Best Practices in Energy Efficient Industrial Technologies: Motor Systems

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Motor Systems

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The Institute for Industrial Productivity (IIP) provides companies and governments with the best energy efficiency practices to reduce energy costs and prepare for a low carbon future. Our global team and independent experts offer an integrated service package comprising technology, policy and financing components.

We are the partner of choice for companies and governments—whether the need is best practice information or a tailored approach to implementing an initiative.

The Institute for Industrial Productivity works across the globe with a near-term focus on China, India, and the USA to ensure industrial stakeholders have access to the most effective energy efficiency technology, policy and financing approaches. We do this by:

• sharing best practices and providing access to a network of international experts;
• developing original research, analysis and databases; and
• bridging the gap between government policy and industry implementation.

Companies, industry associations and governments can leverage our expertise to achieve their goals.

Many companies, industry associations, and governments are aware that increasing energy efficiency cuts costs and helps achieve sustainable economic growth, and they establish goals to boost energy productivity. The Institute for Industrial Productivity helps these organizations understand which technologies, policies and financing options will help them achieve their vision. Our integrated technology, policy and financing model and our broad network of experts makes us the partner of choice for governments, and companies that share our goal of competitive industries through a low carbon future. The Institute for Industrial Productivity is a nonprofit organization independently funded by the ClimateWorks Foundation, serving as its Best Practice Network partner for the industrial sector.
Abstract

As part of its mission, the Institute for Industrial Productivity (IIP) endeavours to help industry develop and implement practices that will dramatically reduce greenhouse emissions and improve economic efficiency in the industrial sector. Acting as a clearinghouse, IIP has developed a digital library of global best practices in the area of Motor Systems. This compendium includes an overview of energy efficiency measures as well as a comprehensive collection of international resources on the subject, all made available via the IIP website.
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Introduction

The Institute for Industrial Productivity (IIP) recognizes that decision-makers in energy-intensive industries, including cement, iron & steel, chemicals, petroleum refining, and pulp & paper can help reduce greenhouse emissions and improve economic efficiency through implementation of best practices.

Motor systems have been identified as being the major electricity consumer in the industrial sector and have been recognised as having one of the largest savings potential.

30 million new electric motors are sold each year for industrial purposes; 300 million motors are in use in industry, infrastructure and large buildings. These electric motors are responsible for 40% of global electricity used to drive pumps, fans, compressors and a large variety mechanical of drivepower equipment.

Typically electric motors are a component in a motor system, being responsible for the conversion of electrical power into mechanical power.

Electric motor systems are by far the most important type of electric load in industry, in the EU, using about 70% of the consumed electricity. In the tertiary sector, electric motor systems use about one third of the consumed electricity (1) (2)

There is a potential to improve the energy efficiency of industrial motor systems typically by 20% to 30% (3) (4) (5). In most cases, the three major contributors to these savings are the following:

- Use of Energy Efficient Motors: Major improvements have been achieved in the last decades with the large scale introduction of high-efficiency and Premium motors. New developments are already making available a new generation of Super-Premium motors (6).
- Use of adjustable-speed drives, where appropriate, to match the speed and the torque to the load requirements; this allows in some cases the replacement of inefficient throttling devices and in other cases the simplification (or even avoidance) of wasteful mechanical transmissions;
- ...
Optimization of the complete system, including a correct sized motor, pipes, gears and efficient end-use equipment (fans, pumps, compressors, traction systems) to deliver the required energy service most efficiently.

Potential energy savings in motor systems can have very wide variations, depending on many variables. However, typical potential energy savings for typical measures are estimated for the most relevant motor systems (pumps, fans and compressed air) and presented in the tables that follow.

