In support of the G8 Plan of Action

Industrial motor systems energy efficiency: Towards a plan of action

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This document contains the proceedings of the Industrial Electric Motor Systems Efficiency Workshop which took place 15-16 May 2006, at the International Energy Agency in Paris. This workshop was organised as part of a set of industrial sector activities in the G8 Plan of Action. The goal is to assess the efficiency performance and to identify areas where further analysis of energy-efficiency measures by industry sector could add value, across developed and interested developing countries. This document reflects the presentations and discussions of the participants at the workshop. The views expressed in this paper do not necessarily represent those of the IEA or IEA policy. A CD-ROM with the workshop presentations is available from the IEA Secretariat in Paris.

Summary

It is estimated that up to 7% of global electricity demand could be saved if the energy-efficiency of motors and their related drive systems were to be cost-optimised from an end-user perspective. High-efficiency technologies are widely available, and proper maintenance and repair practices are well known. However, due to a number of barriers, cost-optimisation rarely occurs. Barriers and means of overcoming them are well documented. Many but not all OECD countries and a number of non-OECD countries have implemented energy-efficiency policy measures to encourage greater motor efficiency, including minimum energy performance standards for motors and motor energy-efficiency programmes. These policies have been cost-effective: however, they have been insufficient to bring about the majority of the cost-effective potential that is available. Much more can be done by standardizing and strengthening policies and programmes.

Technology status and energy-efficiency potentials

Approximately forty percent of global electricity use is accounted for by industry, and approximately two-thirds of the industrial electricity demand is accounted for by motor systems. Motor systems are widely used across all industrial sectors. Motors are also widely used in other sectors, but non-industrial motor use was not specifically addressed at this workshop. A motor system in this case means a machine (i.e. pump, fan, compressor, etc.) that is driven by a rotating electrical machine (the motor). The application of a motor system (i.e. pipeline, compressed air system, cooling system) has important energy impacts. While the efficiency of motors is generally comparatively high, the efficiency of motor systems or their applications is often low. In particular existing installations (so-called "brownfield" installations) -- but also many new installations, especially in rapidly industrializing countries -- are poorly designed for system efficiency.

Consistent and comprehensive data on motor system efficiency worldwide is lacking. Available market data from selected countries presented at the workshop indicate that there is potential to improve the energy efficiency of industrial electric motor systems worldwide by roughly 20-25%, representing a potential of up to 7% of total global electricity use. This does not take into account potential process improvements and the "demand side savings" from changes in useful energy distribution and use. Motor systems in the service sector would further increase this potential by about 50%. To achieve this savings potential, a systems approach is required. Motor systems provide a key option to enhance energy efficiency in industry and reduce CO_2 emissions. They would account for 3-4% of total emissions reduction in a global emissions stabilisation scenario for 2050.

A number of different types of electric motors exist. The most important motor type is the three-phase induction motor in the range of 0.5 kW to 200 kW. The efficiency of these motors ranges from below 75% to more than 96% at full load rated power. The measured efficiency is lower as the motor power, load and rotation speed decrease. The efficiency can also decrease due to a variation of the design voltage and actual voltage differences, the voltage unbalance increase and harmonic distortions of power. Also, rewinding and/or repairing motors can result in energy efficiency losses of several percentage points. Smaller size single-phase induction motors are the most widely used motor type, but they account only for around 20% of electricity use. Their efficiency is lower than for three-phase motors.

An energy-efficient motor not matched to the application results in lower system efficiency than a low-efficiency motor that is well-matched to its load. Oversized motors are by far the most important cause of poor power factor, which leads to larger distribution losses, large voltage fluctuations, and to the underutilization of power systems networks. However, thus far policies have mainly focused on motors as components. More efforts should be focused on the whole system.

The electricity demand of industrial motor systems can be reduced by:

- use of high-efficiency motors;
- proper sizing of the motor to the load requirements (i.e. many motors are over-sized and thus run at sub-optimal load factors, which reduces efficiency and power factor drastically);

- use of adjustable-speed drives (ASD, also known as variable speed drives (VSD)), where appropriate, to match the speed and the torque to the load requirements; this allows in some cases for the replacement of inefficient throttling devices and in other cases the simplification (or even avoidance) of wasteful mechanical transmissions;
- optimisation of the complete system, including the driven equipment (fans, pumps, compressors, traction and conveyance systems); distribution (pipes, ducts, and flow control devices such as valves, regulators, and dampers) and efficient end-use equipment (tools, presses, heat exchangers, mixers, etc) to deliver the required energy service most efficiently;
- proper maintenance and repair (e.g., poor rewinding practices can damage motors and lower their efficiency significantly and dirty heat exchange surfaces or filters can reduce system efficiency); and
- maintaining acceptable levels of power quality.

