

# Efficient electric motor systems in Dutch industry – a three way approach

Maarten van Werkhoven  
TPA Consultants bv  
For NL Agency, Energy and Climate  
Croeselaan 15, 3521 BJ Utrecht  
The Netherlands  
mvanwerkhoven@tpabv.nl

Frank Hartkamp  
NL Agency, Energy and Climate  
Croeselaan 15, 3521 BJ Utrecht  
The Netherlands  
frank.hartkamp@agentschapnl.nl

## Keywords

electric motors, long-term agreements, pumps, fans, electricity savings, compressors, energy management system, technology dissemination, technical innovation, drives, awareness, industrial process equipment, life cycle cost (LCC), system design, market barriers

## Abstract

This paper gives an overview of the initiatives of the Dutch government and the Dutch motor systems industry to accelerate market penetration of efficient electric motor drives in industry along 3 lines of activity: LTA-programs, technology network and EMSA (Electric Motor Systems Annex – part of the IEA Implementing Agreement 4E).

## Introduction

Electric motor systems (EMS) use up to 69 % of electricity in Dutch industry. Research and projects show that system optimization and best available drive technology can deliver reductions of 20–30% in pumps, fans and compressors in heating, cooling and ventilation systems, and industrial handling, processing and production systems. Thus lowering the national electricity bill by 5 to 8 %. Obstacles in the marketplace and a low awareness of best practice and technology hamper market penetration. Government and the Dutch motor systems industry have started initiatives to accelerate market penetration along 3 lines of activity: LTA-programs, technology network and EMSA.

## LTA

Around 1000 industrial companies work in LTAs with the government on increasing their energy efficiency. The LTAs represent together more than 80 % of the industrial energy use and a quarter of the total energy use in The Netherlands.

## INSTRUMENT OF LTA

The Long-Term Agreements on Energy Efficiency (LTAs) were made in a series of three: LTA1 began in 1992 as the first covenant on Long-Term Agreements on Energy Efficiency, at the initiative of the Ministry of Economic Affairs. Under this covenant, the Government reached a voluntary, though binding, agreement about energy efficiency with the industry and institutions. Objective: reducing the quantity of required energy per unit of product or service by improving energy efficiency by 2 percent annually. In LTA1, the focus was on process efficiency.

After LTA1 came to an end in 1998, the parties continued the covenant through LTA2. The large industrial enterprises adopted the Benchmarking Covenant at that time. In LTA2, the focus was still on process efficiency, but was broadened to include sustainable energy and chain efficiency, amongst others.

In 2008, in view of the success of LTA as an instrument, the choice was made to intensify, extend and broaden LTA2 into LTA3. Amongst others, the intensification means that businesses exert efforts to attain an improvement in energy efficiency of 30 percent in the period 2005–2020. Roadmaps have been introduced as well. There is also more focus on chain efficiency and cooperation across sectors (see also the paragraph on KnEMS).

**Table 1. Electricity use in the Netherlands, by sector and by electric motor systems.**

Sectors NL	Electricity use by sector (PJ)	Elektricity use motor systems (PJ)	Elektricity use motor systems (%)	Electricity use by sector (%)
Industry	264	182	60%	69%
Services	176	67	22%	38%
Transp. & Agric.	31	12	4%	39%
Dwellings	193	43	14%	22%
	660	304	100%	46%

\*) based on data from IEA 2011 paper by P. Waide, C. Brunner and Results LTA/LEE 2010, EL&I

For large industrial companies the LEE covenant was signed in 2009 and is based on LTA3. LEE is a sequel to the Benchmarking Covenant which is intended for large industrial companies that are obliged to participate in the Emissions Trading System of the European Union (ETS). The LEE participants come wholly or partly under the ETS.

## RESULTS

The total of circa 1,000 energy intensive companies from 40 different sectors, improved their energy efficiency in 2010 jointly with an average of 1.4 % (compared to 2009, LEE and LTA 3 together). Compared to 2009, the energy consumption increased in 2010 by 99 PJ. In the case of LEE, this is mainly due to an increase in production in almost all sectors. For LTA3, that increase may also be attributed to an increase in production, and to the accession of some new sectors and companies as well.

