

FINAL EVALUATION

Polish Energy Efficient Motors Program (PEMP)

**Government of Poland
United Nations Development Programme
Global Environment Facility**

VERSION v3

2009

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LIST OF ABBREVIATIONS

4EM MCP	The Motor Challenge Program, supported by the European Union
APR-PIR	Annual Performance Report – Project Implementation Review
BPI	Best Practice Initiative
CEMEP	European Committee of Manufacturers of Electrical Machines and Power Electronics
CHP	combined heat-power generation
CO	Country Office
CO ₂	carbon dioxide
EcoFund	Ecofund Foundation
EC	European Commission
EE	energy efficiency <i>or</i> energy efficient
ESCO	energy service company
EU	European Union
EuroDEEM	European database of energy efficient motors
FEWE	Polish Foundation for Energy Efficiency
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	greenhouse gas
GJ	gigajoule (= 10 ⁹ Joule)
GUC	Customs Service
IEC	International Electrotechnical Commission
KAPE	Polish National Energy Conservation Agency
LTA	long term agreement
MGPiSP	Ministry of Economy, Labor and Social Policy
NFOSiGW	National Fund for Environmental Protection and Water Management
PDF	GEF project preparation and development facility
PEMP	Polish Energy Efficient Motors Program
PJECC	Poland-Japan Energy Conservation Center
PLN	Polish zloty
PMU	Project Management Unit
PSC	Project Steering Committee
SME	small and medium-sized enterprises
t	ton
TWh	terawatt-hour (= 10 ¹² watt-hour)
GWh	gigawatt-hour (= 10 ⁹ watt-hour)
MWh	megawatt-hour (= 10 ⁶ watt-hour)
kWh	kilowatt-hour
US\$	US dollar
USD	US dollar
VSD	variable speed drive
yr	year

EXECUTIVE SUMMARY

Poland is open to the introduction of energy efficiency technologies either from domestic production, import or technology transfer. Domestic producers and importers are prepared to buy energy efficient motors if market opportunities are introduced. Unfortunately, energy end users and investors are accustomed to installing the lowest-efficiency and cheapest equipment, replacing worn out or damaged equipment with inefficient models and repairing obsolete equipment rather than replacing it with more efficient or state-of-the-art technologies. For example, the economic potential of investments with a payback period (PBP) of less than 2 to 3 years (which is the criterion applied by most investors) is often not exploited. In addition to the economic potential that is very profitable from the investor's perspective, a large additional potential exists for investments with a payback period of between 2-3 and 6 years, a range where profitability is considered low by most investors. A range of other informational, capacity, financial and institutional barriers have prevented Poland from realizing the economic potential for energy efficiency in electric motor systems.

To address these barriers, the United Nations Development Programme (UNDP), the Polish National Conservation Agency (KAPE) and the Polish Foundation for Energy Efficiency (FEWE) developed a project to promote the application of energy efficient motors in the public and private sectors in Poland entitled "*Polish Energy Efficient Motors Program*". The project idea was presented to Global Environment Facility (GEF) in 1999 and was endorsed by the GEF in November 2003. Project activities started in February 2003 and were operationally closed in February 2009.

The Project Document mentions as the main **objective**: "to reduce greenhouse gas emissions by overcoming existing barriers for increased market penetration of energy efficient motors and related efficiency improvements in the electric motor system (including variable speed drives), particularly, but not exclusively, in the manufacturing industry, the energy sector (heating), the utility sector (water supply and sewage treatment) and mining".

The project has four main **components**:

1. Build Capacity by Providing Information and Services Related to Energy Efficient Electric Motor Systems;
2. Demonstrate Efficient Motors under Polish Market Conditions
3. Stimulate Market Transformation Using a Financial Incentive Mechanism and Awareness Raising
4. Develop Energy Efficiency Policy in Industry for Energy Efficient Drives

As the project has been operationally closed, a final **evaluation** review was needed to review the progress of the project with its stated project activities, outputs and outcomes. An independent consultant, Mr. Jan van den Akker (Netherlands) was selected as evaluator and he undertook a one-week mission to Poland in June 2009.

At the time of writing of the Project Document, the economic potential for electricity savings of electric motor systems was estimated at 5.6 terawatt-hours (TWh) per year (which is 5% of overall electric energy consumption in Poland) with a payback period of less than 10 years (of which 3.1 TWh per year with a payback period of less than 6 years). Achieving the total technical potential of electricity savings of 6.3 TWh per year would result in reduction of greenhouse gases (GHGs) emission in Poland of 6.8 million tons of CO₂ per year.

Main **findings** of the mission are:

Achievements

Objective

The Project Document mentions the environmental objective of reducing electricity consumption by 55.7 GWh per year by the final year of the project (due to investments directly associated with the project) and corresponding cumulative greenhouse gas emission reductions of 0.83 million tons over the project's lifetime. The last progress report (APR-PIR, 2009) mentions having achieved the greenhouse gas emission reduction of 1.31 million tons.

Outcomes

- 1 - Capacity building by providing information and services related to energy efficient electric motors.

The Polish Energy Efficient Motors Program (PEMP) has contributed to increased awareness on energy efficient motor systems and capacity building in terms of expanding a pool of knowledgeable staff at KAPE and FEWE.

- 2 - Implementation of four demonstration projects for efficient motor systems in different key sectors

The four demonstration projects are successfully being implemented or are under implementation. After failing to get much interest in large industry, project management (rightly) shifted its attention to smaller industries and two of the demos are now implemented in small and medium-sized enterprises. However, the planned revolving fund for energy efficient investments could not be set up. Regarding finance mechanism, FEWE will formulate a proposal for NFOSiGW on a PLN 100 million funding window, which will leverage funds at a much higher level than the revolving fund foreseen in the Project Document. If realized, the fund would allow a strong replication of PEMP Center's activities on energy efficiency (in motors) promotion, especially if the new Energy Efficiency Law would be enacted.

- 3 - Market transformation, using a financial incentive mechanism coupled with awareness rising.

Despite the incentive scheme for motor manufacturers (funded by Ecofund with a contribution from PEMP), the project has not been able to achieve real market transformation with sales of motors much less than expected, i.e. 1,800 instead of the 42,600 planned. Nonetheless, since the focus was shifted from smaller to much larger motors (and thus larger energy savings per motor), this has paradoxically resulted in greenhouse gas emissions even higher than the target figure mentioned in the Project Document.

- 4 - Development of industrial energy efficiency policy, particularly in the field of efficient motor systems.

The project has undertaken various efforts, such as promoting the labeling of motors, developing voluntary standards, contributing to awareness raising and providing inputs for the formulation of the Energy Efficiency Act and other policy measures. The Energy Efficiency Act is currently under discussion and it looks like that its main tool will be the so-called 'white certificates'. Energy efficiency policies will also become a more important part of ongoing implementation of EU emission reduction and energy efficiency directives. At one point in time, minimum energy performance standards (MEPS) for motors are likely to be introduced in the European Union.

Project implementation

PEMP has partnered well with a number of co-financiers and partners from government and the private sector in Poland and abroad (such as the Poland-Japanese Energy Conservation Center, Ministry of Economy, Ecofund, NFOSiGWM). Also, the project management team has responded correctly to barriers encountered in project implementation (adaptive management), such as shifting its customer target group from large to smaller industries and focusing more on larger motors, when it became clear that more success could be obtained in this segment, although maybe more corrective actions could have been undertaken to achieve market transformation. On monitoring and evaluation, the mid-term evaluation should have been carried out earlier, especially since the performance of certain indicators (such as motor sales) by the middle of the project implementation period was disappointing.

On the budget, it was expected by the Project Management Unit (PMU) that the project would have been extended beyond February 2009 and that at least part of the funds remaining (some USD 2 million, about half of the original budget!) would still have been used. The project was operationally closed however in February 2009. Given this situation, the PMU should have reacted earlier if such large part of the funds could not have been dedicated to other useful PEMP-supported activities. Also, the UNDP Office in Poland, though admittedly quite small, as well as the UNDP Regional Center in Bratislava (UNDP-BRC) should have been more assertive and creative in this.

It has been suggested by the Polish counterpart (FEWE) that the remaining USD 2 million might be used to help set up the newly proposed NFOSiGW finance mechanism. This might be discussed with UNDP Regional Office in Bratislava, however, the Evaluator feels that it will be difficult to justify transferring the relatively big amount of USD 2 million for a mechanism that does not exist yet without being able to properly monitor, also because the UNDP representation in Poland was closed in June 2009. To the Evaluator, it seems likelier that the funds will therefore need to be returned to the GEF in the end.

Project concept and design

It took almost 5 years after first presentation of the project concept to get approval by the GEF Secretariat (1999-2004). By the time the project started, the setting had fundamentally changed with Poland's accession to the European Union (EU) in 2004. Nonetheless, when writing the Project Document, the fact that Poland would one day join the EU should have been anticipated and the market for EE motors and the need for the before-mentioned incentive and financial mechanisms could have been studied more profoundly. On the other hand, the Evaluator recognizes that it was difficult to exactly predict the effects of EU accession on the electric motor market.

Some **lessons learned** are:

- It is difficult to achieve real market transformation in the very short span of a typical UNDP/GEF project of about 4-5 years. To create awareness and really change the mindset of people easily takes several years.
- Regarding the revolving fund, it is difficult to get banks interested in managing a relatively small fund as these have relatively high operating cost in comparison with the amount of capital covered. It may be easier to support existing credit lines (perhaps with an new energy efficiency window) rather than setting up a new fund.
- The active involvement of the Government plays an important role. A project, such as PEMP, can contribute to formulating appropriate energy efficiency legislation as a framework for various energy policy instruments. However, formulation of such policies and legislation is a political process that can take many years, often longer than the time span of a typical UNDP/GEF project. In this case, there is still no Energy Efficiency Act and PEMP may have achieved more had the right policy instruments would have been in place during the project period.
- A proper project design is crucial. This implies that sufficient info is gathered on market, market players, needs of beneficiaries and barriers, etc. The establishment of a revolving fund and incentive system should have been carefully analyzed by means of feasibility studies and market surveys. Last, but not least, the time from project concept to actual start of implementation should have been much reduced.

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1. INTRODUCTION

1.1 Background

Motors and energy use

Power production in Poland relies on hard coal and brown coal. About 95% of electric energy is generated in coal-fired power plants, as well as in coal-fired heat and power stations. As a result, the share of carbon dioxide emission from electricity generation represents 38 percent of the country's overall carbon dioxide emissions. In 2001, Poland's annual CO₂ emissions totaled 318 million tons of CO₂. Of this, 38 per cent of the emissions came from electricity production, of which 50% were attributable to electric motor systems (i.e., 60 million tons of CO₂ per year).

Electric motor systems (which include motors, drives, pumps, fans, compressor, and control equipment) use 40-50% of all electricity consumed in Poland. The share differs by end-use sector; from 40-90% in production sector to 20-40 per cent in households and public services. Manufacturing activities (35 per cent), electric energy, gas, heat and water supply (17 per cent) and households (17 per cent) constitute the biggest share of Poland's electricity consumption, which totaled 152 TWh (terawatt-hour) in 2003.

The most significant application for electric motor systems (60% of electric energy consumption) is for raising pressure and pumping liquids and gases through pumps, fans, compressors, etc. in three industrial sectors: the manufacturing sector, the energy sector (gas, heat, and water supply) and the mining industry. The technical potential for electricity savings of electric motor systems in these applications in these sectors is about 4 TWh per year. The remaining 40% of electricity consumption by electric motor systems is used by freight and passenger transport and for materials processing. Total technical potential for savings is estimated at 6 TWh per year.

At the time of writing of the Project Document¹, the economic potential for electricity savings of electric motor systems was estimated at 5.6 terawatt-hours (TWh) per year (which is 5% of overall electric energy consumption in Poland) with a payback period of less than 10 years (of which 3.1 TWh per year with a payback period of less than 6 years). Achieving the total technical potential of electricity savings of 6.3 TWh per year would result in reduction of greenhouse gases (GHGs) emission in Poland of 6.8 million tons of CO₂ per year.

Energy efficiency policy

The 1997 Energy Law established the basis for third party access, independent power producers, renewable energy sources, least cost planning, integrated resource planning, energy regulatory authority, demand side management and energy efficiency labels, among others.

To implement the European Union's Directive on electricity from renewable energy sources (2001/77/EC) in Poland, the Polish Energy Law was amended in 2005 to provide a quota

¹ Most background info has been taken from the Project Document.

system obligation in the form of a "green certificate" system which was introduced on 1 October 2005. Since the amendment, the Law has imposed an obligation on energy companies selling electricity to final consumers to obtain and submit the certificates of origin (so called "green certificates") for cancellation by the Energy Regulatory Office (ERO). Failure to obtain the green certificates results in paying a substitution fee that is set annually by ERO and is tied to the average price for electricity from coal in Poland. Certificates can be traded on the Polish Power Exchange.

In accordance with the requirements of the EC Directive on energy end-use efficiency and energy services, Poland submitted its National Energy Efficiency Action Plan in June 2007. The plan sets out an indicative target for energy savings of 9% in 2016 and an intermediate target of 2% in 2010. The proposed measures depend on market and budget financing and according to the principle of least cost. Proposed measures in the industrial sector include the promotion of combined heat-power generation (CHP), a system of voluntary energy efficiency undertakings in industry as well as the development of an energy management system and an energy audit system. The plan also proposes a 'white certificate' system to stimulate energy saving actions together with an obligation placed on suppliers of electricity, heat or gas fuels to end users, analogous to the above-mentioned 'green certificate' system for renewable energy. Additionally, it provides for information campaigns and educational projects on energy efficiency and financial support for actions relating to the promotion of energy efficiency. However, the needed legislation (Energy Efficiency Act) to introduce the above-mentioned measures is still under discussion.

Barriers

A range of barriers has prevented Poland from realizing the economic potential for energy efficiency in electric motor systems. Poland is open to the introduction of energy efficiency technologies either from domestic production, import or technology transfer. Domestic producers and importers are prepared to buy energy efficient motors if market opportunities are introduced. Unfortunately, energy end users and investors are accustomed to installing the lowest-efficiency and cheapest equipment, replacing worn out or damaged equipment with inefficient models and repairing obsolete equipment rather than replacing it with more efficient or state-of-the-art technologies. For example, the economic potential of investments with a payback period of less than 2 to 3 years (which is the criterion applied by most investors) is not currently exploited. In addition to the economic potential that is already profitable from the investor's perspective, a large additional potential exists for payback period between 2-3 and 6 years, a range where profitability is considered too low by most investors. The Project Document provides the following summary of barriers:

Information and awareness barriers:

- Lack of awareness of the local industries and municipalities regarding available technologies, and the associated economic and environmental benefits of reducing electricity consumption of electric motor systems. Companies tend to rewind old motors despite that it is not profitable over the longer term.
- Lack of information at the company level concerning the potential technical and economic energy saving potential by replacing old motors with new, correctly-sized energy efficient models with variable speed drive control as applicable.
- Lack of information on quality and motor efficiency (lack of standardization and labeling schemes).

- The reduction of electricity consumption is often a secondary concern for the enterprises and it is not considered a priority measure in their investment plans. There is overemphasis on first cost versus operating costs.

Financial barriers:

- Lack of available financial investment mechanisms and financial resources.
- Investors regard investment in energy efficient motors systems as high risk.
- Transaction costs for smaller to medium size investments are relatively high.