FIGURE 4: Efficiency of an electric motor pumping system, showing the energy saving potential (9)

Conventional Pumping System (Efficiency ~ 31%)

<table>
<thead>
<tr>
<th>Input Power</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard motor efficiency = 90%</td>
<td></td>
</tr>
<tr>
<td>Coupling efficiency = 98%</td>
<td></td>
</tr>
<tr>
<td>Pump efficiency = 77%</td>
<td></td>
</tr>
<tr>
<td>Pipe efficiency = 69%</td>
<td></td>
</tr>
<tr>
<td>Throttle efficiency = 66%</td>
<td></td>
</tr>
<tr>
<td>Output power ~31</td>
<td></td>
</tr>
</tbody>
</table>

Efficiency Optimized Pumping System (Efficiency ~ 72%)

<table>
<thead>
<tr>
<th>Input Power</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable speed drive efficiency = 96%</td>
<td></td>
</tr>
<tr>
<td>High-efficency motor (eff. ~ 95%)</td>
<td></td>
</tr>
<tr>
<td>Improved piping (eff. ~ 90%)</td>
<td></td>
</tr>
<tr>
<td>Coupling efficiency = 95%</td>
<td></td>
</tr>
<tr>
<td>High efficiency pump (eff. ~ 88%)</td>
<td></td>
</tr>
<tr>
<td>Output power ~71.5</td>
<td></td>
</tr>
</tbody>
</table>

Based on UNIDO, 2011.
**TABLE 1: Energy Efficiency Measures and % Efficiency Improvement for Pump Systems (10)**

<table>
<thead>
<tr>
<th>Energy Efficiency Measure</th>
<th>Typical % improvement in energy efficiency over current Pump system efficiency practice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Improvement over LOW eff. base case</td>
</tr>
<tr>
<td>Upgrade System Maintenance</td>
<td></td>
</tr>
<tr>
<td>Fix Leaks, damaged seals, and packing</td>
<td>3.5%</td>
</tr>
<tr>
<td>Remove scale from components such as heat exchangers and strainers</td>
<td>10.0%</td>
</tr>
<tr>
<td>Remove sediment/scale buildup from piping</td>
<td>12.0%</td>
</tr>
<tr>
<td>Eliminate unnecessary uses</td>
<td></td>
</tr>
<tr>
<td>Use pressure switches to shut down unnecessary pumps</td>
<td>10.0%</td>
</tr>
<tr>
<td>Isolate flow paths to nonessential or non-operating equipment</td>
<td>20.0%</td>
</tr>
<tr>
<td>Matching Pump System Supply to Demand</td>
<td></td>
</tr>
<tr>
<td>Trim or change impeller to match output to requirements</td>
<td>20.0%</td>
</tr>
<tr>
<td>Meet variable flow rate requirement w/o throttling or bypass*</td>
<td></td>
</tr>
<tr>
<td>Install variable speed drive</td>
<td>25.0%</td>
</tr>
<tr>
<td>Replace pump with more energy efficient type</td>
<td>25.0%</td>
</tr>
<tr>
<td>Replace motor with more energy efficient type</td>
<td>5.0%</td>
</tr>
<tr>
<td>Initiate predictive maintenance program</td>
<td>12.0%</td>
</tr>
</tbody>
</table>

* For pumping systems dominated by static head, multiple pumps may be a more appropriate way to efficiently vary flow.
### TABLE 2: Energy Efficiency Measures and % Efficiency Improvement for Compressed Air Systems (11)