The LTA3-companies from industry, food and beverages and services sectors accounted an energy efficiency improvement of 2.3 % in 2010. In comparison to 2005 the companies are working 10.6 % more energy efficiently<sup>1</sup>. This means that the companies perform above the government target of 2 %: they conserved an average of 2.1 % a year. The results are due to measures in the field of process and chain efficiency. By the start of 2012 the LTA3 sectors will deliver their roadmaps, in which they define their energy efficiency strategy for 2030.

The LEE companies improved their energy efficiency with 1.1 % in 2010. This is due to the fact that this is the first full year for the LEE participants. They needed a starting period to start working with the methods of the new covenant. Besides this last year the production volume increased sharply and the companies partly delayed measures for energy efficiency improvement. By the end of 2012 these companies will be 8.2 % more energy efficient compared to 2009 – based on the saving ambition in the Energy Efficiency Plans (EEP). These plans describe the energy saving measures that are to be taken from 2010 to 2012. In mid 2012 the roadmaps of the LEE-sectors will be ready.

## 4 YEAR CYCLE

The participating companies in LTA3 have to implement a three fold set of activities: (1) making an Energy Efficiency Plan every four years, (2) yearly monitoring of production level and energy use and (3) having an up and running energy management system.

The Energy Efficiency Plan (EEP ) describes the energy saving measures that are to be taken in a period of 3 years, an assessment of the expected energy saving and the appurtenant time line. With these measures, the company or institution also creates the basis for the development of the energy paragraph in the environmental licence. NL Agency performs an assessment to determine whether an EEP meets the requirements of an LTA. On the basis of the individual plans, NL Agency has aggregated the expected joint improvement in energy efficiency or the ambition of the companies.

In the past few years specific attention has been paid to motor system efficiency within the LTA-approach. Working together with other countries in the Motor Challenge Program project, all known measures from the MCP are listed on the LTA measure lists as described above for use in formulating the Energy Efficiency Plans. The Motor System Action plan has been put on the Energy List of the Energy Investment Allowance. As well as IE3-motors<sup>2</sup> from 7.5 kW up to 375 kW. This is a tax relief program which gives a direct financial advantage to Dutch companies that invest in energy saving equipment and sustainable energy. The net profit can amount up to 11 % depending on the exact profit-tax percentage. Companies may also apply for EIA support to cover the costs of an action plan for electric motors. However, these costs are only eligible for EIA support if you have actually implemented the recommended energy measures.

The instrument of LTAs make the companies accessible and active with energy efficiency related activities like thematic workshops, pilot projects, energy audits and technology roadmaps. They operate a required energy management system, based on (elements of) ISO14001. Which is being transformed towards standards as ISO50001 and new methods as the CO<sub>2</sub> performance indicator. EMS is addressed and clear links towards organization, procurement and sustainability issues are being developed.

1. In the LTA3 covenant, the contribution rests on three pillars: production process, chains and sustainable energy. A specific monitoring methodology portrays the baseline and the results for the three pillars. The objective of the methodology is to identify the effort of companies per pillar and in this way track to what extent companies meet the agreements contained in the covenants. In terms of the production process, the companies are asked to identify each year the new energy saving measures and the extent of the savings consequently realised. The volume of the savings associated with these measures forms the basis for calculating the energy efficiency improvements in the production process.

2. The new international standard, IEC 60034-30:2008, defines efficiency classes IE1, IE2 and IE3 for three-phase motors.

Table 2. Joint results LTA and LEE in 2010.

	Energy consumption 2010	Improvement in energy efficiency*
	PJ	%
LEE	626	1.1
LTA3	219	2.3
<b>Joint result</b>	<b>845</b>	<b>1.4</b>

\*Savings resulting from measures in the production process and production chain within the Netherlands

### MONITORING ENERGY MANAGEMENT SYSTEMS

NL Agency performs a yearly monitoring the state of the energy management systems of the participating companies. In order to be able to value the chances for improvement, adjustment and to assess the state or quality of the management systems in place. Some results of the audit of 2010/2011 were that Technical management moves to Facility support, leading to a reduced guidance on technical buying within companies. And a reduction of the number of operational (technical) personnel, leading to reduced time for development (of energy efficient measures). Also although there is the introduction of more automated process control, but less attention (or capacity) for energy consumption analyses. Overall there is a development towards less single-head technical responsibility within the participating companies.