There is broad agreement that the replacement of standard-efficiency motors with high-efficiency models captures only about 10% of the energy saving potential. The remainder is achieved by a combination of proper motor sizing; appropriate use of adjustable speed drives; and other measures listed above. A systems approach is required to achieve the full savings potential.

Many motor systems are over-designed, and this results in low load factors and low efficiency. For example in the US, two-fifths of all motors operate below 40% load, resulting in an average 5% efficiency loss related to the motor operation. Adjustable speed drives can be used to reduce these losses by correctly matching the motor speed and torque to the driven load.

Motor transmission systems (e.g., gears, belts, ducts) may have 50 to 95% efficiency. A typical savings potential is 5%. Motors drive pumps, compressed air systems, fans, compressors, cooling and refrigeration equipment and other uses. Often, this equipment is over-designed, it does not match the load or it is not designed for energy efficiency. The equipment may also provide fluid or compressed air into a system that does not support useful work, e.g. such as leaks in compressed air systems and the use of throttle valves in pumping systems. Optimisation of the whole motor system can result in 20-25% efficiency gains.

Harmonic distortions and voltage variations may result in significant efficiency loss. These effects may be caused by the equipment installed in industrial facilities. Harmonic distortion because of ASDs can be avoided if filters are installed. These add about 5-10% to the cost of ASDs. Generally a system analysis (also called an Electromagnetic Compatibility, or EMC, Plan) can help to minimize cost and optimize energy efficiency in cases where many different pieces of equipment (also IT-equipment) have to be combined on the same supply line.

Recently, the use of permanent-magnet motors as high efficiency motors has become more widespread in some applications – e.g., for robots, heat-pumps, washing machines, etc. Super-conductors may be introduced for large motors in order to enhance efficiency and to reduce size, and solid copper core technology has proven to likewise increase efficiency.

Re-design of plants or processes may result in considerable motor system savings. For example, motor systems may continue to run while the production is stopped. Process re-design may also make motor systems superfluous.

Demand may be reduced by fundamental changes such as reverse osmosis instead of vapour recompression for water desalination. Direct casting of steel would remove the need for steel rolling. New paper drying methods can reduce the need for motor drives in the paper industry. However, basic process redesign usually faces important technological hurdles. Such options may first be applied in niche markets, followed by bulk applications and their widespread introduction may require decades, as introduction may be part of normal stock turnover dynamics.

Repair and rewinding of motors has two potentially negative impacts on energy efficiency. First, poor-quality motor repairs can reduce the efficiency of the motor. Secondly, the continued practice of repair can lead to the restoration of an old motor for which the low efficiency is not worth resurrecting. That is, by repairing an extremely old and inefficient motor, the end user is unwittingly losing significant energy savings. A Life Cycle Cost (LCC) analysis of such a motor would reveal that replacement is a much better option.

Hence, common rewind and repair practices must be evaluated from two standpoints.

- Develop or adopt "best practice" repair procedures (such as those put forth by the Electrical Apparatus Service Association (EASA) in the US) to ensure that motor repair facilities follow guidelines that will minimize or eliminate losses that can occur during the repair process.
- Educate end users to their responsibility and benefits of quality repair
- Educate end users to not use old "horsepower breakpoint" or similar criteria for motor repair that do not take LCC and operating costs into account when deciding how to proceed after a motor-failure.

The cost of electricity that is used during the life span of a motor is typically at least one order of magnitude greater than the investment and maintenance cost. As a consequence, small efficiency gains can easily outweigh the moderate additional investment cost and result in significant cost savings during the motor system's life span. While investment decisions for large motors often account for life cycle cost, most smaller-motors are bought off-the-shelf. And while large horsepower motors naturally use more energy, in aggregate the overwhelming number of small horsepower motors account for more energy use and hence represent a large savings potential.

Barriers to efficient motor systems

Most motor users are unaware of the large savings potential, both technological and economic, to reduce motor system energy consumption. Strategies for reducing consumption include the use of more efficient motor systems, appropriate application, retrofitting of inefficient motors and retirement of unneeded motors. Motor distributors or motor systems manufacturers (e.g., pump, fan and compressor manufacturers) respond to industrial customers, who typically make purchasing decisions based on lowest first cost, rather than life cycle cost.

