**	$9,441	$8,984	**$457**
25	$11,695	$11,303	**$392**	$11,303	$11,158	**$145**	$11,695	$11,158	**$537**
30	$13,988	$13,564	**$424**	$13,564	$13,390	**$174**	$13,988	$13,390	**$598**
40	$18,526	$17,968	**$558**	$17,968	$17,758	**$210**	$18,526	$17,758	**$768**
50	$22,878	$22,460	**$418**	$22,460	$22,104	**$357**	$22,878	$22,104	**$775**
60	$27,305	$26,779	**$525**	$26,779	$26,385	**$395**	$27,305	$26,385	**$920**
75	$34,168	$33,296	**$871**	$33,296	$32,843	**$454**	$34,168	$32,843	**$1,325**
100	$45,261	$44,207	**$1,054**	$44,207	$43,790	**$417**	$45,261	$43,790	**$1,471**
125	$56,638	$55,259	**$1,378**	$55,259	$54,738	**$521**	$56,638	$54,738	**$1,900**
150	$67,381	$65,962	**$1,419**	$65,962	$65,411	**$551**	$67,381	$65,411	**$1,969**
200	$89,360	$87,949	**$1,411**	$87,949	$86,852	**$1,097**	$89,360	$86,852	**$2,508**
Size[2] (hp)	Pre-EPAct Motors	NEMA Energy Efficient Motors	**Energy Efficient → EPAct**	NEMA Energy Efficient Motors	NEMA Prem Motors	**Energy Efficient → NEMA Prem**	Pre-EPAct Motors	NEMA Prem Motors	**Energy Efficient → NEMA Prem**
250	$110,870	$109,937	**$934**	$109,937	$108,565	**$1,371**	$110,870	$108,565	**$2,305**
300	$132,763	$131,371	**$1,392**	$131,371	$130,279	**$1,092**	$132,763	$130,279	**$2,484**
350	$154,562	$153,266	**$1,296**	$153,266	$151,992	**$1,275**	$154,562	$151,992	**$2,571**
400	$176,270	$175,161	**$1,109**	$175,161	$173,705	**$1,457**	$176,270	$173,705	**$2,565**
450	$198,095	$197,057	**$1,038**	$197,057	$195,418	**$1,639**	$198,095	$195,418	**$2,677**
500	$220,105	$218,038	**$2,068**	$218,038	$217,131	**$907**	$220,105	$217,131	**$2,974**

1. This chart provides an estimated comparison of annual energy costs for Pre-EPAct, EPAct and NEMA Prem motors. Actual costs and savings may differ from the values shown.

2. The break in Motor Size between 200 and 250 hp occurs because EPAct applies to motors up to 200 hp. Above that value, NEMA's Energy Efficient Motor specification has been used as the reference.

3. The nominal efficiency values used in these calculations are defined as follows: Pre-EPAct Motors: DOE's MotorMaster+ software version 4.00.01 (9/26/2003) "Average Standard Efficiency" motor defaults ; EPAct Motors: Energy Policy Act of 1992 ; Energy Efficient Motors: NEMA MG 1-2003 Table 12-11 ; NEMA Premium Motors: NEMA MG 1-2003 Table 12-12.

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Resources on Motors

- ***NEMA Premium:*** The energy specification tables for NEMA Premium® motors are available on NEMA's website www.nema.org.
- ***Buying an Energy-Efficient Electric Motor*** (U.S. Department of Energy, 1996) www.eere.energy.gov/industry/bestpractices/motors.html
- ***Efficient Motors: Selection and Application Considerations*** www.cee1.org/ind/motrs/motr-broch.pdf.
- ***Replacing an Oversized and Underloaded Electric Motor*** (U.S. Department of Energy) www.eere.energy.gov/industry/bestpractices/motors.html

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Motor Repair Resources

- ***A Guide to AC Motor Repair and Replacement*** *(EASA)*
  www.easa.com, under "Industry Info."
- ***Guidelines for Maintaining Motor Efficiency During***
- ***Rebuilding*** *(EASA Tech Note No. 16)*
  www.easa.com, under "Industry Info."
- ***Service Center Evaluation Guide*** (U.S. Department of Energy, 2001)
  www.eere.energy.gov/industry/bestpractices/techpubs_motors.html

VFD Resources

- ***Application Guide for AC Adjustable Speed Drive Systems*** (National Electrical Manufacturers Association, 2001, www.nema.org, under "Standards."
- ***National Summary of Energy-Efficiency Programs for Motors and Drives*** (*Consortium for Energy* Efficiency, 2004) www.motorsmatter.org to download a PDF of the National Summary.
- ***Variable Frequency Drives: Technical Data Sheet (Wisconsin's Focus on Energy program, 2004***) www.focusonenergy.com/data/common/dmsFilesStaging/B_GC_MKFS_BPVariablefrequencydrives.pdf.

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VFD Resources (continued)

- ***Determining Electric Motor Load and Efficiency*** (U.S. Department of Energy) Available online at www.eere.energy.gov;
- ***Energy-Efficient Motor Systems: A Handbook on Technology, Program, and Policy Opportunities*** *(2nd ed.)*
- ***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) Available online at www.eere.energy.gov/industry/bestpractices/motors.html.

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Key Websites

- ***Motor Decisions Matter Sponsors:*** 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 www.eere.energy.gov/industry/resources.

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