Institutional barriers:

- There is a lack of targeted national policies and programs for industrial energy efficiency.
- There is a lack of sustainable expertise in this field that is accessible for all stakeholders
- There is no strong promoter or advocate for energy efficiency in motor systems. No professional organization for motor manufacturers exists in Poland.
- Development is slow in the field of new businesses with specialized, high-quality services like energy services companies.

Lack of capacity for project development:

- Companies often do not have the resources to identify and address this component of their expenses.
- Often the companies, investors and sponsors lack the capacity to develop technically and financially sound projects in the area of efficient electric motor systems because of shortcomings in knowledge and experience.

1.2 Project objectives and strategy

To address the above-mentioned barriers, the United Nations Development Programme (UNDP), the Polish National Conservation Agency (KAPE) and the Polish Foundation for Energy Efficiency (FEWE) developed a project to promote the application of energy efficient motors in the public and private sectors in Poland entitled “*Polish Energy Efficient Motors Program*” The project idea was presented to Global Environment Facility (GEF) in 1999 and was endorsed by the GEF in November 2003. Project activities started in February 2003 and were operationally closed in February 2009.

KAPE is a non-profit organization of public service character, which was set up in 1994. Shareholders are the National Economy Bank, Industrial Development Agency, Ministry of Treasury and the National Fund for Environmental Protection and Water Management². The mission of KAPE is to develop and implement the principles for the attainment of sustainable energy policies in Poland (see www.kape.gov.pl). FEWE - was established in 1990 as independent, non-governmental and non-for-profit organization. Its mission is promoting the efficient use of energy and environment friendly energy production (see www.fewe.pl).

The Project Document (ProDoc) mentions as the main **objective**: “to reduce greenhouse gas emissions by overcoming existing barriers for increased market penetration of energy efficient motors and related efficiency improvements in the electric motor system (including

² The Ministry of Economy, Labour and Social Policy, the Ministry of Environment; the Ministry of Interior and Administration and the Ministry of Infrastructure development are represented in the Supervisory Board of the Agency

variable speed drives), particularly, but not exclusively, in the manufacturing industry, the energy sector (heating), the utility sector (water supply and sewage treatment) and mining”.

The project has four main **components**:

5. Build Capacity by Providing Information and Services Related to Energy Efficient Electric Motor Systems;
6. Demonstrate Efficient Motors under Polish Market Conditions
7. Stimulate Market Transformation Using a Financial Incentive Mechanism and Awareness Raising
8. Develop Energy Efficiency Policy in Industry for Energy Efficient Drives

FEWE has been responsible for all activities under Component 1 and Component 2. KAPE has been responsible for all activities under Components 3 and 4.

The expected results are the following:

- To reduce domestic greenhouse gas (GHG) emissions by 832 thousand tons CO₂ by 2008 and 3.7 million tons CO₂ by 2013;
- Energy efficiency goal: reduce electricity consumption in motor systems by 55.7 GWh in 2008 and 231.6 GWh in 2013;
- Ecological goal: reduce emission of air pollutants - dust, NO_x, SO₂
- Economic goal: introduce to the market a new generation of energy-efficient motors and achieve their 15% share in total motor sales over 5 years, increase the number of adjustable speed drives, activate market niches for manufacturing and services of ca. 90 million PLN.

1.3 Evaluation purpose and methodology

As the project has been operationally closed, a final review is needed to review the progress of the project with its stated project activities, outputs and outcomes, although a mid-term was carried out only recently in the beginning of 2009.

An independent consultant, Mr. Jan van den Akker (Netherlands) was selected as Evaluator and he undertook a one-week mission to Poland in June 2009. During the mission, extensive discussions were held with the project team, UNDP, KAPE, FEWE as well as other stakeholders and beneficiaries. In addition, project progress reports and other materials were reviewed.

During the mission, the Evaluator drew up a table of contents that covers the issues to be addressed as mentioned in its Terms of Reference and follows the structure of this report:

- Introduction (background, project description, evaluation purpose and methodology)
- Findings on project progress
 - Project’s performance in terms of results (achieving objectives and outputs by means of realized activities and inputs used) and impacts, quantitatively and qualitatively measured by indicators (as set in the project document and the annual project review documents)
 - Description of project impacts

- Evaluators' assessment of the project design and execution (way of implementation and management, monitoring and evaluation, budget and cost-effectiveness, external factors, stakeholder involvement)
- Conclusions and recommendations
 - Conclusions, taking into account sustainability and replicability issues
 - Lessons learned and recommendations

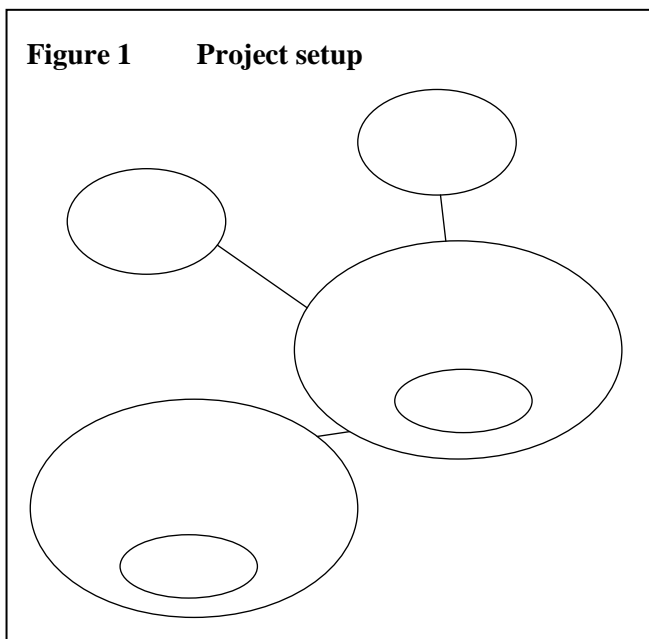
The Evaluator adopted the following **methodology of evaluation**

- i) Review of project documentation, such as the Project Document and Executive Summary, APR-PIRs (annual project implementation reviews),
- ii) Meetings with the PEMP team, main project partners and stakeholders

The report is divided into three sections. This first introduction section provides general background of the project, purpose of evaluation, project implementation setup, partners/stakeholders and evaluation methodology. The next section dwells on findings regarding project management and achievements. These findings are described within the logical framework design of the project, as described in the Project Document and progress reports. In the third section, conclusions from the observations and findings are discussed in the context of project objectives. These also pertain to sustainability and replicability of project. The section ends with recommendations for the further direction of the Project and some lessons learnt.

1.4 Project set-up and stakeholders

The Polish National Energy Conservation Agency (KAPE) has been the local executing agency for the proposed project. KAPE has implemented the project together with the Polish Foundation for Energy Efficiency (FEWE).



A Project Management Unit was established at KAPE in Warsaw, headed by a Project Manager³, overseeing daily management and coordination. The PEMP Center was housed at FEWE's facilities in Katowice, which is located in an area of heavily industrialized region.

A Project Steering Committee (PSC) was set up to advise the Executing Agency on the direction of project implementation and development and to act as platform to exchange info on the project's progress. The PSC was chaired by a National Project Director⁴.

³ Mr. Krzysztof Brzoza-Brzezina

⁴ Mr. Tadeusz Skoczkowski

Members of the PSC:

- KAPE
- FEWE
- Electrotechnical Institute
- Energy Regulatory Authority
- Ministry of Economy
- Ministry of Environment
- National Fund for Environmental Protection and Water Management (NFOSiGW)
- Office for Competition and Consumer Protection
- Polish Copper Promotion Center
- Silesian Technical University
- Ecofund Foundation
- UNDP.

2. FINDINGS

2.1 Results achievement: status of project outcomes and outputs

For each of the three outcomes, as mentioned in paragraph 1.2, this section assesses the progress in the implementation of the project's outcomes and outputs, following the format and information provided as given in the UNDP Project Document (ProDoc) and as reported by the Project Management Unit (PMU) in the annual Project Implementation Review - Annual Performance Reports (APR-PIRs).

The description and order of outputs and corresponding indicators in the Tables 1 to 4 may slightly differ from the wording used in APR-PIRs and the original UNDP Project Document, in order to make clear the relation between the various outputs mentioned in the ProDoc (1.1, 1.2, etc) and the progress indicators (1., 2., etc.) reported in the APR-PIRs. Also, the Evaluator has tried to make a summary, by trying to capture the essence of the wording.

2.1.1 Outcome 1 *Build capacity by providing information and services related to EE motor systems*

Table 1 Performance Indicators of Component 1

Outputs (Project Document) Indicator (no. as in APR-PIR)	Value of indicators	
1.1 Prepare a business plan for PEMP Centre <ul style="list-style-type: none"> • PEMP Centre established (5) • PEMP Centre operations continue after GEF support (6) 	<i>Baseline:</i> <ul style="list-style-type: none"> • PEMP Centre not existing <i>Target:</i> <ul style="list-style-type: none"> • PEMP Centre operation continue after GEF support 	<i>Achieved by early 2009:</i> <ul style="list-style-type: none"> • PEMP Centre has been established at FEWE • Capacity building of PEMP Center is strengthened by implementation of demo projects and cooperation with several other energy agencies in the frame of 4EM MCP (European Motor Challenge Project) co-financed by EU. • However, continuous operation of the PEMP Center without additional support is not feasible yet. • It was expected that financial mechanisms like EcoFund's subsidies for modernization of large motor system will drive needs for PEMP Center services. Unfortunately, availability of the financial mechanisms of EcoFund Foundation was finished in June 30 2008 and new financial mechanisms (such as 'white certificates' are still under development (to be introduced in the awaited Energy Efficiency Act) • A new financial mechanism together

		with National Fund for Environment Protection and Water Management (NFOSiGW) is currently being formulated with FEWE's support (about PLN 100 million)
<p>1.2 Generate and disseminate market information on EE matters</p> <ul style="list-style-type: none"> Majority of target consumers have received info about EE motors (7) Website established and accessed by customers (8) 	<p><i>Baseline:</i></p> <ul style="list-style-type: none"> Target consumers have not received sufficient info No website on EE motors <p><i>Target:</i></p> <ul style="list-style-type: none"> Majority of consumers have received info Website established 	<p><i>Achieved by early 2009:</i></p> <ul style="list-style-type: none"> Information were continuously provided to consumers through conferences, seminars, workshops, trainings, printed materials, internet www.pemp.pl, www.mcpeuop.net, advertisements, direct contacts, electronic newsletter, articles printed in technical press and books issued by PEMP; According to the APR-PIR 2009, the PEMP website has been visited by approx 11,000 visitors and an additional 4 000 visitors visited the EFE motor software web page. Information campaign on energy efficient motor systems in the co-operation of the PEMP with MCP-European Motor Challenge; Web sites of European Motor Challenge Project (MCP) directly linked to the PEMP website, see www.mcpeurope.net and www.motor-challenge.eu/ Newsletter of PEMP is being issued quarterly and distributed among registered visitors. The continuation of information campaign is planned. A proposal was submitted to NFOSiGW for one year financing of PEMP Center informational activities (web service operation and development, advisory service to electric motor user).
<p>1.3 Provide technical and business advisory services</p> <ul style="list-style-type: none"> Proposal for promotion of EE motors and VSDs through ESCOs completed (11) 	<p><i>Baseline:</i></p> <ul style="list-style-type: none"> There is no ESCO involvement in motor-related projects <p><i>Target:</i></p> <ul style="list-style-type: none"> At least one existing or new ESCO involved in motor-related projects by the end of the project; Proposal for promotion of EE motors through ESCOs completed 	<p><i>Achieved by early 2009:</i></p> <ul style="list-style-type: none"> ESCOs, which are active in Poland and on the European market are identified. It seems they are not interested in electric motor systems now, but in near future it should change due to the increase of energy prices. In light of the developing national energy efficiency legislation ESCO's could become an important partner in achieving national energy efficiency goals. The PEMP Center undertook initiative to translate and adopt two guidelines: Measurement and Verification for Federal Energy Projects and International Performance Measurement and

		Verification Protocol and disseminate them among the Polish electric motors users.
1.4 Establish and operate an advisory system for the EE motors market <ul style="list-style-type: none"> Number of projects developed directly or indirectly through the PEMP Centre (10, 14) 	<i>Baseline:</i> <ul style="list-style-type: none"> Zero projects promoted <i>Target:</i> <ul style="list-style-type: none"> At least 34 projects developed that were developed or inspired by PEMP Centre 	<i>Achieved by early 2009:</i> <ul style="list-style-type: none"> Actions have resulted in implementation or starting of implementation of 20 projects in different sectors: <ul style="list-style-type: none"> Energy sector (electricity generation, heating, transmission of fuel)⁵: 7 Water utility⁶: 3 Manufacturing industry⁷: 4 Mining industry⁸: 6 The projects are in different stages of implementation process and were inspired and supported by PEMP on several ways (information on effectiveness, available financial mechanisms, direct support in project preparation phase).

Note: activity 1.5 of the ProDoc and will be discussed under outcomes 3 and 4.

Narrative

Draft guidelines of activity profile of the PEMP Centre were developed beginning of 2006. Since that time document was discussed on regular basis and consequently adapted to external conditions including demanded activities, sources of incomes (European programs and projects, National Economy Bank, environmental funds), experiences gained during implementation of demonstration projects. Because the self financing of the PEMP Center after the PEMP project termination was not considered feasible, several attempts were undertaken to mobilize European financial sources. Follow-up activities on info dissemination have been proposed for financing by NFOSiGW. In the frame of the Intelligent Energy Europe Program several proposals were submitted, of which one, the 4EM-MCP project (also known as the Motor Challenge program) was successful. The 4EM-MCP disseminating, extending and applying a number of tools⁹ through national programs in a number of Eastern European countries in order to build capacity and to raise awareness of policy makers and industry in this area. The program is executed by national and regional energy agencies or other specialized organizations and companies. In Poland national focal points are the Polish Copper Promotion Centre (based in Wroclaw) and FEWE (based in Katowice).

Capacity building by providing information and services related to energy efficient electric motors have been carried out *satisfactorily*, through development of informational materials, continuous operation of web services, participation in conferences, trade fairs, organization of workshops, trainings, meetings, publishing articles, reports and handbooks. A full list of

⁵ EC Lublin Wrotków, SPEC Warszawa, Energetyka Ciepna Opolszczyzny SA, EC Zduńska-Wola, PEC Żyrardów Sp. z o.o., ZE Elsen Sp. z o.o. Częstochowa, ZEC Bydgoszcz SA

⁶ PWiK Sp. z o.o. Dąbrowa Górnicza, MPiWK w m.st. Warszawie SA, ZWiUK w Namysłowie Sp. z o.o.

⁷ Kuźnia GLINIK Sp. z o.o., Rafineria Gdańsk, ZF Polpharma SA, Arctic Paper Kostrzyn SA

⁸ KGHM ZWR rejon Lubin, KGHM ZWR rejon Rudna, KGHM ZWR rejon Polkowice, KWK Wieczorek (KHW), KWK Wesola (KHW), PKW SA ZG Sobieski Jaworzno

⁹ Tools include a European database for motors (EuroDEEM), a motor classification system, tips for accessing profitability, a list of sources of information, a list of European energy service companies (ESCOs) as well as studies and documents on motor, drives, electrical distribution, compressed air, pumps, fans and refrigeration. Tools and documents can be accessed through www.mcpeuropenet

project articles and publications is given in Annex D. In particular, four handbooks have been produced:

- Polish Energy Efficient Motors Program PEMP. High-tech control systems with induction motors. Selection of electric motors;
- Repair or replace large electric motors;
- Energy efficiency of pumps and pumping systems;
- Drive control in industrial heat generator's pumping systems.