### ANALYSES OF MARKET AND BARRIERS FOR EFFICIENT EMS

Analysis of the market of electric motors supply and maintenance in the Netherlands, and the practices of the OEM's and industrial end-users shows that for a successful acceptance of efficient EMS all market parties have to get involved. As a result of this and of the above mentioned market developments NL Agency broadened the focus of their activities on efficient EMS from end-users alone towards addressing all market parties in a 'knowledge network efficient EMS'. This KNEMS lays also more responsibility on to the market itself, as became necessary with a government which has to meet new efficiency goals in supporting businesses in their pursuit for energy efficiency.

### KnEMS (Knowledge network on EMS)

The motor systems industry started in cooperation with NL Agency a 'knowledge network' to support the implementation of Efficient Electric Motor Systems (EMS) and raise the awareness of its potential. Two Dutch sector associations of suppliers (FEDA) and of installation engineers (Uneto-VNI) have joined the network. And representatives of two OEM sectors are also involved: the pump association and the OEM for the food industry.

A short film on efficient EMS has been made. Introducing the new EU regulation for efficient electric motors. Three managers of LTA-companies show how they got involved in applying efficient EMS in their businesses. The situations for two of them – end-users – are different, but the benefits and results are comparable. Large savings economically in HVAC, in luggage handling and in inside passenger transport systems. As well in industrial ventilation systems. The OEM applies the IE2 high efficiency motor as standard as part of its company policy in delivering high quality, modern equipment with low mainte-

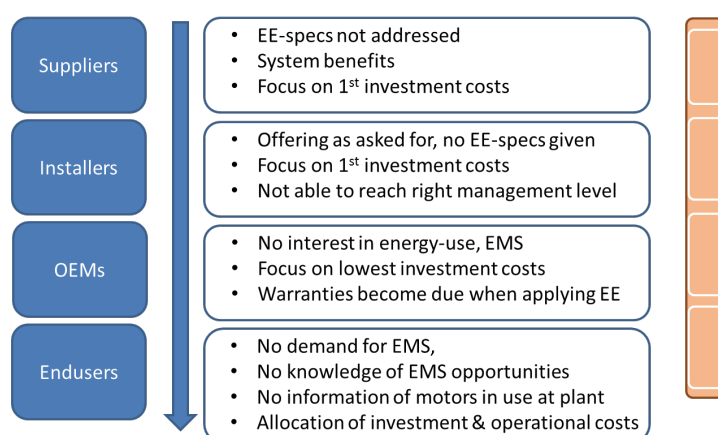


Figure 1. Obstacles in marketplace for Efficient Motor Systems.

nance cost over its life cycle (the link to the short film: <http://www.youtube.com/watch?v=CtSCeMFe4V4>).

The network assists in organizing 3 workshops specific for LTA-companies on the opportunities of efficient EMS. This is an extra effort to bring efficient EMS under the attention of the companies and make a start with the transition towards motor management as a regular activity.

The network will also work on capacity building in the market as well with the end-users themselves. This will not only appeal the technical representatives, but also the financial and general management representatives. Tools which will be used are the EMSA Motor Systems Tool and the Dutch tool EconuVE. Both tools have the benefits of having datasets from different large suppliers, and working with a system approach. Not only the motor is calculated, but the transmission, the drive and the load itself are calculated and optimized. Best practices and factsheets will be produced suitable to inform technical and non-technical public.

The KnEMS will also develop knowledge related efficient EMS activities for sectors which have incorporated efficient EMS in their technology roadmap for 2030. These are several food sectors – dairies, meat and vegetables –, the metallurgical sector, the paper industries and the foundries and surface treatment companies. Examples are variable speed drives (VSDs) for motors used for cooling and ventilation, more efficient coolingcycle for motors, fans, pumps; Motors, fans and pumps are replaced by systems which are well fitted in a process or installation; Optimisation of cooling and process set up, a well as optimisation of drives of utility-processes like pumps, compressors and equipment.