<table>
<thead>
<tr>
<th>Energy Efficiency Measure</th>
<th>Typical % improvement in energy efficiency over current Compressed Air system efficiency practice</th>
<th>% Improvement over LOW eff. base case</th>
<th>% Improvement over MED eff. base case</th>
<th>% Improvement over HIGH eff. base case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upgrade System Maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fix Leaks, adjust compressor controls, establish ongoing plan</td>
<td></td>
<td>20.0%</td>
<td>15.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Replace existing condensate drains with zero loss type</td>
<td></td>
<td>5.0%</td>
<td>3.0%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Correct compressor intake problems/replace filter</td>
<td></td>
<td>2.0%</td>
<td>1.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Improve system pressure profile/reduce supply side target pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address restrictive end use drops and connections, faulty FRLs</td>
<td></td>
<td>5.0%</td>
<td>4.0%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Reconfigure branch header piping to reduce critical pressure loss</td>
<td></td>
<td>4.0%</td>
<td>3.0%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Correct excessive pressure drops in main line distribution piping</td>
<td></td>
<td>5.0%</td>
<td>3.0%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Correct excessive supply side pressure drop; i.e., treatment equipment</td>
<td></td>
<td>5.0%</td>
<td>3.0%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Reduce compressed air waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eliminate inappropriate compressed air uses</td>
<td></td>
<td>20.0%</td>
<td>13.0%</td>
<td>3.0%</td>
</tr>
<tr>
<td>Improve end use efficiency; shut-off idle equip, engineered nozzles, etc.</td>
<td></td>
<td>12.0%</td>
<td>8.0%</td>
<td>3.0%</td>
</tr>
<tr>
<td>Replace motor with more energy efficient type</td>
<td></td>
<td>10.0%</td>
<td>7.0%</td>
<td>3.0%</td>
</tr>
<tr>
<td>Initiate predictive maintenance program</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eliminate artificial demand with pressure optimization/control/storage*</td>
<td></td>
<td>5.0%</td>
<td>3.0%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Isolate high pressure and intermittent high volume uses**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Install dedicated storage with metered recovery</td>
<td></td>
<td>5.0%</td>
<td>3.0%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Balance supply with demand and improve control strategy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Install sequencer</td>
<td></td>
<td>15.0%</td>
<td>8.0%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Improve trim compressor part load efficiency; i.e. variable speed drive</td>
<td></td>
<td>20.0%</td>
<td>15.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Match air treatment to demand side needs</td>
<td></td>
<td>8.0%</td>
<td>6.0%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Size replacement compressor to meet demand</td>
<td></td>
<td>18.0%</td>
<td>13.0%</td>
<td>9.0%</td>
</tr>
<tr>
<td>Initiate predictive maintenance program</td>
<td></td>
<td>20.0%</td>
<td>15.0%</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

* Eliminating artificial demand can be addressed to some extent with manual, low cost approaches; more expensive automated approaches may yield higher savings depending on the variability of system demand and other factors.

** There are several ways to efficiently address a high volume intermittent uses, including booster compressors and dedicated compressors, and metered storage.
TABLE 3: Energy efficiency measures and percentage efficiency improvement for Fan systems (12)

<table>
<thead>
<tr>
<th>Energy Efficiency Measure</th>
<th>Typical % improvement in energy efficiency over current Fan system efficiency practice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Improvement over LOW eff. base case</td>
</tr>
<tr>
<td>Upgrade System Maintenance *</td>
<td></td>
</tr>
<tr>
<td>Fix leaks and damaged seals</td>
<td>5.0%</td>
</tr>
<tr>
<td>Repair or replace inefficient belt drives</td>
<td>4.5%</td>
</tr>
<tr>
<td>Remove sediment/scale buildup from fans and system surfaces</td>
<td>2.5%</td>
</tr>
<tr>
<td>Correct damper problems</td>
<td>5.0%</td>
</tr>
<tr>
<td>Correct System Flow Problems</td>
<td></td>
</tr>
<tr>
<td>Isolate flow paths to nonessential or non-operating equipment</td>
<td>12.0%</td>
</tr>
<tr>
<td>Correct poor airflow conditions at fan inlets and outlets</td>
<td>10.0%</td>
</tr>
<tr>
<td>Correct Fan Size/Type/Position to Increase Efficiency **</td>
<td></td>
</tr>
<tr>
<td>Replace oversized fans with more efficient type</td>
<td>18.0%</td>
</tr>
<tr>
<td>Efficiently meet variable flow requirement (w/o dampers or bypass) ***</td>
<td></td>
</tr>
<tr>
<td>Install variable speed drive</td>
<td>35.0%</td>
</tr>
<tr>
<td>Replace motor with more energy efficient type</td>
<td>5.0%</td>
</tr>
<tr>
<td>Initiate predictive maintenance program</td>
<td>3.0%</td>
</tr>
</tbody>
</table>