For the moment, continuation of PEMP's promotional activities will continue during July 2009-December 2010 with a PLN 87,300 funding from the National Fund (NFOSiGW). The funds will be used for reorganizing of the existing content of the website, creation of new topics, e.g.. obtaining finance), creation of educational modules (internet training) as well as setting up an EE motors database and new publications, such as a portal bulletin, booklet on the new classification of electric motors (see Box 2) and a new guide on compresses air systems.

In the beginning of the project, third party financing and ESCO concept was examined as a promising tool for energy efficient motor system promotion. For example, re-developing of the demonstration projects, as an alternative option of financing based on guaranteed saving principle, was offered, but beneficiaries preferred ordinary loans with no interest rates. Also talks with existing ESCOs and other companies potentially interested in that form of operation took place, but few expressed interest in developing an ESCO activity under PEMP. Therefore, the project team undertook other activities, such as the translation of International Performance Measurement and Verification Protocol.

Also new project proposal were written, such as the "PERformance Risk MANagement for ENergy efficiency projects through Training: enhancing the credibility of the energy services industry in Poland, Czech Republic, Romania, Bulgaria and Croatia" were developed and submitted to Intelligent Energy Europe (IEI). The PERMANENT proposal was accepted in 2008 was awarded and the contract is under negotiations now. The expected launch of the project is scheduled for July-September 2009 and project duration will be 30 months. The PERMANENT project will address the most common barrier to deployment of energy performance contracts by end users: disbelief that planned project results will be achieved and pay back the investment in a sustainable manner. This project expects to address these fears by (a) Developing and testing harmonized and integrated approaches for the end users to measure and verify their energy savings in the five participating EU Member States (based on approaches used in western Europe and the International Performance Measurement and Verification); (b) Educating energy end users, financiers and energy services suppliers on performance risk measurement and management techniques in energy saving projects; (c) Creating trained instructors who will be able to continue imparting PERformance Risk MANagement ENergy Training after the completion of this project.

2.1.2 Outcome 2 Demonstrate EE motors under Polish market conditions

Table 2 Performance indicators of Component 2

Outputs (Project Document) Indicator (no. as in APR-PIR)	Value of indicators	
<p>2.1 Demonstration projects implemented</p> <ul style="list-style-type: none"> • Demo projects implemented (12) and continuing with additional non-GEF financing (13) 	<p><i>Baseline:</i></p> <ul style="list-style-type: none"> • No demo projects <p><i>Target:</i></p> <ul style="list-style-type: none"> • Four demo projects are implemented in the following target sectors: district heating, water and sewage treatment utility, chemical industry and coal mining 	<p><i>Achieved by early 2009:</i></p> <ul style="list-style-type: none"> • PEMP Center closely cooperates with Clean Business Project and gives trainings, and support for SMEs participating in that initiative. As a result, after several unsuccessful attempts to develop demonstration projects in large enterprises such as coal mines or chemical plants, PEMP Centre switched to supporting SMEs and finally the two other demonstration projects were developed (with approval of the PSC) in small manufacturing companies (see Box 1) • There is no need for additional financing of demo projects specified in the project document from any public funds. Three of the follow-up projects were co-financed by EcoFund.
<p>Funding:</p> <ul style="list-style-type: none"> • Establishment of a revolving fund (16) • Additional funding for project obtained from domestic funds (15) 	<p><i>Baseline:</i></p> <ul style="list-style-type: none"> • No specific funding for EE motors <p><i>Target:</i></p> <ul style="list-style-type: none"> • Revolving fund established and operating with repayments between 50-95% by year 4; • USD 1.3 million available from domestic funds 	<p><i>Achieved by early 2009:</i></p> <ul style="list-style-type: none"> • For example, EcoFund made about USD 3.388 million in grants available for energy efficient motors in 2006 (Energy efficiency projects in electric motor system over 200 kW could receive up to 30% co-financing in form of grants from the EcoFund). It was expected that financial mechanisms like EcoFund's subsidies for modernization of large motor system will drive the needs for PEMP Center services. Unfortunately, the availability of financial mechanisms of EcoFund

		<p>Foundation was finished in June 30 2008¹⁰. FEWE is currently formulating a proposal to develop new financial mechanism together with National Fund for Environment Protection and Water Management (NFOSiGW).</p> <ul style="list-style-type: none"> • A proposal of the revolving fund was developed, and various financial institution were asked to host and give support for such a fund, finally only Environment Protection Bank (BOS) gave a positive answer to the inquiry. Finally due to the low level of available financial means (ca \$200k spend for demonstration projects), the decision of project closure and lack of interest in strengthening of the fund, the process of setting up the revolving fund was stopped. The loans from the demonstration projects are being collected on the bank account of the Executing Agency (KAPE).
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Narrative

Two of the demonstration projects are with SMEs, i.e. the Ekowod water and sewage treatment plant in Namyslow and the heat plant in Rydultowy. After several unsuccessful attempts to run demo in large companies such as coal mines, chemical plants, paper mills, and power plants, but with positive experiences with small and medium-sized enterprises (SMEs) the project team decided to switch to SMEs. Once approval by the PSC was achieved (September 2005), a number of companies were contacted, several energy audits were performed in those companies and interest in receiving support offered by PEMP was expressed by several companies. Projects under implementation are at the Fritar plant in Tarnow (that produces deep-frozen food products, such as french fries, vegetables and salads) and the Rondo 2 plant at Katowice (that manufacturers flexible tubes for pneumatic transport).

¹⁰ The basic source of EcoFund's revenues consisted of the funds received from the Polish-debt-for-environment-swap scheme pursuant to agreements signed by Poland with the USA, France, Switzerland, Italy, and Norway. The relevant funds were provided every year in the Budgetary Act in the section entitled "servicing the foreign debts" and are regularly paid to EcoFund's bank account from the state budget as a Poland's commitment towards the donor countries. In the years 1992 ÷ 2007, the receipts from the Polish-debt-for-environment swap scheme totalled about 500 million US dollars, which made about 87% of the total amount to be received by EcoFund from 1992 till 2009. In the years 1993 ÷ 1994, the EcoFund's receipts from the debt-for-environment-swap scheme were on a level of 12 to 19 million zlotys a year (equivalent to 6.9 to 8.7 US dollars a year). Funding substantially increased after 2000, by virtue of the conversion of 10% of the Polish debt to the USA are equivalent to a constant amount of 24.2 million US dollars. More info can be found at www.ekofundusz.pl

In total 4 demo projects are successfully implemented, as is described in more detail in Box 1. A number of other demo activities have been identified, but further development has been hanging due to PEMP's termination in February. These include demo at the Chemical Rescue Unit Sp., the sewage treatment in the chemical plant Jednostka Ratownictwa Chemicznego and setting up an ESCO scheme with ELZAT Tarnow.

The availability of soft interest loans through a revolving fund does not appear to have attracted the interest of the large industries, whose involvement was initially planned. The Fund could have been of more interest of SME (as the two demo projects with SMEs shows, see Box 1). A proposal for the revolving fund was developed. Several financial institution specified in the project document were asked to host and give support for such a fund¹¹, as well as commercial banks¹². Finally, only the Environment Protection Bank (BOŚ) provided a positive proposal that was further worked out together with BOŚ and presented to the Project Steering Committee (PSC). However, the PSC suggested that, due to the low level of available financial means (only about USD 200,000 for demonstration projects) the fund should be strengthened with other sources. Finally, with the decision of project closure and lack of interest in strengthening of the fund, the process of setting up the revolving fund was stopped.

FEWE has initiated talks with the NFOSiGW on setting up decision to set up an independent mechanism with a possible budget of PLN 100 million (ca 28 million USD) working on similar rules as the proposed revolving fund. The mechanism would offer co-financing for replacement of presently used motors and equipment driven by the motor with state-of-the-art EE motors and devices as well as for VSD systems (if resulting from variations in the technical process), 'soft-start' controllers and energy management systems. The loans given would be up to PLN 50,000 – 1million with a loan period of up to 5 years at an interest rate no less than 4%. The loans could be used to finance energy audits, purchase of equipment, disassembling the old devices and assembly of the new ones, necessary retrofitting work and monitoring of the energy savings results.

Figure 2 Examples of PEMP publications



¹¹ BKG, EcoFund, NFOSiGW, BOS SA
¹² PeKao SA, PKO BP SA, ING Bank Śląski SA, BZ WBK, CitiBank Handlowy y Warszawie SA, BRE Bank SA, Raiffesien Bank SA, Deutsche Bank Polska SA

Box 1 PEMP demonstration projects

This text box gives some details of the demo projects supported by PEMP.

(1) Rydułtowy heat plant:

Technical data of the heat plant: thermal power: 58 MW; 30 km of district heating network with 253 heat substations and an annual heat production of about 340,000 GJ. The demonstration project has been implemented over the period 2002-2005 years and supported the modernisation of main electric drives in plant and control system for heat production and modernisation of heat substations including telemetric system. A significant share of electric drives electricity consumption in total electricity consumption, over 70%. Energy gains can be made by flexibility of heat production control especially during low loads periods (summer season) when only one boiler is operated often lower than minimal capacity (< 7,5 MW) as well as flexibility of heat distribution due to pumps control system alike for winter season as well as for summer season. The telemetry system provides quick and reliable information from crucial points of the district heating network for the above mentioned control systems.

(2) EKOWOD, sewage treatment plant, Namysłów

The municipal company provides water supply, sewage collection and treatment as well as waste management. The project was implemented during 2006-2007. Data gathering has continued until the end of PEMP. The demo project concerns the modernisation of electric drives and control systems:

- Pumps 3 x 25 kW providing 400 m³/h and pumps 2 x 30 kW (not operated). The pumps receive signals from level sensors. Pumps work at the start-stop mode so the next technology objects in the process are supplied no evenly, leading to energy losses
- Pumps 3 x 15 kW; 2 x 17,5 kW working after chambers, which are located 5 m below of sewage level in chambers. The pumps thus need to pump the sewage again 5 m up. The drives used are oversized, however.
- Further in the treatment process are 4 blowers Roots type (2 x 30 kW, 20 m³/min and 2 x 95/115 kW, 40/80 m³/min). Aeration in chambers is controlled manually based on oxidation sensors. One of the bigger blowers is damaged.

(3) Rondo 2

Improvements that were implemented in 2008 include:

- Control of the injection molding machines by a hydrokinetic clutch and improvement of the synchronization between injection molding machines, tools units and formative headers.
- 3 electric motors Eff1 with power range 1.5, 22 and 30 kW adapted to control by VSD and VSD installation
- Improvement of the performance precision and quality of products

The investment was PLN 30,000, of which 90% financed by the PEMP demo loan. Energy savings are an estimated 20 MWh per year at the assumed electricity price: PLN 400 per MWh with a payback period of less than 4 years.

(4) Fritar SA

The plant uses low efficiency motors. Proposed improvements include 2 motors SEE 355 ML2Bs (315 kW; 2982 rpm) and improvements in the reliability of the cooling and freezing system. The investment needed is PLN 90,000, of which 75% financed by the PEMP demo loan. Energy savings are an estimated 185 MWh per year at the assumed electricity price of PLN 246 / MWh with a payback time of about 2 years. The contract was signed in October 2008 and implemented by April 2009. Data gathering by FEWE will continue after the end of PEMP.

Source: "Polish Energy Efficient Motors Programme", presentation by J. Piszczek (PEMP Centre)

2.1.3 Component 3 Stimulating market transformation using financial incentive mechanisms and awareness raising

Table 3 Performance Indicators of Component 3

Outputs (Project Document) Indicator (no. as in APR-PIR)	Value of indicators	
<p>1.5 Support development and implementation of industrial EE policy</p> <p>3.1 Labeling of energy efficient motors</p> <ul style="list-style-type: none"> • Development of labels for EE motors (20) • Labels are being used by manufacturers and accepted in the market (9) 	<p><i>Baseline:</i></p> <ul style="list-style-type: none"> • Electric motor manufacturers united in CEMEP organization have introduced the labels for three categories of motor efficiency: EFF1, EFF2, EFF3. However, awareness of consumers on the above efficiency ratings and labels is poor <p><i>Target:</i></p> <ul style="list-style-type: none"> • All motors sold under PEMP are equipped with PEMP label • Labels are being used and accepted in the market 	<p><i>Achieved by early 2009:</i></p> <ul style="list-style-type: none"> • Awareness of consumers with respect to energy efficiency labels EFF1, EFF2, EFF3 is rising through activities of the PEMP project. Majority of electric motors manufactured and sold in Poland and all motors covered by financial incentive program are marked with EFF1-EFF3 sign. • Also logo of the PEMP became popular and label developed for the purpose of financial incentive program is widely promoted. • A new international labeling system was developed by the International Electro-technical Commission (IEC). PEMP representative participated in the works of the Commission. • Information about development of new international labeling system (IE1, IE2, IE3) in frame of the standard IEC 60034 -30 (2008) was disseminated in papers, articles and presentations • The CEMEP labeling system (EFF1, EFF2, EFF3) has been incorporated to the environmental criteria recommended by the Public Procurement Office in Poland (see Box 2)
<p>3.2 Financial incentive program for EE motor manufacturers</p> <ul style="list-style-type: none"> • Implementation of the financial incentives mechanism (18) • Number of motors sold (17) 	<p><i>Baseline:</i></p> <ul style="list-style-type: none"> • No financial incentive program • No manufacturers are involved in the program <p><i>Target:</i></p> <ul style="list-style-type: none"> • Implementation of financial 	<p><i>Achieved by early 2009:</i></p> <ul style="list-style-type: none"> • Contracts with six major electrical motor manufacturers were signed for the implementation of the Financial Incentive Program. During the project's lifetime, the financial mechanism was

<ul style="list-style-type: none"> • Significant number of motor manufacturers involved in the program (19) 	<p>mechanism on the basis of the stated criteria finalized</p> <ul style="list-style-type: none"> • After 4 years of implementation 42 600,- energy efficient motors sold (171,3 MW of installed capacity) in total under the proposed financial mechanism • The program is covering approximately 75% of the Polish market (as compared to the baseline survey) 	<p>adapted to the changing situation on the market in respond to manufacturer's requests, as is explained in the main text below.</p> <ul style="list-style-type: none"> • All major motor manufacturers (ABB, Besel, Celma, Indukta, Tamel) were involved in the preliminary phase of the program and submitted initial offers. Finally three major Polish motor manufacturers (Besel, Celma, Indukta) and one international company (Siemens) were qualified to the program. The company EMIT, manufacturer of large motors, joined the financial incentive program. In the end, a significant number of motor manufacturers, covering approximately 75% of the Polish market, were involved in the program.
<p>3.3 End-user outreach to enhance awareness and acceptance of EE motors</p> <ul style="list-style-type: none"> • Awareness of buyers and financiers increased (22) • Key customers in industry and utilities become aware of the benefits of energy-efficient motors by the end of the project. 	<p><i>Baseline:</i></p> <ul style="list-style-type: none"> • Poor awareness of buyers and financiers • Insignificant amount of key customers in industry and utilities are aware of the benefits of energy-efficient motors <p><i>Target:</i></p> <ul style="list-style-type: none"> • Key customers in industry and utilities become aware 	<p><i>Achieved by early 2009:</i></p> <ul style="list-style-type: none"> • Key customers in industry and utilities become aware of benefits of energy efficient motors. • Several meetings with management of biggest industrial users of electric motors took place. • Awareness has increased through seminars conferences, workshops, direct contacts, the project's websites and the PEMP Electronic Newsletter. Also, implementation of Financial Incentive Program strongly supported those activities

Narrative

Energy efficient motor labeling has been successfully implemented. The PEMP logo was developed for use in the sale and marketing of energy efficient motors under the program. PEMP label with logo and information that the Energy Efficient Motor was co-financed by Global Environment Facility (GEF). Labels were handed over to manufacturers, who were obliged to stick them on all energy efficient motors sold under the financial incentive program.