## EMSA

The Netherlands is participating in the 4E Electric Motor Systems Annex (EMSA) – part of the IEA Implementing Agreement for a Co-operating Programme on Efficient Electrical End-Use Equipment (4E). The joint experience of the 6 member countries is applied to provide technical guidance, capacity building and knowledge on performance and IEC/ISO standards. The 4E EMSA is continued in 2012 and will run for three years. The Netherlands participate in several areas of interest of EMSA: International Standards. EMSA works for globally harmonized and robust technical standards for the classification and testing of motors and variable frequency drives through representation in standards working groups, and for implementing motor systems management as part of the energy management systems standard ISO 50001.

### IMPLEMENTING ISO 50001, OPPORTUNITIES FOR EFFICIENT EMS

The quality of the energy management systems implemented by the LTA participants is monitored every year. And opportunities as identified to improve the system and its effectiveness. The systems are based on (elements of) the standard ISO14001 and some participants have started already a transition towards ISO50001.

In the 2012 monitoring of the energy management systems special attention will be given towards the opportunities for efficient EMS. Some examples of possible opportunities are shown below:

- Energy Planning: give in the energy review specific attention to drives in relation to the electricity use. Are the

important groups of motor systems identified? ISO 50001 characterizes significant users also as users with a significant efficiency potential.

- Implementation, operation and monitoring: is 'motor management' identified and described as activity? Is there adequate knowledge and capacity to implement this activity? Which part of the organization holds this domain?
- Maintenance and repair of EMS. How are these technical issues organized? What procedures are in place for rewinding or replacement, for redesign or adjustment of drives and for preventive replacement versus replacement by failure. Is Total Cost of Ownership (TCO) a standard element in the business cases?
- Procurement and Design. Are minimum efficiency requirements for motors in place? Are they differentiated towards the motor system, e.g. processing equipment or pumps? How are the responsibilities allocated between engineering, energy and procurement? Is personnel trained in the use of TCO principles?

The implementation of these specific aspects of and opportunities for EMS in ISO 50001 will enhance the implementation of efficient EMS in industry. And will help industry, OEM, suppliers and maintenance parties to work more efficient and increase their competitiveness.

EMSA provides a forum for the direct and in-depth exchange between members on their experience with motor systems efficiency policy, as well as a vehicle for collaborative projects. EMSA's research results are publicly available.