* Vibration analysis and addressing bearing maintenance are important for system operation, but are more of a reliability issue.
** Relocating a fan to the clean side of a process can increase energy efficiency, but is more of a design issue for new systems and is rarely possible in existing systems.
*** Use controls to shut down or slow down unnecessary fans.

One of the identified barriers to the penetration of more efficient technologies and practices has been the lack of information and detailed knowledge regarding their implementation. Sometimes the dispersed state of the materials and the difficulty in finding the right information for the purpose and level of expertise needed also acts as a further deterrent.
Why Compile Motor Systems Best Practices?

A structured library of electronic resources comprised of relevant, usable information can provide valuable insight for those seeking to research and implement the best practices available in the field of Motor Systems. Consolidating this information in one convenient location:

- Raises interest in energy savings
- Simplifies the access to quality information, taking into account the purpose and complexity of the materials
- Provides tools for different audiences and for different applications in order to effectively implement energy saving projects

- Reduces the costs of generating new materials through shared international efforts.
- Identifies “World leading” publications that deserve greater dissemination.
- Establishment of a vital database of best practices also provides a destination where useful information and evolving techniques can be shared.
Resources for Motor Systems

Since there is substantial information available to help industrials and other large users throughout the world maximize the efficiency of motors, we have organized resources into manageable categories. Figure 4 provides a quick overview of the organizational structure.

**FIGURE 4: Efficiency Categorization of Collected Resources**

<table>
<thead>
<tr>
<th>MOTORS</th>
<th>MOTOR SYSTEMS</th>
<th>END USES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High Efficiency Motors</td>
<td>Variable Speed Drives</td>
<td>Pumps</td>
<td></td>
</tr>
<tr>
<td>Repair / Maintenance</td>
<td>Controllers</td>
<td>Fans</td>
<td></td>
</tr>
<tr>
<td>Best Practices</td>
<td>Transmission</td>
<td>Compressors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Best Practices</td>
<td>Refrigeration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Best Practices</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**International Organizations**

**The International Energy Agency (IEA)**
http://www.iea.org/

The International Energy Agency is an autonomous organisation which works to ensure reliable, affordable and clean energy for its 28 member countries and beyond. One of its main areas of activity is the promotion of greenhouse gas emission abatement, through enhanced energy efficiency.

The IEA has recently launched the 4E program (Efficient Electrical End-Use Equipment) in which motor systems are included through the Electric Motor Systems Annex (EMSA). EMSA bundles best technical practice and policy know-how in order to stimulate market transformation towards energy efficiency in the field of electric motor systems and their applications in industry, infrastructure and large buildings. The project deals with pumps, fans, compressors, industrial handling & processing.

The goal of EMSA is to propagate energy efficiency in electric motor systems of advanced technology and engineering by coordinated policy and market mechanisms. The reduction of electricity demand will reduce global CO2 emissions.

**United Nations Industrial Development Organisation (UNIDO)**
http://www.unido.org/index.php?id=1000475

UNIDO runs programs in developing and emerging economies to develop capacity and transfer technology, which includes motor activities. An example is the China Motor Systems optimisation program.

**International Copper Association (ICA)**

The ICA and its regional organisations run a variety of programs either alone or in conjunction with other bodies to promote the use of copper through encouraging the uptake of energy efficient motors.