Incentive structures within companies are often structured in such a way that they create disincentives to optimise motor system energy costs. For example, the equipment procurer often does not pay the energy bill, and is not rewarded for its minimisation. Furthermore the main preoccupation of plant managers is to keep the production process operating as long as possible – this makes them risk averse and inclined to operate unduly conservative motor management practices regardless of theoretical cost saving opportunities from the use of more efficient equipment or operating practices.

Furthermore, many motors are purchased as part of a “packaged system” (e.g. pump, compressor, manufacturing process), in which the end user has no impact on the choice of (energy efficient) motor. The system supplier has no incentive to use high-efficiency motors if there is a cost penalty involved, as first-cost is more important for this group.

Even though motors systems are used throughout industry and account for a large proportion of the total global electricity consumption, they are not usually the direct focus of industrial energy savings initiatives. One explanation is that each industry tends to focus their energy management efforts on the main industrial process in which they specialise, rather than supporting systems, such as motor systems, that are not unique to their industry.

Experience has shown that regulation is required to achieve high penetration rates for high-efficiency motors. Although motor system components are widely-traded commodity goods, there are large variations in the market penetration of high-efficiency motors and motor system components around the globe. Countries that have implemented minimum energy performance standards (MEPS) at relatively high efficiency levels, such as Canada and the United States, have market shares for high-efficiency motors of over 70%, whereas the market share in countries without them, such as European countries, stagnates below 10 or 15%, despite voluntary programs. Additionally, benchmarking of electric motors in Asia has shown that Australia’s MEPS for electric motors has helped to protect its market from a flood of lower-efficiency imported motors from Asian suppliers.

Current policy framework

Policies in place

Current policy packages in place worldwide to promote high-efficiency motors and motor systems comprise a range of efforts such as:

- mandatory minimum energy performance requirements with the focus on market regulation. (applied to the motor not the system);
- energy savings as a system, such as controlling a motor a adjustable speed drive;
- energy labelling or energy performance rating (mandatory and voluntary schemes exist) like the "Voluntary Agreement" between CEMEP motor manufacturers and the European Commission with the focus on motor manufacturer's self regulation;
- programmatic motor system market transformation efforts e.g. *Motor Challenge* or *BestPractices* style programmes;
- financial and fiscal incentives such as utility rebate schemes and reduced capital allowance taxation for the acquisition of efficient motors; and
- awareness building and technical support.

There are also a number of other broader-based measures that have implications for motor system efficiency, and applications of energy efficiency, such as:

- requirements or incentives to perform industrial energy efficiency audits and act upon the results i.e. codify efficient motor specification mandates in purchasing policy to ensure persistence;
- negotiated industrial energy or carbon-intensity agreements;
- support for energy service companies (ESCOs) that service the industrial and commercial sector;
- provision of favourable finance terms for energy-efficient capital investments; and
- white certificates to promote market based energy efficient motor systems implementation (Italy and France just started this mechanism).

Policy impacts

A broad assessment of policy measures oriented towards motor system efficiency has not yet been conducted; nevertheless, based on information presented at the workshop it appears that:

- In OECD countries with mandatory minimum efficiency performance standards (MEPS) for motors, the market share of high-efficiency motors typically exceeds 70%[1] after five years of implementation; in contrast, the market share in the rest of the countries stagnates below 10 or 15%, despite incentive programs. This empirical evidence indicates that such mandatory regulations that limit inefficient equipment are highly cost-effective, with the main cost associated with compliance testing. However, it must be stressed that these regulations influence only the efficiency of individual motors and do not address the efficiency of the entire motor driven system.

- Programmes oriented toward motor energy efficiency appear to have produced significant and extremely cost-effective results when of sufficient size, and with sufficient resources to attract participation. Such programmes are more resource intensive than regulatory measures, but they have the advantage that they can stimulate improvements in the efficiency of the motor driven system.

- Despite the above progress, the policies currently implemented have been insufficient, in most countries, to raise average motor system efficiency levels to cost-optimised levels.

- While important policies and programmes exist that focus on motor efficiency, the efficiency of motors differs considerably across countries and world regions. Efficiency levels are higher in countries that have had strong policies and programmes in place for more than a decade. Significant cost effective savings opportunities exist in OECD as well as non-OECD countries.