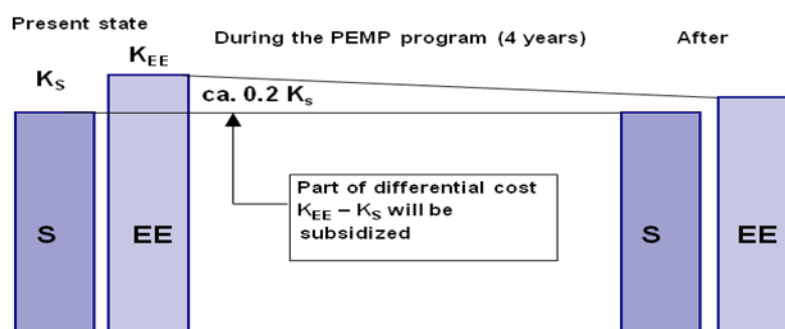


At the beginning of the project the lack (or weakness) of technical efficiency standards were addressed. After accession to the EU in May 2004, the previously existing efficiency standards had been cancelled as part of the harmonization in legislation

process. The decision was made that CEMEP's electric motor efficiency classification (eff1, eff2, eff3) would be used for the financial incentive program and the EFF1 mark together with the newly developed logo of the PEMP became part of the information campaign. The European classification was extended and applied to a wider power range of electric motors (up to 160 kW instead of 90 kW). At that time also the new voluntary efficiency standard for energy efficient motors was developed and promoted with the support of the PEMP. The standard "Energy Efficient Motors. Requirements, sizing, commentary" (N SEP-E-006) was issued by the Association of Polish Electrical Engineers (SEP) in 2006. A representative of PEMP center was involved in developing a new IEC standard on Efficiency classes of single-speed three-phase cage induction motors (IEC 60034-30) as the only representative of Poland (with approval of the Polish Standard Committee) . When the new standard was completed the financial incentive mechanisms were adapted to the new requirements.

The financial incentive mechanism was implemented with the participation of six motor manufacturers participate in the program. Marketing and information campaign was performed (issue of leaflets, advertisements and articles in technical press and in internet, presentations during seminars, participation in meetings organized by the motor manufacturers with distributors and original equipment manufacturers (OEMs), direct mailing and direct contacts with the end users)¹³. Under the financial incentive mechanism part of the differential cost of old and newer EE motors was subsidized (see Figure 3 and Table 4). The incentive program started with some delay. Poland's access to the European Union in year 2004 caused that an acceptance from the European Commission for public aid to the

Figure 3 Financial incentives for EE motors



¹³ For example, Four thousand brochures promoting PEMP and advantages of energy efficient motors were printed and distributed. Eight thousand leaflets promoting energy efficient motors and financial incentive programme were printed and distributed by the implementing agencies during the conferences, seminars, workshops, trainings, fairs, meetings etc. Part of the leaflets were given to the motor manufacturers to be distributed during the fairs and to be handed over to their distributors. Several dozen advertisements promoting energy efficient motors were placed in different periodicals

motor manufacturers became required. Public Procurement Office (Uzp) and Office for Competition and Consumer Protection (UOKiK) were asked by KAPE for their opinions regarding incentives for motor manufacturers. The last opinions, fortunately, were only received by September 2005 and as a result the sales under the program started with delay.

During the implementation of the project, the financial mechanism was adapted to the changing situation in the market. Unit incentives for motor manufacturers were increased in the last three years to mitigate the unfavorably changing exchange rate of the USD to the Polish zloty (PLN) and as a response to the manufacturers' request, as will be discussed below. Four manufacturers (Besel S.A., Celma S.A., Indukta S.A. and Siemens Sp.z o.o.) signed the contracts with the Implementing Agency KAPE in November 2005. The manufacturer Tamel S.A. joined the program in 2006. The sixth manufacturer (Emit S.A.) joined the program in the year 2008. These manufacturers (five Polish and one foreign) represent 75% of the market.

Sales of variable speed drives (VSDs) have increased sharply during the project duration. Variable speed drives (VSDs) have been widely promoted by the PEMP project in different ways. However, the motor market transformation part of the project is significantly underperforming taking into consideration the initial goals in terms of number of EE motors sold. Initially the sale of 42,600 energy efficient motors was planned and by the beginning of 2009 only 2,300 motors seem to have been sold (see Table 5). In terms of installed power the results are significantly better, because the larger penetration of sales of energy-efficient motors in the high-power range. The greenhouse gas (GHG) emissions reductions directly associated with energy efficient motors in the targeted power range is therefore much less than the planned value, but GHG emissions from large motor systems compensate this.

Table 4 Examples of incentives provided to motor manufacturers

kW	Minimum EE	Incentive (USD)
0.75	80%	16
7.5	89.5%	52
11	90.5%	71
37	93.3%	275
45	93.7%	330
160	95.8%	490

Source: Mr. Krzysztof Brzoza-Brzezina, p.c.

In Poland there exists a huge energy efficiency potential in large electric motor systems, because of the relatively high importance of the heavy industry. The project team addressed this situation through a credible strategy through the incentive program and an information campaign for large motor systems, coupled with EcoFund's grant to support the incentive program.

There are a number of reasons as to why the project was less successful in promoting small EE motors. Poland had already set efficiency motor standards, more or less set on the EFF2 class. This meant that small motors were relatively efficient in comparison with the older large motors (which can last up to 20 years and thus date back from the centrally planned era). When Poland joined the EU in 2004, the opening of the market actually paradoxically worsened the general acceptance of the more expensive high-efficient motors.

Box 2 Electric motor efficiency

With the backing of the European Commission, manufacturers representing 80% of the European production of standard motors, have agreed to establish three efficiency bands or classes for their standard totally enclosed fan ventilated (TEFV), 2 and 4 pole, induction motors in the power range 1.1 to 90kW. The bands are designated EFF1, EFF2 and EFF3 with EFF1 being the highest band.

2 pole			4 pole		
kW	efficiency %		kW	efficiency %	
	EFF1 equal to or above	EFF2 equal to or above		EFF1 equal to or above	EFF2 equal to or above
1.1	82.8	76.2	1.1	83.8	76.2
1.5	84.1	78.5	1.5	85.0	78.5
2.2	85.6	81.0	2.2	86.4	81.0
3	86.7	82.6	3	87.4	82.6
4	87.6	84.2	4	88.3	84.2
5.5	88.6	85.7	5.5	89.2	85.7
7.5	89.5	87.0	7.5	90.1	87.0
11	90.5	88.4	11	91.0	88.4
15	91.3	89.4	15	91.8	89.4
18.5	91.8	90.0	18.5	92.2	90.0
22	92.2	90.5	22	92.6	90.5
30	92.9	91.4	30	93.2	91.4
37	93.3	92.0	37	93.6	92.0
45	93.7	92.5	45	93.9	92.5
55	94.0	93.0	55	94.2	93.0
75	94.6	93.6	75	94.7	93.6
90	95.0	93.9	90	95.0	93.9

A typical motor of 7.5 kW, 30 kW and 90 kW would cost EUR 460, 1650 and 4800 respectively. On average an EFF1 motor can reduce energy losses up to 40%. Financial savings can be calculated in a quick way as follows:

Annual saving = hrs × kW × %FL × €kWh × (1/η_{Std} - 1/η_{Shem}), where:

- hrs = annual running time (hours)
- kW = motor rating (in kilowatt)
- %FL = fraction of full load power at which the motor runs
- €kWh = electricity cost in €kWh
- η_{Std} = efficiency of standard motor
- η_{Shem} = efficiency, energy efficient motor.

As an example, let us take a 4-pole 15 kW motor driving a water cooling pump at full load for 6000 hours per year. Electricity costs EUR 0.05/kWh and the efficiency of the standard and EFF1 motor are 88.2% and 91.8% respectively. Thus energy savings are about 4 MWh per year and more than EUR 200 on the electricity bill. Saving = 6000 × 15 × 100% × 0.05 × (1/91.8 - 1/88.2) = EUR 200

However, the purchasers of motors are generally not the end-user, who receives them embedded in other equipment, so the energy cost savings do not benefit the purchaser. An EFF1 typically costs about 20-30% more than EFF2, because they contain more active material. Thus, penetration of EFF1 has remained low in the EU market (e.g., in 2004: EFF1 7%, EFF2 85% and EFF3 8%). It has been proposed to introduce mandatory minimum efficiency standards in EU, as for example exists in North America and in Australia

Sources: CEMEP (European Committee of Manufacturers of Electrical Machines and Power Electronics)

Table 5 Target and sales of EE motors under the financial incentives programme

(a) Targets					
Motor Class	Rated Power (kW)	Number of units to be sold under according to the project document (unit)			
		Year 1	Year 2	Year 3	Year 4
Group 1:	0.75 – 7.5	2 600	5 304	10 820	20 694
Group 2:	11 – 37	180	367	749	1 433
Group 3:	45 – 250	30	61	125	239
Total:		2 810	5 732	11 694	22 365
Total over four years					42 601

(b) Actual sales					
Motor Class	Rated Power (kW)	Number of units sold under program (unit)			
		Year1 (2005)	Year2 (2006)	Year3 (2007)	Year4 (2008)
Group 1:	0.75 – 7.5	0	0	254	203
Group 2:	11 – 37	0	167	880	616
Group 3:	45 – 250	0	12	48	125
Total:		0	179	1182	944
Total over four years					2 305

Source: Final Report (2009)

Due to the rapid economic growth of Poland in the first decade of the 21st century, demand for motors increased rapidly. However, as prices of raw materials on the international market increased in the same period, industry probably preferred not to buy the most efficient EFF1 type of motors, which became relatively more expensive as they contain relatively more copper and electronics.

2.1.4 Component 4 Develop energy efficiency policy in industry for EE motors and drives

Table 6 Performance indicators of Component 4

Outputs (Project Document) Indicator (no. as in APR-PIR)	Value of indicators	
4.1 Increase the knowledge of industrial EE policy <ul style="list-style-type: none"> Policy makers receive info on instruments to promote EE and on the 	<i>Baseline:</i> <ul style="list-style-type: none"> Policy makers do not receive this information <i>Target:</i>	<i>Achieved by early 2009:</i> <ul style="list-style-type: none"> Development of energy efficiency act and implementation mechanisms for national energy

<p>results of the project (23)</p> <ul style="list-style-type: none"> • Policy-makers from key ministries and agencies are trained in project-related areas (24) • The Government receives info from the projects on labeling, LTA (long-term agreements) and BPIs (best practice initiatives) (26) • Best practices regarding electric motors are presented to the government (27) 	<ul style="list-style-type: none"> • Policy-makers receive yearly information on instruments for promoting energy efficiency and on the results of the project. • Policy-makers from key ministries and agencies are trained in project-related areas through seminars at least once a year for at least 50 persons. • The government receives yearly information from the projects on labeling, long-term agreements, and best practices in motors. • Best practices regarding electric motors are presented to the government to be incorporated into Polish national energy efficiency policy. 	<p>efficiency policy (white certificate scheme, long term agreements) is being actively monitored for potential role of motor systems and PEMP center.</p> <ul style="list-style-type: none"> • Progress in development and implementation of EU's climate change and energy efficiency directives are continuously monitored with focus on possible long term activities • Policy-makers from key ministries and agencies have been trained through following seminars, conferences and workshops¹⁴ in project related areas and have received the PEMP newsletter. • Steering Committee members received info on labeling and best practices, which has also been disseminated at workshops, e.g. in lectures undertaken by PEMP with PJECTC
<p>4.2 A national action plan for industrial EE is drafted (25)</p> <p>1.5 Support development and implementation of industrial EE policy</p>	<p><i>Baseline:</i></p> <ul style="list-style-type: none"> • No national action plan <p><i>Target:</i></p> <ul style="list-style-type: none"> • A National Action Plan for Industrial Energy Efficiency is drafted and submitted to the Government of Poland before 15-th month of the project. 	<p><i>Achieved by early 2009:</i></p> <ul style="list-style-type: none"> • KAPE has prepared or contributed to the preparation of a number of documents, such as <ul style="list-style-type: none"> ○ Elaboration of Poland's Energy Policy by the Year 2025 (part on EE) ○ Expertise and elaboration concerning energy efficiency improving energy efficiency action plan, implementing 2006/32/WE directive as well as Green Paper on energy efficiency (2005), as a basis for Energy Efficiency Act and included issues of labeling, LTA and BPI ○ Analysis of possible solutions in framework of energy efficiency with the goal to decrease

¹⁴ Examples are: (1) 'Effective Energy Management as Condition to Improve Competitiveness of Enterprises', organized by KAPE at the Technical University of Warsaw (2004), (2) Conference "Future of Sustainable Energy Policy in Europe", organized by KAPE (2005), (3) conference "Energy Efficiency, Lower Energy Costs. Energy Outsourcing, organized by KAPE (2006), three conference organized by KAPE at Economy Ministry called "Energy Efficiency, Lower Energy Costs in Industry" (2007), (4) two conferences on energy efficiency in electric drive systems (by PEMP, 2005), (5) PEMP participation in IEA workshop in Paris on efficiency in industrial electric motors (May 2006), (6) seminar on green procurement specifications (2006), workshop on EE in Polish industry (2006), chaired by KAPE, (7) presentation of results of PEMP at conference at Ministry of Economy (2007).

		<p>continuously the energy consumption with the economic growth (2008)</p> <ul style="list-style-type: none"> ○ Green procurement guidelines and recommendations for energy efficient electric motors and pumps were included in Green Procurement Catalogue (see www.uzp.gov.pl) ● The proposed Energy Efficiency Act is still under discussion
4.3 Develop schemes for the implementation of labeling, long-term agreements (LTA) and best-practice initiatives (BPIs)	<p><i>Baseline:</i></p> <ul style="list-style-type: none"> ● No information provided 	<p><i>Achieved by early 2009:</i></p> <ul style="list-style-type: none"> ● CEMEP labels (EFF1, EFF2, EFF3) were used by manufacturers who were beneficiaries of the Financial Incentive Program (see also output 3.1 in Table 3). ● Participation of PEMP in Ecofys-SenterNOVEM organized seminars on ‘white certificates’ and voluntary LTAs, based on the Dutch experience
4.4 Link and coordinate with other EE programs in Poland	<p><i>Baseline:</i></p> <ul style="list-style-type: none"> ● 	<p><i>Achieved by early 2009:</i></p> <ul style="list-style-type: none"> ● See section 2.4.2 in the main text

Narrative

The project team has undertaken appropriate initiatives and information dissemination efforts the in frame of policy component and international cooperation, including themes such as PEMP project, energy efficient motors and motor systems, voluntary long term agreements (LTA), labeling of electric motors, minimum efficiency standards, best practices in electric motors, white certificates, voluntary agreement of electric motor manufacturers, minimum energy performance standards, and the upcoming Energy Efficiency Act.