International work has included the leadership of the IMSSA (International Motor Systems Software Analysis) tool, and co-funding of many regional energy efficiency programs. In Europe, they run and maintain the Leonardo electrical power quality web-site, which is the pre-eminent site for many aspects of electrical energy efficiency. They have a regular schedule of web-casts.
Air Movement and Control Association (AMCA)
http://www.amca.org/
AMCA is the pre-eminent international testing body for air movement applications, and develops and publishes guides and international standards that underpin efficiency regulations for fans and buildings.

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
http://www.ashrae.org/
Similar to AMCA, ASHRAE develops and publishes a range of guides and international standards that underpin efficiency regulations in the building sector.

Electrical Apparatus Service Association (EASA)
http://www.easa.com/
The Electrical Apparatus Service Association, Inc. is an international trade organization of over 2,100 electromechanical sales and service and maintenance firms of motors, drives, controls and other electromechanical equipment in 58 countries. Through its many engineering and educational programs, EASA provides members with a means of keeping up to date on materials, equipment, and state-of-the-art technology.

Collaborative Labelling and Standards Programme (CLASP)
http://www.clasponline.org/clasp.online.about.php
CLASP’s primary objective is to identify and respond to the assistance needs of Standards and Labelling practitioners in targeted countries and regions while making the highest quality technical information on S&L best practice available globally.

To this end, CLASP works on the ground providing technical assistance and expertise to national governments and local partners; aggregates resources; assembles project teams from diverse and highly-qualified organizations; oversees projects; partners and collaborates with policy makers and members of industry alike; and disseminates information for maximum impact.

CLASP’s projects result in enhanced institutional capacity at local, regional, and international levels, improved energy efficiency of appliances, lighting, and equipment, significant reductions in electricity consumption, and abatement of greenhouse gas emissions.

North America

United States Department of Energy (DOE)
http://www.energy.gov/
The United States Department of Energy (DOE) is a department of the United States government concerned with the United States’ policies regarding energy and safety.

Dependant from the DOE is the Office of Energy Efficiency and Renewable Energy (EERE) which leads the Federal government’s research, development, and deployment efforts in energy efficiency. Program activities are conducted in partnership with the private sector, state and local government, DOE national laboratories, and universities. EERE also works with stakeholders to develop programs and policies to facilitate the deployment of advanced clean energy technologies and practices (13).

The Industrial Technologies Program (ITP) is the leading government program working to increase the energy efficiency and reduce carbon emissions of U.S.

Through Best Practices, ITP helps improve the energy intensity of the U.S. industrial sector, by implementing proven technologies and energy management practices. The program offers resources such as software tools, training and technical information and resources for corporate executives, plant managers, technical staff and the general public (14).

Consortium for Energy Efficiency (CEE)
http://www.cee1.org
CEE is a consortium of efficiency program administrators from across the U.S. and Canada who work together on common approaches to advancing efficiency. Through joining forces, the individual efficiency programs of CEE are able to partner not only with each other, but with other industries, trade associations, and government agencies.

CEE is the promoter of Motors/Motor Systems Initiatives which establishes premium efficiency specifications for motors and develops programs for motor-system efficiency.

The goals of the CEE Motors & Motor Systems initiatives are to advance efficiency in industrial motors and motor systems by:

• defining and promoting premium efficiency motors
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- identifying opportunities to support motor system optimization
- promoting sound motor system management through the Motor Decisions Matter Campaign

**Lawrence Berkeley National Laboratory (LBNL)**
http://www.lbl.gov/

The Lawrence Berkeley National Laboratory is a member of the national laboratory system supported by the U.S. Department of Energy through its Office of Science and managed by the University of California. It is charged with conducting unclassified research across a wide range of scientific disciplines.

The Laboratory’s 14 scientific divisions are organized within the areas of Computing Sciences, General Sciences, Energy and Environmental Sciences, Life Sciences, and Photon Sciences.

The Energy Analysis Department of the Environmental Energy Technologies Division studies aspects of energy end use in the United States, including the energy use of appliances, commercial and residential buildings, industry, the public sector, electricity markets, and transmission and distribution. The Department also analyzes the effect of proposed policy measures on energy use, and they apply their expertise in energy analysis to global energy end use research, including the potential effects of policies to mitigate carbon emissions and climate change.