- In summary, there are a few countries with motor-system efficiency programmes, but their effectiveness and efficiency can be improved. Many countries have no motor systems efficiency programmes in place.

Recommendations

Policy instruments

- The efficiency of industrial electric motors and motor systems must be addressed under a comprehensive market transformation strategy. A portfolio, or menu, of policies and instruments is essential in order to address the multitude of barriers

[1] The remaining 30% are motors with special features (not "general purpose") and motors for non continuous operation. That means 70% is a practical maximum.

that are faced by the various stakeholders. Hence, no single policy or instrument will provide the “silver bullet” solution.

- Mandatory minimum performance requirements for discrete equipment – both motors and the equipment they drive – must be complemented by a comprehensive package of measures to address system efficiency. A high-efficiency motor is a prerequisite to achieve the full energy-saving potential, but it is insufficient; the entire system must be properly designed and maintained.

- To capitalize on the significant potential for energy savings and greenhouse gas reductions in industrial electric motor systems, governments need to reach high-level agreement to launch a market transformation program for industrial electric motor systems that:
    - is global in geographical scope;
    - has a cross-sectoral technology focus on industrial electric motor systems (rather than a sectoral, or motor-based focus);
    - includes a comprehensive set of policies & measures;
    - is a multi-stakeholder effort, involving governments, utilities, equipment manufacturers, motor dealers/distributors, business associations, motor system end-users, efficiency experts, financial institutions, and other relevant stakeholders.

- A comprehensive market transformation strategy should include the following elements:
    - harmonization of energy efficiency testing procedures, efficiency classes and marking schemes;
    - implementation of mandatory minimum efficiency performance standards (MEPS), harmonized at a high efficiency level and implemented worldwide, to gradually prohibit low-efficiency motors (and other equipment such as pumps) from entering the market. This could be a gradual process with, as a first step, harmonisation of test procedures; then establishing common or harmonised rating schemes; and then, possibly, setting a common set of efficiency "tiers" from which countries could draw to establish their own MEPS. National producers and importers should face the same MEPS. International coordination can reduce the cost for producers and provide a global level playing field;
    - implementation of policies and measures to promote uptake of efficient motor systems, including voluntary agreements; training and education, especially in system optimisation techniques; standard methodologies for the motor system assessment and efficient operation; procurement programs; promotion of efficient systems via energy services companies (ESCOs), incentive programs, financing facilities, carbon markets, white certificates, and other mechanisms; measures to improve access to information and market transparency (e.g., labeling schemes, standard harmonization efforts); and organizational innovation by companies (e.g., introduction of energy management systems).

- Market instruments such as carbon finance and white certificates can help to get energy efficient systems to the market, but experience suggests that there are many non-cost barriers. The impact of CO_2 prices and credits is therefore likely to be small until carbon finance instruments are streamlined to reduce the substantial opportunity costs for energy-efficiency investments. Use of electricity does not result in direct emissions and therefore may sometimes not be of concern to those that are responsible for CO_2 reduction in a company. However, electricity prices in many European countries have significantly increased as a consequence of the European Emissions Trading System, which creates an economic incentive to save electricity.

- General tools to promote energy efficiency must be tailored to the specifics of motor systems and their applications. Minimum energy performance standards (MEPS) and motors classification (i.e. rating) schemes are the two most important policy instruments for motors as components. Training and user awareness programmes (including software such as MotorMaster and EuroDeem), voluntary energy efficiency programmes coupled with a recognition program (Energy Star, Motor Challenge), and energy management schemes (Energy Star (US), Denmark, Sweden and Ireland) are already utilized in the US and in Europe. The same approach could be applied in other world regions. Voluntary agreements only reach 10-20% of the market. Minimum energy performance standards could help, but system assessments are also needed in order to increase motor system energy efficiency.

- A similar classification approach, as for motors, could be applied for pumps and fans. The EU procurement guidelines and the US Federal Energy Management program are examples of such approaches that could be extended.

- Energy Service Companies (ESCOs) can be used to enhance motor system efficiency, though the experience so far is mixed, especially in industry. The lack of receptivity within industrial markets to the ESCO business model, combined with the challenge of developing contracts that are sufficiently responsive to changes in production, are two significant barriers to more widespread penetration of ESCOs in industrial motor system markets.