While some positive initiatives have been carried out, the Energy Efficiency Act is (still) under discussion for a long time now. One reason is that in the period 2005-2007 apparently there was lack of active involvement from the Government in energy efficiency matters. This has delayed the formulation of energy efficiency policy. Since end of 2007 situation has changed, with a new government more involved in the implementation of energy efficiency (energy services) and climate change EU directives. Clearly, more efforts are needed, such as mandatory public procurement of EE motors, financial and tax incentives, voluntary long term efficiency agreements in key industrial sectors, white certificates (a market mechanism to promote energy efficiency analogous to the green certificates used to promote renewable energy in the power sector), eco-designs and minimum energy performance standards. An Energy Efficiency Act would provide the framework to speed up energy efficiency transformation, not only in motors, but in industry and other sectors in general.

2.2 Impacts; monitoring and evaluation

Table 7 in this section provides an overview of the envisaged or potential environmental and energy savings impacts of the project. The list of impacts is taken from the APR-PIR, while the indicators and values in Table 7 are combined from the 2009 APR-PIR, the Project Document and the MTE (2008) report.

Table 7 Indicators of project impacts on energy use and GHG emissions

Impact of the Project (based on the APR-PIR and Project Document)	Indicators (relation with project objective and outcome indicator as mentioned in the impact metrics table of the APR-PIR and the original ProDoc)	Verification (as assessed by the Evaluator)
Market transformation	<p><i>Taken from objectives in logframe in ProDoc and indicators in APR-PIR</i></p> <ul style="list-style-type: none"> • Sales of EE motors (see Table 5) <ul style="list-style-type: none"> ○ Small: 39,418 ○ Medium-sized: 2,729 ○ Large: 455 • Sales of EE motors reach 15% of total electric motor sales • Significant number of motor manufacturers involved • Development of labels • Sales of variable speed drives (VSDs) increases with 15% • Some 34 projects in different sectors (in)directly supported by PEMP 	<ul style="list-style-type: none"> • Sales of EE motors (see Table 5): <ul style="list-style-type: none"> ○ Small: 457 ○ Medium-sized: 1,663 ○ Large: 185 • Sales were an estimated 9% with a relative large share of large EE motors • About 75% of manufacturers involved (see indicator 19 in Table 3) • Labels developed (see indicators 9 and 20 in Table 3) • The 2008 APR-PIR mentions a cumulative 80% increase in the sales over the project's lifetime (2004-08) • Some 20 projects supported by PEMP (see Indicators 10 and 14 in Table 1)
<ol style="list-style-type: none"> 1. Annual energy savings 2. Annual and cumulative CO₂ reduction 	<p><i>Taken from objectives in ProDoc:</i></p> <ul style="list-style-type: none"> • Electricity consumption reduced by 55.7 GWh per year by the final year of the project; • Reduction of CO₂ emissions by 832,000 tons over project's lifetime 	<ul style="list-style-type: none"> - The MTE report (2008) mentions the following (see Annex C) <ul style="list-style-type: none"> ○ Saved energy: 64.6 GWh ○ CO₂ emissions avoided of 65,649 tCO₂ annually; assuming a 12-year lifetime of the motor this implies a reduction of 787,800 tCO₂ - The final data are (APR-PIR, 2009): <ul style="list-style-type: none"> ○ CO₂ emissions avoided of 87,247 tCO₂ annually; assuming a 12-year lifetime of the motor this implies a reduction of 1,308,740 tCO₂

2.3 Project design and relevance

2.3.1 Project relevance and country ownership

The project has a strong national character in terms of the key drivers (KAPE and FEWE) and stakeholders. As a member of EU, Poland has to implement the Energy Services Directive, to achieve 9% energy savings by 2016. Member states have autonomy on how to achieve the required savings. In the period 2005-2007, the Evaluator was informed that there was lack of real active involvement from the Government in energy efficiency matters. This has delayed the formulation of energy efficiency policy. Since end of 2007 situation has changed, with a

new government more involved in the implementation of energy efficiency (energy services) and climate change EU directives. In order to achieve electricity savings, energy efficient motor systems present large cost-effective savings opportunities and are therefore a target for Polish national energy policy.

2.3.2 *Conceptualization*

The approach used in the overall project design, in the problem conceptualization, and the selected general intervention strategy seem quite appropriate, by addressing the main barriers which prevent cost-effective energy-efficient motors technologies from entering the market. The different project components and activities proposed to achieve the objectives are in principle appropriate, viable and responded to contextual institutional, legal and regulatory barriers to a more widespread introduction of EE motors.

The indicators defined for guiding implementation and measurement of achievement (e.g., number of energy efficient motors and variable speed drives (VSDs) sold, energy savings and environmental impacts) in general are appropriate, with two notable exceptions:

- Some activities in the logical framework (logframe) are duplicating or not logically placed within the outcome. For example, labeling of motors appears in two activities, 3.1 and 4.3, which should have merged into one activity. Similarly, activity 1.5 could have been merged with 4.2 and 4.3 in one activity, which could have been called 'development of policy and policy instruments'. The indicators for 4.2 are not adequate; it is not sufficiency that policy makers are informed', another indicator should be that policies, plans and/or instruments are formulated and that the project has contributed to it;
- While a revolving fund (linked with the demonstration projects) absorbs large part of the project budget, it is not mentioned as an activity in the Project Document, although it is discussed in its Annex E and referred to in Indicator 16 in the APR-PIR. On further questioning the project team, it was mentioned that originally indeed there was no revolving fund in the project design, but was later incorporated on suggestion by UNDP/GEF. In the end, no revolving fund could be set up in Poland.

2.4 **Effectiveness of project implementation**

2.4.1 *Management and implementation approach*

In general, the project management team has responded correctly to barriers encountered in project implementation (*adaptive management*), such as shifting its customer target group from large to smaller industries and focusing more on larger motors, when it became clear that more success could be obtained in this segment.

On monitoring and evaluation, the mid-term evaluation should have been carried out earlier, especially since the performance of certain indicators (such as motor sales) had been disappointing. Based on such a mid-term evaluation, more corrective actions could have been undertaken to achieve market transformation.

In the period 2005-2007 there was apparently a lack of active involvement from the then Government in energy efficiency issues, resulting in the withdrawal of the representative of

the Ministry of Economy from the PSC (PEMP Steering Committee), in difficulties in getting the demonstration projects implemented in large state-owned companies (such as mines and chemicals), while discussion on energy efficiency legislation stalled.

2.4.2 Stakeholder participation and partnerships

The stakeholder participation in the project has been quite effective. The project seems to have established a wide network with local, national and international entities, as well as the involvement of governmental institutions. In particular information dissemination with a variety of tools and activities has been quite intensive.

The following stakeholders were involved with the described interactions:

- Ministry of Economy, Labor and Social Policy (Steering Committee member), responsible for economy, energy and industrial policy. The Ministry was involved in green procurement recommendations (motors are the part of the document), distribution of PEMP leaflets, co-organization of annual conferences on energy efficiency, the PEMP was included in the Energy Efficiency Action Plan for Poland.
- Energy Regulatory Authority (Steering Committee member), responsible for energy economy regulation and energy market mechanisms development.
- Polish Committee for Standards (PCS). The PEMP team has represented PCS in IEC in frame of developing IEC 60034-30 standard.
- National Fund for Environment Protection and Water Treatment (NFOSiGW) – Steering Committee member – is the financial institution responsible for investment of public resources for projects with positive environmental impacts. NFOSiGW has shown the will to co-finance projects, declaration of future cooperation and support EE motor financing,
- Ecofund (Steering Committee member). Apart from being the GEF operational focal point, Ecofund provided co-funding for large motor systems, to promote of EE motors.
- PCPP - Polish Copper Promotion Center (Steering Committee member). Partner of the project, PEMP team together with PCPC developed 4EM-MCP project - PCPC became a sponsor and took responsibility for the project implementation as the project coordinator, and for the promotion of the PEMP abroad.
- Association of Polish Electrical Engineers (SEP), has provided support for the project by issuing the standard N- SEP-E-006
- Public Procurement Office – incorporation of energy efficient motors to the green public procurement scheme.
- Ministry of Environment (Steering Committee member,
- Office of Competition and Consumer Protection (Steering Committee member)
- Silesian Technical University (Steering Committee member)
- Poland-Japan Energy Conservation Centre of KAPE has organized workshops and training sessions with PEMP
- Associations of Industrial Companies. Active involvement the dissemination of project information, namely tools, activities about the project, and cooperation in organisation of seminars and conferences.
- The manufacturers of electric motors – introduction of energy efficient motors to the market, cooperation in distribution of promotional materials, organisation of seminars (meetings with the distributors and OEMs) and securing the participation of PEMP representative in those meetings, participation in conferences organized by PEMP,

presenting energy efficient motors during the conferences, promotion of energy efficient motors.

2.4.3 Financial planning and delivery of co-financing

Table 8 provides an overview of the planned budget per component, actual total expenditures related to the GEF and co-financing budget as well as a breakdown per budget line of the project budget (per revision January 2008) and actual disbursements per February 2009)

Table 8 GEF budget, co-financing and actual disbursements

PROJECT DOCUMENT CASH (USD million)		GEF	Buyers	Motor producers	Ecofund NFOSIGW	Govr't/ KAPE	PEMP FEWE	UNDP	Total
1	Build capacity and raise awareness	1.25	-	0.30			0.50		2.05
2	Demonstrate EE motors	0.40	7.48		1.22				9.10
3	Stimulate market development	2.06	7.82						9.88
4	Policy	0.59	-						0.59
5	PMU								-
<i>Subtotal</i>		4.30	15.30	0.30	1.22	-	0.50	-	21.62
IN-KIND (USD million)						0.30	0.10		0.40
GRAND TOTAL		4.30	15.30	0.30	1.22	0.30	0.60	-	22.02
PDF B		0.20				0.05		0.04	0.29
ACTUAL DISBURSEMENTS									
(in USD million)		GEF	Buyers	Motor producers	Ecofund NFOSIGW	Govr't/ KAPE	PEMP FEWE	Others	Total
CASH		2.27	16.84	0.61	0.90		0.10	0.32	21.03
IN-KIND						0.32	0.12		0.44
TOTAL		2.27	16.84	0.61	0.90	0.32	0.22	0.32	21.47
Description		ProDoc budget (USD '000)	Febr. '09 expenditures (USD '000)						
71200	Int. consultants	70.82	0.81						
71300	Nat. consultants	1,538.87	1,374.00						
71600	Travel	70.33	49.15						
72100	Contractual services	294.01	55.36						
72200	Equipment	9.42	11.21						
72400	Communication	30.00	17.22						
72500	Supplies	34.20	5.36						
72600	Grants	1,898.45	538.36						
72700	Hospitality	20.00	1.75						
72800	Information techn. Equipm.	71.58	41.02						
73100	Rental & maintenance	92.26	98.98						
74100	Professional services	35.00	3.87						
74200	Audiovisual and printing	100.00	60.00						
74500	Miscellaneous	37.27	7.95						
TOTAL		4,302.20	2,265.03						

Source: data collected from ProDoc, APR-PIR (2008/9) and MTE (2008)

Of the originally planned budget only 53% was spent by the time of operational closure of the project in February 2009. This is mainly due to the fact that of the budget line 'grants' only 28% was spent, but the remainder has remained unspent, due to the delay in establishing the revolving fund and its subsequent cancellation as well as less-than-expected expenditures on the motor incentive scheme.

In general, other activities (namely capacity building) have been progressing well. Breakdown per organization of the expenditure of USD 2.265 million till February 2009 is:

- KAPE – PMU: USD 0.520 million
- KAPE – activities: USD 0.656 million
- FEWE: USD 1.089 million

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Effectiveness of project implementation

The following summarizes the main findings of the evaluation, regarding project progress towards results as well as project implementation and management.

3.1.1 Attainment of project's outcomes and achievements; project design

The Polish Energy Efficient Motors Program (PEMP) has strongly contributed to increase the awareness on energy efficient motor systems and capacity building in terms of creating a pool of knowledgeable staff, as discussed in detail in section 2.1 The Evaluator therefore rates the corresponding component 1 (capacity building) as 'highly satisfactorily'.

Regarding component 2, the four demonstration projects are successfully being implemented and can be rated as 'satisfactorily'. After failing to get much interest in big industry, project management rightly shifted its attention to smaller industries. However, the planned revolving fund could not be set up and this part of component has performed 'unsatisfactorily'.

Despite the incentive scheme for motor manufacturers (funded by Ecofund with a contribution from PEMP), the project has not been able to achieve real market transformation in all the segments of the motor market with sales of motors much less than expected.

Regarding electric motor sales, there are a number of external reasons outside the project's control that are explained in section 2.1.3, such as increase in the prices of electric motors, exchange rate changes and Poland's entry into the European Union (EU) in 2004. The latter changed market conditions considerably. Furthermore, it was unclear for almost 1 year, whether the motor manufacturers' incentive scheme would not conflict with EU regulations, leading to further delay in project implementation.

But maybe some faults lie in the design of the project, which the Evaluator rates as only 'marginally satisfactory'. Some factors here were outside the control of the project formulators; for example, it took almost 5 years after first presentation of the project concept to get approval by GEF Secretariat (1999-2004). The proposed financial incentive mechanism was awaited manufacturers and was carefully designed in accordance with the pre-accession situation. By the time the project started, the setting had fundamentally changed with Poland's accession to the EU, rendering the incentive schemes unfeasible in the end. Nonetheless, when writing the ProDoc, the fact that Poland would one day join the EU should have been anticipated and the market for EE motors and the need for incentive and financial mechanisms could have been studied more profoundly. The fact that only half of the budget has been spent raises questions whether the budgeting in the project design should not have been done more diligently.

A more fundamental problem lies on the focus on motors and VSDs. At first look this makes sense; steam and motor-driven systems account for approximately 50% of manufacturing energy use worldwide. Typical energy savings by putting in an EE electric motors are around 5-10%. However, from a cost-benefit point of view, companies may be more convinced if not only one component in their production process is looked at (motors and VSDs), but by looking at production system as a whole. Instead of looking at the efficiency of each component in the system (motor, VSD, fan, pump, compressor, heater), a system optimization approach also looks at better matching the supply system to demand and configuring each of the components such that these better match work and by eliminating inefficient practices and correcting maintenance problems. In such a holistic approach, often energy savings up to 40% can be obtained. This may also explain the lack of interest shown by ESCOs.

While the sales in the low-power motor range have been disappointing, the sales of large motors have performed better. As large motors consume more power than small ones, in absolute terms more savings will be obtained per motor. Although only 1,800 motors were sold instead of the planned 42,600, the fact that relatively much more large motors were sold than originally planned, this paradoxically has led to overall energy savings and greenhouse gas emission reductions more or less as targeted in the ProDoc. Despite this achievement, the feeling is that market transformation has been performing ‘unsatisfactorily’.

Regarding component 4 (industrial energy efficiency policy) the project has undertaken various efforts, such as promoting the labeling of motors, developing voluntary standards and contributing, awareness raising and providing inputs for the formulation of the Energy Efficiency Act and other policy measures. The Evaluator rates the achievements in this component as ‘satisfactory’.

Overall, the project’s achievements are rated by the Evaluator as ‘marginally satisfactory’.