**National Electrical Manufacturers Association (NEMA)**
http://www.nema.org/

NEMA is the trade association for the US electrical manufacturing industry. It has extensive work done on standardization, application guides, white papers, and technical papers.

NEMA established a NEMA Premium® energy efficiency motors program to provide highly energy efficient products that meet the needs and applications of users and original equipment manufacturers (OEMs).

**American Council for an Energy-Efficient Economy (ACEEE)**
http://www.aceee.org/

The American Council for an Energy-Efficient Economy is a nonprofit organization dedicated to advancing energy efficiency as a means of promoting economic prosperity, energy security, and environmental protection.

ACEEE has conducted research on energy efficiency trends, the potential for process modernization and efficiency improvements in manufacturing, the potential productivity gains from energy efficiency and pollution prevention measures, and policies and programs for accelerating efficiency improvements.

**Motor Decisions Matter (MDM)**
http://www.motorsmatter.org/

Motor Decisions Matter is a North-American public-awareness campaign sponsored by a consortium of electric utilities, industry trade associations, and others. MDM and its sponsoring organizations provide support for companies interested in motor management in the following ways:

- Tools: guides that outline the basic components of effective motor management, and spreadsheets that allow users to complete simple, "back of the envelope" calculations of life cycle cost analysis.
- Webcasts: users can participate in online informational events that cover the basics of motor management and demonstrate how to use MDM tools.
- Information: direction to helpful resources about topics such as energy legislation, motor repair, motor selection, and DOE and EPA resources.

**Hydraulic institute (HI)**
http://www.pumps.org/

HI is a US based association working for US pump manufacturers. It publishes both its own reference documents, such as those created in conjunction with Europump, and also works with ASME and US DOE on energy related documents. It maintains a comprehensive and up to date series of training materials under the Pumplearning.org initiative, and offers e-learning courses.
Natural Resources Canada (NRCan)
Natural Resources Canada, is the ministry of the government of Canada responsible for natural resources, energy, minerals and metals, forests, earth sciences, mapping and remote sensing. Its Office of Energy Efficiency (OEE) is responsible for energy conservation, efficiency and alternative fuels information and programs. The OEE is mandated to strengthen and expand Canada's commitment to energy efficiency in order to help address the Government of Canada's policy objectives. In addition, the OEE provides resources, including workshops for professionals, statistics and analysis, and publications.

Comisión Nacional para el Uso Eficiente de la Energía (CONUEE)
http://www.conuee.gob.mx/wb/
The Comisión Nacional para el Uso Eficiente de la Energía is a decentralized body of SENER (Ministry of Energy, or Secretaria de Energia) that will advise the National Public Administration and promote the implementation of best practices related to energy efficiency in México.

Europe
European Motor Challenge Programme
http://re.jrc.ec.europa.eu/energyefficiency/motorchallenge/
The Motor Challenge Programme is a European Commission voluntary programme (launched in February 2003) through which industrial companies are aided in improving the energy efficiency of their Motor Driven Systems. Any enterprise or organisation planning to contribute to the Motor Challenge Programme objectives can participate.

Companies that use Motor Driven Systems can request "Partner" status. Through the Motor Challenge, they will receive:

- Aid in defining and carrying out an Action Plan, to reduce energy related operating expenses, while maintaining or improving reliability and quality of service;
- Public recognition for their contribution to achieving the objectives of the European Union’s energy and environmental policies.

In support of this, guidelines on energy saving with the different technologies are accessible.

Europump
http://www.europump.org/
Europump is the trade association representing European pump manufacturers. It is actively involved in European pump efficiency regulation, in particular through the EUP Directive. In parallel with, and in support of this, it writes and publishes reports/books on different aspects of energy saving in pump design, selection and usage. Several of these publications are written in conjunction with the US Hydraulic Institute.