- White certificate schemes, in which utilities pay for end-user savings, could make a difference, at least in OECD countries. There is very limited experience with white certificates, and their effectiveness as a policy instrument is not yet clear. There is a clear need to develop standardised methodologies for estimating the baseline and savings for white certificates. Wide-reaching white certificates, such as those proposed in France, might help to raise motor system efficiency. White certificates such as implemented in Italy give an incentive of $ 100/toe saved to utilities and to ESCO's. This is an example of an approach that combines targets and management systems.

- The equipment "dealer" must be leveraged to act as a partner in any market transformation activity. This *may* require a monetary incentive, but can be based on tools, training, marketing, and customer audits. If a dealer can be trained to understand and sell on the financial energy savings benefits to his customers, this generates a competitive advantage which may be a sufficient incentive by itself. Some US motor manufacturers actually offer their own end user rebates on high-efficiency products.

Enabling actions

There is a need for a common language, notably regarding efficiency. Different countries and regions (e.g., USA Energy Policy Act; EU energy label) apply different testing methods, minimum standards, and rating schemes use different testing methods and marking schemes (e.g., Premium vs. EPAct in the USA; Eff1 – Eff2 – Eff3 European motor classes; and JIS C 4212-JIS C 4210 Japanese motor classes).

The profusion of standards should be simplified. The already launched International Electrotechnical Commission (IEC) Standardisation for motor efficiency levels could clarify the international confusion. There is a need to harmonise international test procedures (i.e. IEC 60034-2) for electric motors -- similar to what is being done for compact fluorescent lamps (CFLs) through the International CFL Harmonisation Initiative (www.apec-esis.org/cfl). The Standards for Energy Efficiency of Electric Motor Systems initiative (SEEEM, www.seeem.org) could also play an important role at the interface between the standardisation bodies and government regulators.

In addition to harmonising international test procedures, it would be useful to establish a common set of efficiency "tiers" from which countries could draw when they establish minimum energy performance standards for motors.

It is crucial that end users understand the concept of life-cycle cost (LCC) when they purchase motors, and motor-driven equipment and the advantage of more efficient products. The use of tools such as MotorMaster or EuroDeem can ensure that both dealer and end user make the proper decision. Education is a key to overcoming the first cost barrier. Energy performance rating schemes are essential tools to deliver this; however, it would be beneficial in terms of stimulating industry response were there to be greater international commonality in the choice of efficiency thresholds used within these schemes.

- Eco-management and audit schemes (EMAS) may be used as a management approach (and included within an energy efficiency toolkit).

- Benchmarking for sectors may be a way to entice the use of energy-efficient equipment in general and motor system practices in particular. Additionally, international benchmarking of motor efficiency levels can be a useful tool for countries to compare the efficiency of products sold on their market to the efficiency of products exported or sold in neighbouring countries and trading partners.

- ISO could develop an international management standard for energy efficiency. There is an existing American National Standards Institute (ANSI) standard for energy-efficient management that has been applied in several countries. Motor energy-management could be incorporated into company quality assurance schemes such as ISO 14001.

- Emphasize better power quality and general system analysis within companies, in order to reduce efficiency losses; minimise harmonic distortion and voltage variation to ensure appropriate EMC (Electromagnetic Compatibility) .

- Increased R&D is needed with the target of minimising energy use of motor systems. . In the lower power range, optimized integrated systems (e.g. ASD, motor, pump) can de developed with very large potential savings. Additionally, a number of easy, state-of-the-art approaches for increasing efficiency of motor system applications for upstream and downstream processes are available.

- Co-funding or technical assistance for early adopters of basic process redesigns would help increase industry confidence, and hence acceptance of such technologies as well as decrease costs as economies of scale and R&D take effect.

Policy scope

- Policies so far have especially focused on motors as components. High-efficiency end-use equipment such as pumps and fans can bring even more important gains than efficient motors. The efficiency potentials in transmission, equipment (pumps, fans etc.) and applications (pipelines, cooling systems, etc.) should also be considered. The matching of the motor system and the service demand must be analyzed. A systems methodology using a “best practice” approach to motor systems has by far the greatest potential for energy savings.

- It may also be possible to develop minimum efficiency or “reach” standards for the efficient operation of pumps, fans, and compressed air systems. Developing suitable standards for systems efficiency poses important technical challenges; therefore, the initiation of public policy on motor systems should not be made contingent upon this step.

- The introduction of energy management standards could become a significant factor in realizing the energy efficiency potential of motor systems. Although these standards are broader than just motor systems, implementation of such standards would *de facto* require more efficient operational practices for motor systems as a cost-effective way of achieving continuous improvements in energy efficiency.