3.1.2 Project management and partnerships

PEMP has *partnered* well in a ‘satisfactory’ way with a number of co-financiers and partners from government and the private sector in Poland and abroad (such as the Poland-Japanese Energy Conservation Center, Ministry of Economy, Ecofund, NFOSiGWM). Also, the project management team has responded correctly to barriers encountered in project implementation (*adaptive management*), such as shifting its customer target group from large to smaller industries and focusing more on larger motors, when it became clear that more success could be obtained in this segment, although maybe more corrective actions could have been undertaken to achieve market transformation.

On monitoring and evaluation, the mid-term evaluation should have been carried out earlier, especially since the performance of certain indicators (such as motor sales) had been disappointing.

On the *budget*, it was expected by the PMU that the project would have been extended beyond February 2009 and that at least part of the funds remaining (about USD 2 million) would still have been used. Nonetheless, the PMU should have reacted earlier if part of the funds could not have been dedicated to other useful PEMP-supported activities. Also, the UNDP Office in Poland, though admittedly quite small, as well as the UNDP Regional Center in Bratislava (UNDP-BRC) should have been more assertive and creative in this.

3.1.3 Sustainability and replication

The benefits of the project are likely to be sustained:

- On the short run, the PEMP Centre will continue functioning within FEWE with grant money from NFOSGiW and its information (web page, EE motor software, handbooks, etc.) will remain available to the public, while awareness and skills associated with EE motors will remain¹⁵;
- Regarding finance mechanism, FEWE will formulate a proposal for NFOSiGW on a PLN 100 million funding window, which will leverage funds at a much higher level than the revolving fund foreseen in the ProDoc. If realized the fund would allow a strong replication of PEMP Center's activities on EE motor promotion, especially if the new Energy Efficiency Law would be enacted.
- The Energy Efficiency Act is being prepared and it looks like that its main tool will be the so-called 'white certificates'.
- Energy efficiency policies will also become more important as part of ongoing implementation of EU emission reduction and energy efficiency directives. At one point in time, minimum energy performance standards (MEPS) may be introduced in Europe

3.2 Issues and recommendations

One issue discussed during the mission, was the future of the USD 400,000 provided to the demo projects by KAPE as loans to be provided under the revolving fund. The question was raised if these loans should be provided back to UNDP. The second issue was what to do with the about USD 2 million funds left in the project budget as a whole, after the project was operationally closed in February.

Although not claiming to be an expert in UNDP administrative issues, the USD 400,000 are technically provided as 'grants' (as indicated in Table 8), so the Evaluator doubts if these funds need to be returned. UNDP anyhow will want to close the project financially, now that operations have stopped and its country representation in Poland has been closed. Of course, companies would have to continue to repay to KAPE for the soft loans obtained, according to their agreement with KAPE. On the USD 2 million left in the UNDP-GEF budget, it was suggested the funds could be used to help set up the newly proposed NFOSiGW finance mechanism. This might be discussed with UNDP Regional Office in Bratislava, but it seems likelier that the funds need to be returned to GEF in the end.

3.3 Lessons learnt

Some lessons learnt are:

- It is difficult to achieve real market transformation in the very short span of a typical UNDP/GEF project of about 4-5 years. To create awareness and really change the mindset of people easily takes several years.
- Regarding the revolving fund, it is difficult to get banks interested in managing a relatively small fund as these have relatively high operating cost in comparison with the amount of

¹⁵ FEWE will finance will come from both grant money as well as doing audits on a commercial basis

capital covered. It may be easier to support existing credit lines (perhaps with an energy efficiency window) rather than setting up a new fund.

- The active involvement of the Government plays an important role. A project, such as PEMP, can contribute to formulating appropriate energy efficiency legislation as a framework for various energy policy instruments. However, formulation of such policies and legislation is a political process that can take many years, often longer than the time span of a typical UNDP/GEF project. In this case, there is still no Energy Efficiency Act and PEMP may have achieved more had the right policy instruments been in place during the project period.
- In particular market conditions (e.g. the electric motor market oligopolized by a few companies), it is probably more effective to provide financial incentives to end users rather than to the motor manufacturers. In the case of PEMP, the incentives were not necessarily passed on for the customer's benefit. On the other hand, if there is a clear market for EE motors, manufacturers will supply the demand.
- A proper project design is crucial. This implies that sufficient info is gathered on market, market players, needs of beneficiaries and barriers. It has turned out the target group of small companies was more important than large companies, while larger EE motors played a more important role than small EE motors. The setup of a revolving fund and other financial and other incentives should be carefully analyzed by means of feasibility studies and market surveys. Last, but not least, the time from project concept to actual start of implementation should have been much reduced

ANNEX A. TERMS OF REFERENCE (TOR)

The original text of the ToR has been amended in the sense that the numbered items highlighted yellow have been added to be able to refer to the corresponding part in the main body of the text in this report, but otherwise the original text has not been altered.

Project Title: "Polish Efficient Motors Programme"
Project Number: POL/99/G41

INTRODUCTION

The Monitoring and Evaluation (M&E) policy at the project level in UNDP/GEF has four objectives:

- To monitor and evaluate results and impacts;
- To provide a basis for decision making on necessary amendments and improvements;
- To promote accountability for resource use;
- To document, provide feedback on, and disseminate lessons learned.

In accordance with UNDP/GEF M&E policies and procedures, all regular and medium-sized projects supported by the GEF should undergo a final evaluation upon completion of implementation. Final evaluations are intended to assess the relevance, performance and success of the project. It looks at early signs of potential impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental goals. It will also identify/document lessons learned and make recommendations that might improve design and implementation of other UNDP/GEF projects.

Brief project description

The Polish Energy Efficient Motors Programme (PEMP) project was aimed to overcome barriers for increased market penetration of energy efficient motors and related efficiency improvements in the electric motor system (including variable speed drives), particularly, but not exclusively, in the manufacturing industry, the energy sector (heating), the utility sector (water supply and sewage treatment) and mining.

Under the programme four components were developed and implemented during 2004 - 2009: a) Capacity building by providing information and services related to energy efficient electric motors; b) Implementation of four demonstration projects for efficient motor systems in different key sectors; c) Market transformation, using a financial incentive mechanism coupled with awareness raising; and d) Development of industrial energy efficiency policy, particularly in the field of efficient motor systems.

PEMP was expected to achieve has established the following specific targets:

- Increase energy efficient motor sales in Poland to app. 15% of the total motor market as a direct result of PEMP during the duration of the programme (five years);
- Increase the efficiency of electric motor systems by increasing the penetration of variable speed drives in combination with energy efficient motors;
- Achieve a medium-term increase of energy efficient motors sales of 30% of the total motor market in the year 2012;
- Save electricity by promoting the optimization of electric motor systems, including the implementation of energy efficient motors and variable speed drives to a level of 55.7 GWh/year in 2007 and 231.6 GWh/year in 2012; and,
- Reduce domestic GHG emissions by 832 kton CO₂ by 2007 (directly attributable to PEMP and cumulative over the project lifetime), and 3.7 Mton CO₂ by 2012, including the medium-term impact (cumulative over the lifetime of the investments).

OBJECTIVES OF THE EVALUATION

The evaluation should assess:

Project formulation:

The evaluator will assess the project concept and design. He/she should review:

- The problems addressed by the project and the project strategy, encompassing an assessment of the appropriateness of the objectives, outputs, activities and inputs as compared to cost-effective alternatives;
- The extent to which the project idea had its origin within national, sectoral and development plans and focuses on national environment and development interests;
- Information dissemination, consultation and stakeholder participation in design stages;
- The ways in which lessons and experience from the project were or are replicable or scaled up in the design and implementation of other projects.

Implementation

The evaluation will assess the implementation of the project in terms of quality and timeliness of inputs and efficiency and effectiveness of activities carried out. He/she should review:

- Implementation Approach, including an analyses of the project's logical framework, adaptation to changing conditions and overall project management;
- The quality and timeliness of monitoring and evaluation of the project;
- Stakeholder participation in the project, specially – information dissemination, NGOs and local resources users in the implementation, the establishment of partnerships and relationships developed by the project with local, national and international entities and involvement of governmental institutions;
- Financial Planning, including an assessment of the actual project cost by objectives, outputs, activities, the cost-effectiveness of achievements, financial management and co-financing;
- Sustainability – extent to which the benefits of the project will continue, within or outside the project area, after project closure;
- Execution and implementation modalities.

Project outputs, outcomes and impact

The evaluation will assess the outputs, outcomes and impact achieved by the project as well as the likely sustainability of project results (including review of GHG emissions reductions calculations from the project¹⁶). This should encompass an assessment of the achievement of the immediate objectives and the contribution to attaining the overall objective of the project. The evaluation should also assess the extent to which the implementation of the project was inclusive of relevant stakeholders and to which it was able to create collaboration between different partners. The evaluation will also examine if the project has had significant unexpected effects, whether of beneficial or detrimental character.

EVALUATION PRODUCT

The evaluator will produce an evaluation report with findings, recommendations, lessons learned, and rating on performance. The report (in English) should include:

Executive summary

- Brief description of project

¹⁶ Monitoring methodology according to the "Manual for calculating GHG benefits of GEF projects"

- Context and purpose of the evaluation
- Main conclusions, recommendations and lessons learned

Introduction (see Chapter 1)

- Purpose of the evaluation
- Key issues addressed
- Methodology of the evaluation
- Structure of the evaluation

The project(s) and its development context (see Chapter 1)

- Project start and its duration
- Problems that the project seek to address
- Immediate and development objectives of the project
- Main stakeholders
- Results expected

Findings and Conclusions

In addition to a descriptive assessment, all criteria marked with (R) should be rated using the following divisions (according to GEF Project Review Criteria):

Abbreviation	Rating
HS	Highly Satisfactory
S	Satisfactory
MS	Marginally Satisfactory
U	Unsatisfactory
NA	Not applicable

- Project formulation
 - o Conceptualization/Design (R) – it should assess the approach used in design and an appreciation of the appropriateness of problem conceptualization and whether the selected intervention strategy addressed the root causes and principal threats in the project area. It should also include an assessment of the logical framework and whether the different project components and activities proposed to achieve the objective are appropriate, viable and responded to contextual institutional, legal and regulatory settings of the project. It should also assess the indicators defined for guiding implementation and measurement of achievement and whether lessons from other relevant projects (e.g., same focal area) are incorporated into project design (see sections 2.3.2 and 3.1.1)
 - o Country ownership/Driveness – must assess the extent to which the project idea had its origin within national, sectoral and development plans and focuses on national environment and development interests (see sections 1.1 and 2.3.1)
 - o Stakeholder participation in the project (R), specially – information dissemination, NGOs and local resources users in the implementation, the establishment of partnerships and relationships developed by the project with local, national and international entities and involvement of governmental institutions (see section 2.4.2)
 - o Replication approach – it would be crucial to determine the ways in which lessons and experiences coming out of the project were/are to be replicated or scaled up in the design and implementation of other projects (see section 3.1.3)
 - o Cost-effectiveness (see Annex C)
 - o UNDP comparative advantage as IA of the project;
 - o Linkages between project and other interventions within the sector (see sections 1.1 and 2.4.2)
 - o Management arrangements (see sections 1.4 and 3.1.2)
- Implementation
 - o Implementation approach (R) – it should include assessment of:

1. The use of the logical framework as a management tool during implementation and any changes made to this as a response to changing conditions (used in APR-PIR, see sections 2.1, 2.2 and 2.3.2)
 2. Other elements that indicate adaptive management such as comprehensive and realistic work plans routinely developed that reflect adaptive management and/or; changes in management arrangements to enhance implementation (see section 2.4.1 and 3.1.2)
 3. The project's use/establishment of electronic information technologies to support implementation, participation and monitoring, as well as other project activities (see section 2.1.1, PEMP website)
 4. The general operational relationships between the institutions involved and others and how these relationships have contributed to effective implementation and achievement of project objectives (see section 2.4.2)
 5. Technical capacities associated with the project and their role in project development, management and achievements (see section 3.1)
 - Monitoring and evaluation (R) – especially their quality and timeliness (see section 3.1.2);
 - Stakeholder participation (R) – it should include (see section 2.4.2)
 1. The production and dissemination of information generated by the project;
 2. Local resource users and NGOs participation in project implementation and decision making and an analysis of the strengths and weaknesses of the approach adopted by the project in this arena;
 3. The establishment of partnerships and collaborative relationships developed by the project with local, national and international entities and the effects they have had on project implementation;
 4. Involvement of governmental institutions in project implementation, the extent of governmental support of the project.
 - Financial Planning, including an assessment of the actual project cost by objectives, outputs, activities, the cost-effectiveness of achievements, financial management and co-financing and Leveraged Resources (see Table 1 attached). See section 2.4.3)
 - Sustainability – the extent to which the benefits of the project will continue, within or outside the project domain, after it has come to an end (see section 3.1.3);
 - Execution and implementation modalities – it should consider the effectiveness of the UNDP counterpart and Project Co-ordination Unit participation in selection, recruitment, assignment of experts, consultants and national counterpart staff members and in the definition of tasks and responsibilities (see 3.1.2 and 3.2)
- Results
- Attainment of Outcomes/Achievement of objectives (R). See section 3.1.1;
 - Sustainability – appreciation of the extent to which the benefits of the project will continue, within or outside the project area, after project closure. See section 3.1.3;
 - Contribution to upgrading skills of the national staff (see 2.1.1 and 3.1.3)

Recommendations (see 3.2)

- Corrective actions for the design, implementation; monitoring and evaluation of the project;
- Actions to follow up or reinforce initial benefits from the project;
- Proposals for future directions.

Lessons learned (see 3.3)

- Best and worst practices in producing outputs, linking them to outcomes and using partnerships strategically

Annexes

- TOR (Annex A)
- Itinerary (Annex B)
- List of persons interviewed (Annex B)

- Summary of field visits (Annex B)
- List of documents reviewed (Annex B)
- Questionnaire used and summary of results (N/A)
- Co-financing and Leveraged Resources (see Table 1 attached), see Table 8)
- Manual for calculating GHG benefits of GEF projects (see Annex C)

EVALUATION METHODOLOGY

The evaluation will be based on the study of documents and interviews with the key persons involved in the project, i.e. representatives of the implementing agency, UNDP project staff, the Project Coordinator and other involved municipalities, the Steering Committee members, as well as other partners, stakeholders and beneficiaries. The evaluators will be provided with basic documentation related to the project, including the project document, summary records of Steering Committee and project reports.

The evaluation will be carried out by the Consultant with support from local project staff. The evaluators selected should not have participated in the project preparation and/or implementation and should not have conflict of interest with project related activities. Former cooperation with GEF is an advantage. Consultants should also have experience/knowledge in/of:

- motors energy efficiency policy options, including
- financial incentives: rebate schemes, grants and demonstrations;
- EE labels and standards
- EU requirements in EE motors
- monitoring methodologies and assessment of CO2 emissions reductions
- similar project evaluations
- The Consultant will be responsible for preparing and submitting the evaluation report to UNDP.

IMPLEMENTATION ARRANGEMENTS

UNDP will provide the necessary substantive and administrative support. UNDP and the Project Coordinator will provide access to project documents. Upon arrival the evaluators will be briefed by the respective UNDP Programme Officer. The UNDP Project Coordinator and the Implementing Agency will plan the mission, organize interviews with selected individuals/institutions, as well as provide interpretation and translation when necessary.