Leonardo ENERGY
http://www.leonardo-energy.org/welcome-leonardo-energy
Leonardo ENERGY is the premier web site delivering a range of virtual libraries relating to electrical energy. Managed by European Copper Institute and its European network of 11 offices, the Leonardo ENERGY initiative is dedicated to building information centres to serve designers, engineers, contractors, architects, general managers, teachers and students, professionally or otherwise involved with electrical power.

Leonardo ENERGY provides its users with continuously updated articles, application notes, briefing papers, interactive training and information exchange and access to the world’s experts on electrical energy and related topics.

Carbon Trust - UK
http://www.carbontrust.co.uk/Pages/Default.aspx
The Carbon Trust is the de facto UK energy efficiency organisation, running a large number of initiatives to encourage energy saving in both industry and buildings. It is funded almost entirely from Government funds, and is responsible for several activities of interest to motor users:

- Industrial accelerator programs. In depth studies of sector energy use to identify particular energy saving measures of interest to individual sectors, many of which.
- Publications library. It maintains and develops a large library of publications on energy saving opportunities. These include some very detailed “Energy Efficiency Best Practice Programme” publications.
Helpline. This gives tailored advice to enquirers, and in some regions access to free or subsidised individual energy audits.

**Enhanced Capital Allowance (ECA) - UK**  
http://www.eca.gov.uk/etl

The Enhanced Capital Allowance (ECA) scheme is a key part of the Government’s program to manage climate change. It provides businesses with enhanced tax relief for investments in equipment that meets published energy-saving criteria.

This website covers equipment that qualifies for the allowance and provides background information about the scheme and its benefits, lists the eligible products and gives the performance criteria for each technology. It also explains how to claim ECAs.

In addition to providing a guide to finding products that can offer this tax allowance, many companies find it useful as a sales tool through Government endorsement of the energy savings of their products.

**Australia**

**Department of Climate Change and Energy Efficiency - Australian Government**  

The Department of Climate Change and Energy Efficiency is a department of the Australian Government. It is the key Commonwealth agency on greenhouse matters, and is responsible for both the coordination of domestic climate change policy and for managing the delivery of major new and existing Commonwealth greenhouse programs.

It has published an online guide on electric motors / motor systems best practices that includes information on the selection process, system optimization issues, control strategies, etc.

**Eco Efficiency for Queensland Manufacturers - Queensland Government**  

A program of the Australian Queensland Government implemented to serve as a tool to assist Manufacturers to implement eco-efficient practices.

It provides information and assistance for manufacturers to follow the pathway to becoming a world class, sustainable manufacturer. Eco-efficiency combines environmental improvement with cost reduction to maintain competitiveness, whilst becoming more sustainable and adapting to the pressures of a carbon constrained economy.

**Eco Smart Electricians**  

Eco Smart Electricians is an initiative of the Australian National Electrical and Communications Association. It is aimed at electricians and electrical engineers that will equip them to deal with the rapidly growing demand by consumers for improved energy efficiency.

**Asia**

**China Motor Challenge**  

The SWITCH-Asia project China Motor Challenge facilitates improvement of the operating efficiency of their systems for over 400 major industrial users of electric motor systems. Furthermore, it contributes to an increase in the demand and supply for high-efficiency motor systems through promotion of best practice in the design, production and application.

Finally, the project actively supports the improvement of a policy environment conducive to promoting industrial energy efficiency.

**China National Institute of Standardisation (CNIS)**  
http://en.cnis.gov.cn/bzygk/

The primary role of CNIS is the development of national standards, including those relating to the energy performance of products. In addition, they run energy saving programs to promote energy saving in commerce and industry. MEPs exist on a large variety of products, and are available from CNIS.