- Significant potentials for improving motor system efficiency exist in the commercial (tertiary) sector as well, in applications such as HVAC, refrigeration and elevators. For example, in elevators energy-efficient motor systems can reduce electricity use by 80%. Motors are also used in cars, notably in hybrid vehicles. The growth of this market may open up new motor systems efficiency potentials and generate learning effects relevant for industrial motor systems.

- Most energy policies tend to focus on the supply side. It would be better if the energy supply and demand side were to be simultaneously optimised.

- Government should be a reliable partner, with policy regimes and directions that are predictable and consistent over long periods.

Market actors and their role

- Equipment sellers, motor distributors, and system users need to be included in order to achieve market transformation.

- Design decisions are often made by people outside the company, such as engineering and design consultants; and these actors also need to be included and made aware of the savings potential through proper training.

- Corporate officials and plant managers – and not just technical staff -- must be made aware of the energy savings potential for motor system efficiency.

- Energy service companies (ESCOs) are also important market players who need attention and promotion. More ESCOs and financial institutions should be made aware of the very high internal rate of return (IRR) in motor system projects.

- The Global Environment Facility (GEF) may assist in the development of a suitable policy framework for developing countries.

- Motor and motor-driven equipment manufacturers need to be brought into the process of policy and programme development, as they are directly impacted, and their buy-in and support is crucial.

- Motor repair facilities, and the process itself, needs best practice guidelines, perhaps administered by an industry association.

Timing

- It is appropriate to set minimum energy performance efficiency standards for motors and system components (e.g. pumps and fans) suitably in advance of the date they come into effect, to allow producers to anticipate what is coming.

- Motor test standards are available, but may require improvement. Motor systems test standards are currently only available for some standardised types of systems. The development of test standards is a prerequisite for the development of regulatory requirements such as minimum energy performance standards (MEPS) and energy labeling or rating schemes.

- Motor system standards should be based on a series of well-accepted engineering practices and could be developed as an outcome of the standardisation of system assessment methodologies.

Follow-up actions in support of developing the G8 Plan of Action

Considering the variety of issues and opportunities identified through the course of this workshop, the G8 are invited to consider the following measures:

- Request the IEA to prepare a detailed study of the most commonly used motor systems and applications worldwide and potential for savings. The study should recommend policies as part of a comprehensive global market transformation strategy to increase motor system efficiency. A quick analysis should be done by the IEA of lessons learned and best practices across end-use efficiency programmes addressing motor systems. As part of that analysis, new methodologies (enhancing the responsibilities of system users) should be developed to quantify properly the effects of policy programmes and guide their design.

- Follow closely and provide input to standards organizations, such as the IEC, in their work to adopt standards for motor efficiency testing procedures and efficiency class designations.

- Work through the IEC to harmonise international test procedures (i.e. IEC 60034-2) for electric motors, in order to have a single commonly used international test standard. At the same time, work to establish a common set of efficiency “tiers” from which countries could draw when they establish minimum energy performance standards for motors.

- In support of the above, engage in and support initiatives to promote convergence on technical harmonization (first test procedures, then efficiency classes, marking schemes, etc.) and share experience, derive best practice and coordinate measures to promote efficient motor systems (eg mandatory and voluntary performance requirements), e.g. through the SEEEM initiative.

- Establish standardized motor system assessment methodologies based on engineering best practices that have been thoroughly field-tested in the US, EU, and China as a foundation for attracting financing (Clean Development Mechanism (CDM) and other) and for future development of system standards, (e.g. through the ISO standards process). Promote the development of a motor system benchmark assessment tool for key industrial sectors.

- Conduct a more detailed assessment of the economic and technical potential of various motor system optimization worldwide (using Life Cycle Cost Analysis, or LCCA). For motors, this could include the development of a monitoring system for motor sales, motor stocks and motor efficiencies worldwide, by country or by region. For motor systems, this could include a survey of the current mix of vendor offerings and sales (equipment /efficiency services) on a regional basis; a survey of the variations in system efficiency in key multinational corporations; and targeted regional surveys of small and medium-sized enterprises (SMEs).

- Support the development of a project on energy-efficiency of motor systems, in order to facilitate their implementation via mechanisms such as demand-side management (DSM) programs, the Kyoto Mechanisms, the Global Environment Facility (GEF), white certificate schemes, ESCOs, etc.

- Support a GEF market transformation program for high-efficiency industrial electric motor systems and provide other sources of financial and technical support to fully engage non-OECD countries.