The evaluation mission will be conducted in April, with the following steps:

Desk review - gathering of data, review of documentation (project document, project revisions, reports, and other relevant project documentation);

Organization of the mission - conducted by the Implementing Agency (scheduling of meetings as agreed with the Consultant, confirming facilities and logistical arrangements) with the assistance of UNDP;

Mission to Poland - will be conducted by the Consultant. Debriefing meetings for the Expert with UNDP representatives shall be organized on the first and last day of the mission.

Preparation of the report - the initial findings of the evaluation should be presented as a debriefing to UNDP Poland and the Project Coordinator on the final day of the mission.

TIME FRAME

The evaluation mission will take place in April 2009. The first draft of the evaluation report shall be submitted by 15 May to allow for comments from UNDP and the Project Director. Upon receipt of these comments, the Consultant shall submit the final report by 30 May. The work will require a total of 10 days, comprised of a 5 days visit to Poland and 5 days for preparation and drafting of the report.

**Table 1. Co-financing and Leveraged Resources
(For projects that have undergone a mid-term, phase or a terminal evaluation)**

A. CO-FINANCING

Co financing (Type/ Source)	IA own Financing (mill US\$)		Multi-lateral Agencies (Non-GEF) (mill US\$)		Bi-laterals Donors (mill US\$)		Central Government (mill US\$)		Local Government (mill US\$)		Private Sector (mill US\$)		NGOs (mill US\$)		Other Sources* (mill US\$)		Total Financing (mill US\$)		Total Disbursemen t (mill US\$)		
	Proposed	Actual	Proposed	Actual	Proposed	Actual	Proposed	Actual	Proposed	Actual	Proposed	Actual	Proposed	Actual	Proposed	Actual	Proposed	Actual	Proposed	Actual	
Grant																					
Credits																					
Loans																					
Equity																					
In-kind																					
Non-grant Instruments*																					
Other Types*																					
TOTAL																					

“Proposed” co-financing refers to co-financing proposed at CEO endorsement.

Please describe “Non-grant Instruments” (such as guarantees, contingent grants, etc):

Please explain “Other Types of Co-financing”:

Please explain “Other Sources of Co-financing”:

Projects that have not realized expected co-financing levels must provide explanations. Please describe in 50 words the resources the project has leveraged since inception and indicate how these resources are contributing to the project’s global environmental objective.

ANNEX B. ITINERARY AND LIST OF DOCUMENTS

B.1 Mission schedule and list of people met

Mon 15/06/09	Arrival of the Consultant, Mr. J. van den Akker, in Warsaw
Tue 16/06	Meeting with Ms. Aleksandra Krukar (UNDP, Programme Assistant)
Wed 17/06	Meeting at KAPE with project team (Ex-project manager, Mr. Krysztof Broza-Brzezina) Meeting at the Poland-Japanese Energy Conservation Centre (Mr. Ryszard Wnuk, Director)
Thu 18/06	Transfer from Warsaw to Katowice Meeting at FEWE with project team (Mr. Szymon Liszka, President and Mr. Jerzy Piszczek, Project Manager)
Fri 19/06	Travel to Tarnow Visit to one of the demonstration sites, Fritar company Return to
Mon 22/06	Debriefing meeting at KAPE premises in Warsaw with Ms. Krukar, Mr. Brzoza-Brzezina, Mr. Przemyslaw Czajkowki (former GEF coordinator) and Mr. Guzowski (Ministry of Economy, member of Steering Committee)

B.2 List of documents reviewed by the Evaluator

APR-PIR

Annual Performance Report – Project Implementation Review, 2009, 2008, 2007, 2006, 2005

Final Report, Febr. '04 – Febr. '09

Polish Energy Efficient Motor Program (PEMP, 2009), prepared by K. Brzoza-Brzezina and S. Liszka

MTE (2009)

Mid Term Evaluation of the Project (March 2009)

PEMP

PowerPoint presentations prepared by S. Liszka and K. Brzoza-Brzezina as well as J. Piszczak

ProDoc (2004)

Polish Energy Efficient Motor Program, POL/02/G31 (PIMS 1645), UN Development Programme

Quarterly Progress Reports, PEMP

ANNEX C. ESTIMATION OF CO₂ EMISSIONS

This section is entirely taken from Annex VII to the MTE (2009) report.

The methodology of estimation of electricity savings and environmental effects (avoided CO₂ emission) in the PEMP project

Introduction

From the beginning of the PEMP project, i.e. since year 2005 within the framework of financial incentive programme 1782 pieces of energy efficient motors were sold. The total power of the energy efficient motors sold was 29 MW.

In the same period outside the financial incentive programme, 343 pieces of large energy-efficient motors with power range from 160 kW to 3,2 MW and 583 pieces other energy efficient motors in power range from 0,75 to 160 kW were sold. The total sales of energy efficient motors was 2708 pieces with the total power about 176 MW. As a result of sales of energy efficient motors and implementation of demonstration projects 64,6 GWh of electricity was saved. This enabled to avoid the emission of more than 65,6 thousands t CO₂ equivalent.

	Saved energy [MWh]	Avoided CO ₂ eq. emission [t CO ₂]
Rebate programme	4145	4047
Large motors	55565	54068
Outside rebate programme	2591	2519
Demonstration projects & follow up	2310	5015*
Total	64611	65649

Notice 1: * with saved coal,

Notice 2: indicator of the emission of greenhouse gases for delivered electricity for last available data; in 2005 – 0,983 kg eq. CO₂/kWh, in 2006 – 0,971 kg eq. CO₂/kWh.

The methodology

Financial Incentive Programme:

The information concerning the sale of energy-efficient motors within the framework of the financial Incentive Programme is presented in detail showing the motor type, power and efficiency. The motor manufacturers know the placement of the motors seldom. Having above in mind that was assumed that the motors are used proportionally to electricity consumed in each sector of the national economy.

The energy effect was defined basing on the power, the number of operating hours of motors and the difference of the efficiency of energy efficient motors and standard motors. The efficiency of the specified energy efficient motor was referred to the efficiency of the standard motor of the same power. The ranges of power and the average number of operating hours of motors is depending from the place of the motor use (industry branch and driven devices: pumps, ventilators, air-compressors and other). This procedure was accepted according to the analysis in “Improving the Penetration of Energy – Efficient Motors and Motors” - Anibal T. de Almeida and others; European Commission, SAVE II - Contract N^o.: 4.1031/Z/96-044.

The following data are specified for different groups of energy efficient motor:
quantities of motors, power, energy saved and avoided emissions.

	From beginning of the project till end of 2 Quarter 2008
Large motors outside Financial Incentive Programme	
Number	343
Power [MW]	184,125
Saved energy [MWh/year]	55 565
Avoided CO ₂ eq. emission [t ekw.CO ₂ /year]	54 068
Motors in rage from 0,75 – 160 kW outside Financial Incentive Programme	
Number	583
Power [MW]	16,723
Saved energy [MWh/year]	2 591
Avoided CO ₂ eq. emission [t ekw.CO ₂ /year]	2 519
Financial Incentive Programme	
Number	1 782
Power [MW]	28,979
Saved energy [MWh/year]	4 145
Avoided CO ₂ eq. emission [t ekw.CO ₂ /year]	4 047
Demonstration projects & follow up	
Saved energy [MWh/year]	2 310
Avoided CO ₂ eq. emission [t ekw.CO ₂ /year]	5 015
Total PEMP project	
Number	2 708
Power [MW]	200,848
Saved energy [MWh/year]	64 611
Avoided CO ₂ eq. emission [t ekw.CO ₂ /year]	65 649

Avoided emission was calculated for the indicator of the emission of greenhouse gases for delivered electricity. The emission indicator for the production of the electricity was calculated according to the emission indicators of greenhouse gases fuels burnt in power plants and heat and power plants public and industrial. The data are the latest information published by the Central Statistical Office (Główny Urząd Statystyczny - GUS).

Outside Financial Incentive Programme Programme (in range from 0,75 to 160 kW):

The energy effect and avoided emission of greenhouse gases for energy efficient motors sold outside Financial Incentive Programme was calculated according to methodology accepted for the Financial Incentive Programme. As producers revealed only the number of energy-efficient motors sold outside the Financial Incentive Programme, that was assumed that structure of efficient motors sold outside the Financial Incentive Programme was similar to that one in Financial Incentive Programme.

For motors - power from 160 kW to 3,2 MW:

The energy effect and avoided emission of greenhouse gases for energy efficient motors with power from 160 kW to 3,2 MW was calculated according to the methodology given in the document “Estimation of Leverage financing coming from the use of energy efficient motors (power 160 kW – 3200 kW) and accompanying CO₂ emission reduction”

Estimation of Leverage financing coming from the use of energy efficient motors (power 160 kW – 3200 kW) and CO₂ emission reduction

Basing on the information from the leading manufacturer of electric motors in the years 2005 – 2007, 343 pieces of large energy efficient motors were sold. The share of energy efficient motors in total production was nearly 40% whereas in year 2007 the share amounted 54%.

Investments on the energy efficient motor purchase as well as energy and ecological effects (avoided emission of CO₂) with reference to standard - motors are presented below:

Voltage [kV]	0,4	6	
Power ranges [kW]	160 - 315	160 - 500	> 500
Representative power [kW]	250	315	1 000
Difference of the efficiency [%]	2,5	4,9	3,5
Operating hours [h]	7400-7500	7900-8400	7500-8300
Energy saved [MWh]	55565		
Emission avoided [tCO ₂]	54068		
Price of representative motor 2005-2006/2007 [PLN]	38300/42200	42100/46300	207925/236600
Investments [10 ³ PLN]	35103,6		
Investments [10 ³ US\$]	12811,5		

Methodology

For each power range the representative power was defined. For the range 160 - 315 kW and for the voltage 400 V the representative power - 250 kW was selected. For the range 160 - 500 kW and for the voltage 6 kV - 315 kW was selected. For the range above 500 kW and for the voltage 6 kV - 1000 kW was selected. For these ranges the difference of the efficiency of energy efficient motors with reference to standard ones according to catalogue data was assumed: 2,5%, 4,9% and 3,5%.

Similarly, the motor price for the representative power was qualified respectively: 42,2 thousands PLN, 46,3 thousands PLN, 236,6 thousands PLN. (according to price-lists from December 2007).

The motors operating hours were estimated according to the places of use (the chemistry, the power sector, the iron and steel, heat and water utilities, the drive of pumps, ventilators, air-compressors and others) according to “Improving the Penetration of Energy - Efficient Motors and Drives” - Aníbal T. de Almeida and others; European Commission, SAVE II - Contract Just.: 4.1031/Z/96-044.

Investments and effects from 2007 were added to investments and effects reached from the beginning of the project. This procedure is connected with different prices of motors, different exchange rates of PLN/US\$ and with different coefficient of the CO₂ emission on the electricity production in each year.

Coefficients of CO₂ emission:

- for the year 2005: 0,983 [kg CO₂/kWh]
- for the year 2006(last available): 0,971 [kg CO₂/kWh]

Calculation of energy savings:

The energy savings were calculated in 3 groups:

- Group 1. Small e.e. motors (0,75-160 kW) sold under financial incentive programme.
- Group 2. Small e.e. motors (0,75-160 kW) sold outside of financial incentive programme.
- Group 3. Large e.e. motors (160kW – 3,2 MW) sold by the manufacturer Emit outside of financial incentive programme.

Description of Group 1.

The detailed information was collected about each motor sold under financial incentive programme such as: type, rated power, efficiency, price, number of poles, etc. (they are included in the manufacturer's proposals to the programme and in the contract). The efficiency of energy efficient motor must be equal or higher than required by the PEMP programme (it is based on eff1 of CEMP). The table, in which minimum energy efficiency is specified for each rated power and for 2 and 4 poles is part of the contract with the manufacturers participating in the PEMP programme.

Because the manufacturers submit the Proof of Performance documentation quarterly, the energy savings were calculated quarterly. The average efficiency for motors sold by all manufacturers - were calculated separately for each rated power and separately for 2 and 4 poles. Then the difference between above average values and values of eff2 efficiency of CEMEP is calculated separately for each rated power.

Example for motors 30 kW sold in 1 Quarter 2008:

Calculated average energy efficiency of energy efficient motors:

$$\eta_{2\text{pole}} = 92,9\%$$

$$\eta_{4\text{pole}} = 93,4\%$$

Energy efficiency of eff2 motor.

$$\eta_{\text{stand } 2\text{pole}} = 91,4\%$$

$$\eta_{\text{stand } 4\text{pole}} = 91,4\%$$

Description of Group 2.

In this group the particular manufactures have provided only the quantities of energy efficient motors in range of rated power from 0,75 to 160 kW which were sold outside of the financial incentive programme in year 2007. In this case it was assumed that the structure of efficient motors sold outside the Financial Incentive Program was similar to that of the Financial Incentive Program.

Description of Group 3

In this group **343** energy efficient motors have been sold in years 2005 – 2007.

Three following power ranges were defined in this group:

160 – 315 kW (0,4kV) ,

160 – 500kW (6 kV),

500kW - 3,2 MW (6 kV)

For each power range the representative rated power was selected as follows.

- For the range 160 - 315 kW and for the voltage 400 V, the representative rated power 250 kW was selected.
- For the range 160 - 500 kW and for the voltage 6 kV, the representative rated power 315 kW was selected.

- For the range 500kW - 3,2 MW and for the voltage 6 kV , the representative rated power - 1000 kW was selected.

For the above representative rated powers, the difference of the efficiency of energy efficient motors with reference to standard ones according to catalogue data was assumed respectively: 2,5%, 4,9% and 3,5%.

In all above groups, the energy savings have been calculated cumulative from the beginning of the project (2005, 2006, 2007).

Calculation of cost of motors:

The cost of motors in 3 groups were calculated as follows:

Group 1. Small e.e. motors (0,75-160 kW) sold under financial incentive programme.

Group 2. Small e.e. motors (0,75-160 kW) sold outside of financial incentive programme.

Group 3. Large e.e. motors (160kW – 3,2 MW) sold by the manufacturer Emit outside of financial incentive programme.

Description of Group 1.

The detailed information about prices of each motor sold under financial incentive programme was collected from the manufacturer's Proof of Performance documentation. Proof of Performance documentation is a table in which the manufactures specify all types, prices, rebates, quantities of motors sold under the financial incentive programme. Copies of invoices are attached to the above tables. Manufacturers submit the Proof of Performance documentation quarterly. The cost of all motors sold under financial incentive programme were monitored in the Excel tool which is updated quarterly.

Description of Group 2.

In this group the particular manufactures have provided only the quantities of energy efficient motors in range of rated power from 0,75 to 160 kW which were sold outside of the financial incentive programme in year 2007. In this case it was assumed that the structure of small efficient motors sold outside the Financial Incentive Programme was similar to that of the Financial Incentive Programme.

Description of Group 3.

In this group **343** energy efficient motors have been sold in years 2005 – 2007.

Three following power ranges were defined in this group:

160 – 315 kW (0,4kV) ,

160 – 500kW (6 kV),

500kW - 3,2 MW (6 kV)

For each power range the representative rated power was selected as follows.

- For the range 160 - 315 kW and for the voltage 400 V, the representative rated power 250 kW was selected.

- For the range 160 - 500 kW and for the voltage 6 kV, the representative rated power 315 kW was selected.

- For the range 500kW - 3,2 MW and for the voltage 6 kV , the representative rated power - 1000 kW was selected.