**Bureau of Energy Efficiency (BEE)**  
http://www.beeindia.in/

The Bureau of Energy Efficiency of India is an agency under the Ministry of Power, India. The agency’s primary aim is to develop programs which will increase the conservation and efficient use of energy in India. It coordinates energy efficiency and
conservation policies and programs and establishes systems and procedures to measure, monitor and verify energy efficiency results in individual sectors as well as at a macro level.

**Hong Kong Productivity Council (HKPC)**  
http://www.hkpc.org

Hong Kong Productivity Council is a multi-disciplinary organization which aims at promoting and assisting Hong Kong business sectors through the introduction of more efficient and updated business and technological methods.

Its Cleaner Production Partnership Programme (CPPP) is one of the key measures taken by the Government of Hong Kong to encourage enterprises to play their part to improve the regional environment. The Program will assist and encourage Hong Kong-owned factories to adopt cleaner production technologies and processes.

**South America**

**Programa Nacional de Conservação de Energia Elétrica (PROCEL)**  

PROCEL’s main goal is to promote the rational production and use of electricity, eliminating waste and therefore, reducing costs and investments, and improving energy efficiency. The program is responsible for the country’s energy label (Selo Procel).

It is a government program run by Electrobras, the major Brazilian power utility.

PROCEL Indústria has supported the elaboration of many publications and technical guides on energy efficiency in Industry, but these publications are only available for Universities, Associations, Enterprises and Libraries and after the approval of Electrobras.

**Excel Database and Structure**

Based on the categorization described previously, a database has been created in Excel format. It is made in such a way that it can be easily updated while maintaining consistency. The database contains 180+ entries with relevant information about Motor Systems Best Practices. It is organized into the following fields:

**Type of Document:** This column describes the type of document listed. Descriptions include:
- Guidelines
- Tipsheets
- Technology reports (e.g. Premium, Super-Premium motors, Advanced motor technologies, etc.)
- Software Tools
- Courses
- Videos
- Case studies

**Date:** Date of publication.

**Title:** The title of the resource.

**Overview/Description:** This is a small summary outlining the contents of the resource.

**Number of pages:** The number of pages is also listed as an indication of the complexity of the resource.

**Institution:** This column contains the names of the institutions which are responsible for the publication of the resources.

**Country:** This provides information on the country, or region, where the resource originated.

**Web Link:** provides the link to the webpage where the information is available.
List of Abbreviations

ACEEE - American Council for an Energy-Efficient Economy
AMCA - Air Movement and Control Association
ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
BEE - Bureau of energy efficiency
CEE - Consortium for Energy Efficiency
CLASP - Collaborative Labelling and Standards Programme
CNIS - China National Institute of Standardisation
CONUEE - Comisión Nacional para el Uso Eficiente de la Energía
EASA - Electrical Apparatus Service Association
EC - European Commission
ECA - Enhanced Capital Allowance
HI - Hydraulic institute
HKPC - Hong Kong Productivity Council
ICA - International Copper Association
IEA - International Energy Agency
LBNL - Lawrence Berkeley National Laboratory
MCP - European Motor Challenge Programme
MDM - Motor Decisions Matter
NEMA - National Electrical Manufacturers Association
NRCan - Natural Resources Canada
NYSERDA - New York State Energy Research and Development Association
PROCÉL - Programa Nacional de Conservação de Energia Elétrica
UNIDO - United Nations industrial Development Organisation
US DoE - United States Department of Energy
Conclusion

Motor Systems represent a vital sector where energy efficiencies and cost savings can be attained by industrial users. Decision-makers in these companies are challenged to seek out relevant, usable approaches. The IIP digital library is an easily accessible collection of global resources that can help inform and facilitate those changes. As a digital resource, it is also scalable, facilitating future growth and change as new sources of information become available.

References

4. de Almeida, Anibal, et al., “Improving the Penetration of Energy-Efficient Motors and Drives”.
9. de Almeida, Anibal, et al., “Improving the Penetration of Energy-Efficient Motors and Drives”.