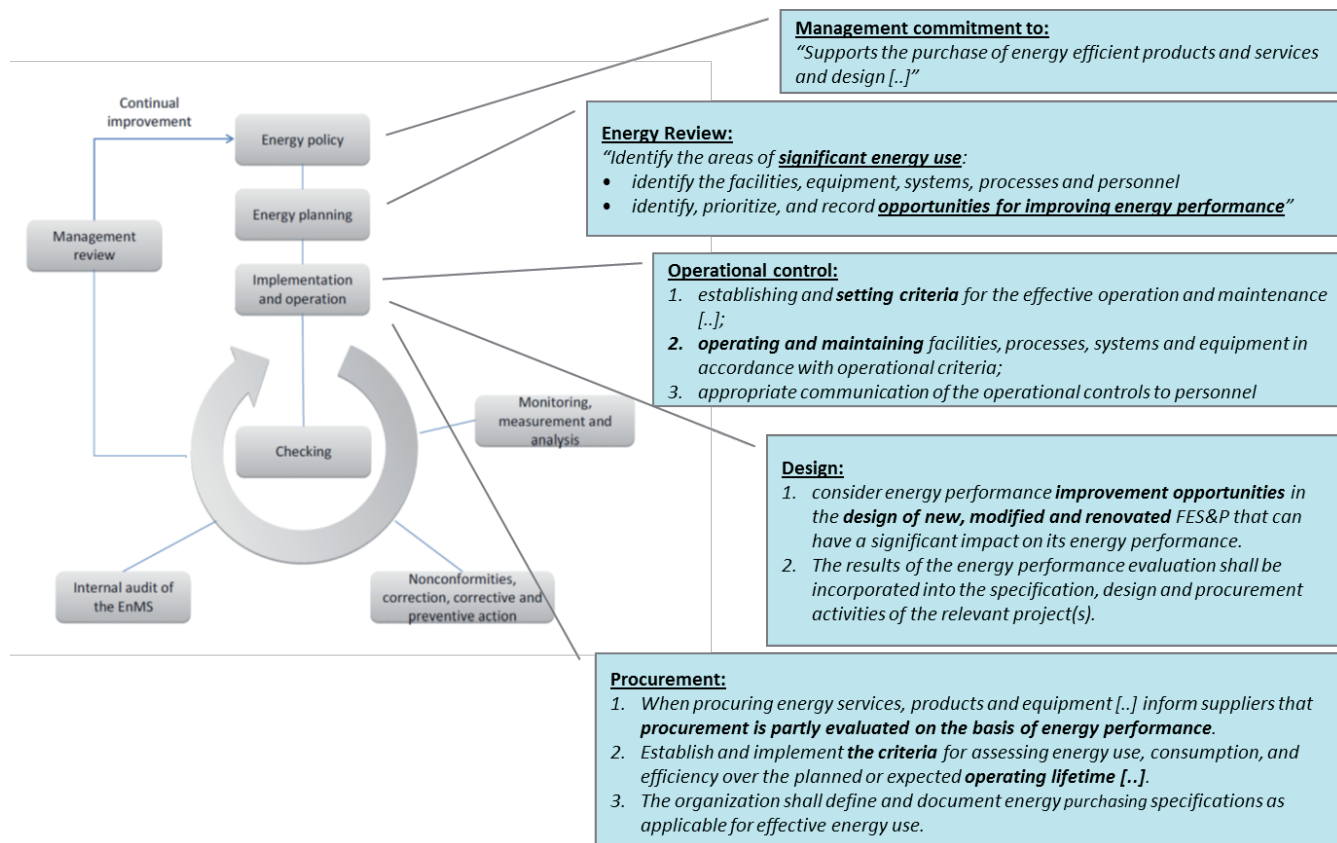


Figure 2. Opportunities for EMS in energy management system.

## Conclusion

The 3 lines of activity of the Dutch government and the Dutch motor systems industry – LTA-programs, technology network and EMSA – are complementary to each other and bring more focus and attention towards the implementation of efficient EMS in industry. Representatives participate in these 3 activities to enable an effective and efficient way of operation and to utilize the opportunities for synergy between the 3 approaches.

The LTA-program provides a framework for the participating companies to integrate energy efficiency activities into their daily operation, and to integrate energy management into their organization. Due to the specific characteristics of electric motor systems the LTA program alone is not enough for a successful uptake by industry. Where the LTA program makes the companies accessible and engaged with energy efficiency activities, the KnEMS activities supply the companies with the information and knowledge on EMS. The network forms a platform for the sector (suppliers, maintenance, services) to deliver objective and consistent information on EMS for end-users. And works actively on knowledge transfer via e.g. best practices, workshops and factsheets. The third line of activity,

EMSA, brings in up to date knowledge on international practices on EMS, on capacity building and the development of new standards. New tools and practices can be introduced and absorbed quickly by the members of the KnEMS and be brought to their members and to the end-users.

## References

- Kennisnetwerk Energie Efficiënte Aandrijfsystemen, 2011/2012.
- Efficiënte Elektrische Aandrijvingen en Elektromotoren, Krachtenveldanalyse; NL Agency, 2010.
- Results of 2010, Covenants results brochure Long-Term Agreements on energy efficiency in the Netherlands LTA/LEE, Ministry of Economic Affairs, Agriculture and Innovation, 2011.
- Energy-Efficiency Policy Opportunities for Electric Motor-Driven Systems, International Energy Agency, Paul Waide and Conrad U. Brunner, 2011.
- EMSA overview Policy Brief, Rita Werle, 2012, [www.motor-systems.org](http://www.motor-systems.org).