The motor prices for the representative rated powers were qualified respectively: 42,2 thousands PLN, 46,3 thousands PLN, 236,6 thousands PLN. (according to price-lists from December 2007).

Cost-Effectiveness and Key Results

Cost of the avoided GHG emissions or alternatively the ratio between the GEF funding and leverage financing can be considered as possible measures of the cost-effectiveness of the project. Initially the sale of 42 600 energy efficient motors was planned and by the end of the first half of 2008 only 1800 motors seem to have been sold. The energy savings and GHG emissions reductions directly associated with energy efficient motors in the target power range is therefore much less than the planned value. Although the impact of small energy-efficient motors is modest, the impact of large motors is very significant. This is

due to the fact of successful promotion of large motors and due to the fact that about 20 kW in power consumption difference per large motor was achieved in 343 large motors sold in the in years 2005, 2006, 2007. As a result of sales of energy efficient motors and implementation of demonstration projects 64,6 GWh of electricity was cumulatively saved.

The investment of PEMP project has been so far been about USD 2.27 million leading to a cumulative reduction (years 2005, 2006, 2007) of GHG emissions of 65,649 ton of CO₂ (about 20 US\$ / ton of CO₂). These numbers seem modest, but it should be emphasized that large motors last on average about 20 years, leading therefore to much higher impact (one order of magnitude larger of the savings and the corresponding decrease in costs) over their lifetime.

The leverage funds have reached about US\$ 19 Million, which is a leverage ratio of about 8.5/1, which seems quite positive.

ANNEX D. LIST OF DOCUMENTS PRODUCED BY PEMP

The list of documents/reports/brochures is taken from the February 2009 APR-PIR

Year 2004:

- KAPE periodical; Energia Pieniadze Srodowisko 12/2004 (Energy, Money, Environment 12/2004) „Polski program efektywnego wykorzystania energii w napędach elektrycznych PEMP”, Energoszczedne układy napędowe-przykładowe zastosowania w przedsiębiorstwach wodociągowych i w ciepłownictwie”.
(Polish Energy Efficient Motors Programme PEMP, Energy efficient motor systems – implementation examples in water treatment and district heating companies).

Year 2005:

- Handbook PEMP No 1 „Polski program efektywnego wykorzystania energii w napędach elektrycznych PEMP”, Nowoczesne energooszczędne układy sterowania i regulacji napędów z silnikami indukcyjnymi klatkowymi”, „Dobór silników elektrycznych” (Polish Energy Efficient Motors Programme PEMP. High-tech control systems with induction motors. Selection of electric motors)– 131 pages.

- Conference proceedings EEMODS 05 „Polish Energy Efficient Motor Programme – PEMP”

- Conference proceedings; EENSE 2007 (Nr 73/2005) „Cele i mechanizmy programu PEMP oraz stan obecny i perspektywy programu rabatowego” (Goals and mechanisms of the PEMP project – actual status and perspectives)

- Conference proceedings; Konferencja Naukowo Techniczna Belchatow 06/10/2005 (Conference in Belchatow 06/10/2005 „Cele i mechanizmy oraz stan zaawansowania projektu PEMP”, (Goals, mechanisms and actual status of the PEMP Project)

- Articles in technical Press:

- Napędy i Sterowanie 11/2005(Drives and Control 11/2005) „Cele i mechanizmy oraz stan zaawansowania Polskiego Programu Efektywnego Wykorzystania Energii w Napędach Elektrycznych PEMP” (Goals, mechanisms and actual status of the Polish Energy Efficient Motors Programme PEMP)

Year 2006:

- Handbook PEMP No 2 „Remontować czy wymieniać silniki elektryczne dużej mocy”(Repair or replace large electric motors) – 38 pages

- Systems, Journal of Transdisciplinary Systems Science Volume 11 2006 „Polski program efektywnego wykorzystania energii w napędach elektrycznych PEMP narzędziem wspierającym transformację rynku silników elektrycznych w Polsce”(Polish Energy Efficient Motors Programme PEMP as a tool supporting transformation of electric motor market in Poland)

- Conference proceedings; Efektywnosc Energetyczna. Nizsze koszty energii. Outsourcing energetyczny 30/11/2006 (Energy Efficiency. Lower Energy Costs, Energy Outsourcing 30/11/2006) „Projekty demonstracyjne w programie PEMP” „System dopłat do elektrycznych silnikow energooszczędnych realizowany w ramach programu PEMP”. (Implemented by PEMP Demonstration Projects and Financial Incentive Programme)

- Articles in technical Press:

- Napedy i Sterowanie 1/2006 (Drives and Control 1/2006) „System dopłat do silników energooszczędnych”, „Jak oszczędzać pieniądze”(Financial Incentives, How to save Money) ,

- Śląskie Eiadomosci Elektrotechniczne 2/2006 (Silesian Electrical News),„Jakosc maszyn elektrycznych problemem technicznym i ekonomicznym”(Efficiency of electric motors – technical and economical matter),

- Napedy i Sterowanie 2/2006 (Drives and Control 1/2006) „Porównanie kosztów w cyklu życia standardowych i energooszczędnych silników indukcyjnych niskiego napięcia”, (Comparison of Life Cycle Cost of standard - and energy efficient electric motors)

- Nowa Elektrotechnika 2/2006 (New Electrotechnical Engineering 2/2006),„Polski Program Efektywnego Wykorzystania Energii w Napedach Elektrycznych PEMP” (Polish Energy Efficient Motors Programme PEMP)

- Czysta Energia 03/2006 (Clean Energy 03/2006),„Sposób na ograniczanie emisji gazow cieplarnianych”,(How to reduce the GHG emmission)

- Napedy i Sterowanie 5/2006 (Drives and Control 5/2006) „Korzyści stosowania elektrycznych silnikow energooszczędnych dofinansowywanych przez program PEMP,(Advantages of the energy efficient motors financially supported by the PEMP project)

- Napedy i Sterowanie 7/8/2006 (Drives and Control 7/8/2006) „Jak oszczędzać na kosztach napędu elektrycznego”(How to cut cost using energy efficient motors),

- Napedy i Sterowanie 9/2006 (Drives and Control 9/2006) „Efektywność energetyczna układów napędowych –europejski program Motor Challenge”(Energy efficiency in electric motors – European Motor Challenge Programme),

- Pompy Pompownie 11/2006 (Pumps and Pumping Stations 11/2006) „Efektywnosc ekonomiczna – znaczące kryterium wyboru układu pompowego”(Energy Efficiency – significant criterion of pumping system,

- Napedy i Sterowanie 11/2006 (Drives and Control 11/2006) „Klasy sprawności silnikow elektrycznych niskiego napięcia”,(Energy efficiency classes of electric motors)

- Napedy i Sterowanie 12/2006 (Drives and Control 12/2006) System dopłat do silnikow energooszczędnych oraz mechanizmy wsparcia wfwktywnych energetycznie układów napędowych realizowane w ramach programu PEMP, (Financial Incentive System and other mechanisms supporting energy efficiency of electric motor systems in frame of the PEMP programme)

Year 2007:

Handbook PEMP No 3 „Efektywność energetyczna pomp i instalacji pompowych”(Energy efficiency of pumps and pumping systems)- 98 pages.

PEMP Newsletter No. 2/2007

- Conference proceedings EEMODS 07 „Alliance to Transform Electric Motor Market in Poland,

- Conference proceedings EENSE 2007 (Nr 78/2007) “Rozwoj rynku elektrycznych silnikow energoszczednych widziany z perspektywy realizacji programu PEMP”(Development of energy efficient motors market from the perspective of the PEMP project), „Sposób na obnizanie kosztow uzytkowania przemyslowych napędów elektrycznych”(How to reduce cost of electrical drives in industry), “Pemp demonstration project: “Combined energy efficient motors and control system for heat production and distribution in the cieplownia rydultowy boiler house” – presentation of energy, ecological and financial effects”, “Pemp demonstration project: “Electric drives modernization in sewage pumping and aeration system on ekowod ltd. Sewage treatmentplant in namysłów” – scope of project and presentation first energy effects”, “Modernization of cellulose defibrizers electric drives in Arctic Paper Kostrzyn S.A. paper mill”, “Potential for energy savings in electric drive systems and EU mechanisms to promote its use”

- Conference proceedings „Mechanizmy stymulujace efektywnosc energetyczna z perspektywy odbiorcy przemyslowego i komunalnego 28/11/2007 (Mechanisms stimulating energy efficiency, 28/11/2008) „Dobrowolne zobowiązania producentow a obligatoryjne wymogi efektywności energetycznej silnikow elektrycznych-doswiadczenia programu PEMP” (Voluntary agreements of motor manufacturers versus obligatory requirements regarding energy efficiency in electric motors),

- Articles in technical Press:

- Napedy i Sterowanie 1/2007 (Drives and Control 1/2007) „Rosnoca rola efektywności energetycznej układów napędowych”,(Increasing role of energy efficiency in electric motors)

- Energetyka i Elektrotechnika 1/2007 (Industrial Energy and Electrical Engineering 1/2007) „Wspieranie poprzez program PEMP rozwiązań efektywnych energetycznie w elektrycznych układach napędowych”,(Energy efficient solutions in electric motor systems supported by the PEMP project)

- Śląskie Eiadomosci Elektrotechniczne 2/2007 (Silesian Electrotechnical News 2/2007)„Energoszczędne silniki oraz układy napędowe”(Energy efficient motors and motor systems)

- Inzynieria i Utrzymanie Ruchu 5/2007 (Engineering and Maintenance 5/2007) „Poprawa efektywności energetycznej elektrycznych układów napędowych sposobem na obnizanie kosztow przedsiębiorstwa”(Reduction of energy costs by improving energy efficiency in electric motor systems)

- Elektro Info 5/2007 (Electro Info 5/2007) „Poprawa efektywności energetycznej elektrycznych układów napędowych”,(Improvement of energy efficiency of electric motor systems)

- Napedy i Sterowanie 9/2007 (Drives and control 9/2007) ‘Wspieanie rozwiazan efektywnych energetycznie przez program PEMP”, (Supporto of the PEMP project for the energy efficient solutions in electric motor systems)

- MEGA-Industry 9/2007 (Mega Industry 9/2007) „Mechanizmy zachet materialnych wspierające stosowanie elektrycznych wysokosprawnych silnikow i układów napedowych” (Financial mechanisms supporting implementation of energy efficient motor systems)
- Elektro Info 9/2007 (Electro Info 9/2007) „Jak obniżyć koszty eksploatacji napędów elektrycznych”(How to reduce operation costs of electric motors)
- Inzynieria i Utrzymanie Ruchu 9/2007 (Engineering and Maintenance 9/2007) „Energoozczędne napedy elektryczne”,(Energy efficient electric drives)
- Automatyka Podzespolu Aplikacje 9/2007 (Automation, Components, Applications 9/2007),„Poprawa efektywności energetycznej elektrycznych układów napedowych” (Improvement of energy efficiency in electric motor systems)
- Czysta Energia 11/2007 (Clean Energy 11/2007) „Energoozczędne układy napedowe – mechanizmy zachet wspierających wdrowzenia” (Energy efficient electric motor systems – mechanisms supporting implementation).
- Czysta Energia No. 7-8/2007 (Clean Energy No 7-8/2007 “Electric drives demonstration projects in PEMP Programme”
- Wiadomości Elektrotechniczne No. 9/2007 Electrotechnical news No 9/2007 and Ecological Bulletin, issued by the Polish Ecological Club, September 2007 “Programs Promoting Energy Efficient Electric Drive Systems: PEMP and MCP Common objectives and tasks in Poland”
- Pompy, pompownie No. 4/2007 (Pumps and Pumping Stations) "When eff1 motors in pumps?"

Year 2008:

Handbook PEMP No 4 „Napedy regulowane w systemach pompowych źródeł ciepła” (Drive control in industrial heat generator’s pumping systems) - (142 pages). was written and issued in 1000 copies.

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- Conference proceedings; Konferencja Naukowo Techniczna Automatykacja w Energetyce - 2008, Słok k.Belchatowa (Conference Automation In Power Energy – 2008 in Słok k. Belchatowa) „Polski program efektywnego wykorzystania energii w napędach elektrycznych PEMP”(Polish Energy Efficient Motors Programme –PEMP),
- Conference proceedings: INFOTECH
“The PEMP Program and preliminary results of PEMP’s demo projects as well as combined activities of PEMP and 4EM-MCP”
- The demo project in Rydułtowy Heat Plant was presented as the best practice case in the guide developed by the Institute for Sustainable Development on energy efficiency aspects of infrastructure projects
- Common presentation of the PEMP and 4EM-MCP Programmes was held during the ProTech International Trade Fair in Wroclaw, 19-20th November 2008. An exhibition unit and 2 workshop presentations about PEMP / MCP were given.

- Common presentation of the PEMP and 4EM-MCP Programs was held during the COP 14 IPCC Conference in Poznan, 1-12th December 2008. A common exhibition stand with Koalicja Klimatyczna was non-stop open and active during COP 14 in the exhibition hall. A multimedia presentation was given continuously. Hard copies of the PEMP and MCP education materials have been distributed.
- Presentation has been performed and stand served on the 10th annual meeting of the Kluby Czystego Biznesu (Clean Business Clubs) in frame of the Clean Business Program in Poland (14th November).
- Representative of the PEMP Center took part in the XI workshop for energy managers of the steel and the coke industries (10 – 11 October).
- Articles in technical Press:
 - Nowa elektrotechnika 1/2008 (New Electrical Engineering 1/2008) „Transformacja rynku elektrycznych silnikow energooszczędných” (Transformation of energy efficient motors market)
 - Automatyka Podzespolu Aplikacje 1/2008 (Automation Components, Applications, No 1/2008) „Dobre praktyki w zakresie elektrycznych układów napędowych”(Good practices in electric motor systems).
 - Pompy pompownie 2/2008 (Pumps and Pumping Systems, No 2/2008) „Efektywność energetyczna silnikow elektrycznych” (Energy Efficiency of Electric Motors)
 - Elektro Info 5/2008 (Electro Info, No 5/2008) „Zielone zamówienia publiczne” (Green Public Procurements).
- PEMP participated in and supported the campaign organized by the “Miesięcznik Gospodarczy Nowy Przemysł” (Newspaper New Industry). Logos of PEMP and KAPE were placed on the internet site of the “Wirtualny Nowy Przemysł (wnp.pl)” and linked to the internet sites of PEMP (www.pemp.pl) and KAPE (www.kape.gov.pl). PEMP became also the Partner of the campaign “ABC Efektywności Energetycznej” (ABC of energy efficiency).
- Energetyka Ciepła i Zawodowa 5/2008 (Heat and Industrial Electro Energy No 5/2008) – „Wysokosprawne silniki elektryczne sposób na obniżenie rachunków za energię” (Energy Efficient Motors – Method to Reduce Bills for Energy)
- Nowa Energia 3/2008 (New Energy, No 3/2008)– „Efektywne wykorzystanie energii w napędach elektrycznych” (Energy Efficiency of Electric Motor Systems)
- Elektro Info 12/2008 (Electro Info No 12/2008)– Elektryczne silniki wysokosprawne (Electric Energy Efficient Motors)
- Conference proceedings; Ministry of Economy, November 20 2008 – „Efektywne wykorzystanie energii w napędach elektrycznych” (Effective Usage of Energy In Electric Motor Systema)
- Euro Info Magazine - “PEMP Programme offer for small and medium-size enterprises”