# Pilot Audit Program for Electric Motor-Driven Systems


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## 1 Background

Efficient electric motor-driven systems (EMDS) can deliver an important contribution to achieving national energy savings and $CO_2$ emission reduction targets. In the Netherlands the savings potential on industrial electricity consumption is more than 15%, or 24.7 PJ [1]. This is equivalent to 6% of the national electricity consumption in the Netherlands. The International Energy Agency shows an industrial savings potential of 24% in the long term [2].

These saving opportunities require additional policies: that is, going beyond the current EU Ecodesign Guidelines for electric motors, for example, and further than the existing measure lists[1] from the national energy saving policy, where the realization of system savings for drives has lagged behind.

According to the current EU MEPS for electric motors (Ecodesign Directive), new motors must meet minimum efficiency requirements IE2 + frequency inverter or IE3 in the power range 0.75–375 kW. MEPS for fans, clean water pumps, and circulation pumps are also in force; a directive is being prepared for air compressors. The current MEPS are at the level of products [3]; system optimizations can bring greater savings especially when high-efficient components are used as well, i.e., IE4 motors, VSDs, controls, and high-efficient applications like pumps, fans,

[1] The Dutch government uses a "Standard Savings Measure List" to specify savings measures per sector. Companies have to comply to this list, i.e., assess the economic and technical viability of these measures for their company and report back to the MSA.

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and compressors in utilities and in process applications. These components can be used cost-effectively in many situations [4] (see Fig. 1).

The Dutch Knowledge Network for efficient electric motor-driven systems (KEEA, a collaboration between three trade associations and government: Techniek Nederland, FEDA, HPG and RVO[2]) sees good opportunities for achieving greater savings: by applying the system approach to electric motor systems and helping industry to apply this approach and harvest the savings. The positive experiences with the Dutch Green Deal in motor systems (2012–2015) together with the KEEA network and experiences from international research and audit programs form the basis for this.

The Dutch government coalition agreement (2017) has set ambitious goals for a new national climate and energy agreement: a 49% reduction in $CO_2$ emissions in 2030. In its analysis of the coalition agreement, a Dutch governmental advisory body (PBL) indicated that additional policies must be developed for around 50% of this objective for 2030. In addition, for short-term results, the so-called Intensification Program for Energy Challenges 2020 (IP2020) needs to focus on concrete extra energy savings for the coming years.

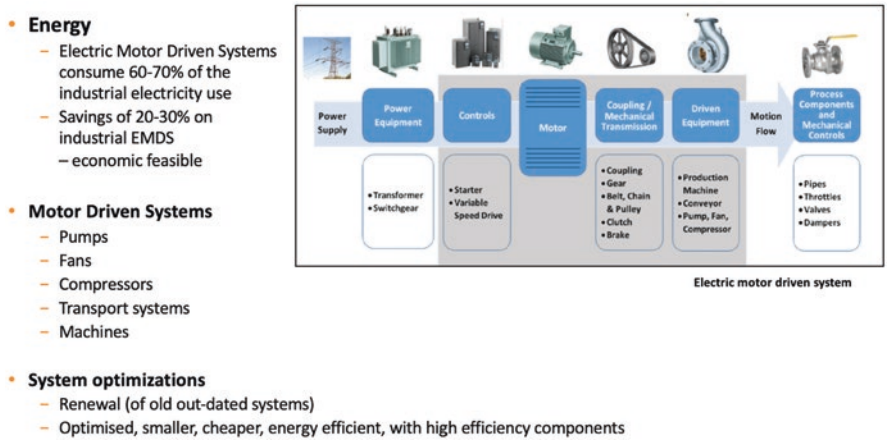


**Fig. 1** Electric motor-driven systems, system optimization

[2] Techniek Nederland = industrial service companies, FEDA = manufacturers, suppliers of motor system components and automation, HPG = manufactures and suppliers of pumps, RVO = Netherlands Enterprise Agency

## 2 Audit Program

The main objective of this program is to achieve energy savings and $CO_2$ emission reduction on short term within the participating industrial companies by conducting a series of 150 audits and to guide the companies during the first implementation. The audits will provide:

- Insight into the overall savings potential within motor systems on short term
- Five concrete business cases for (a group of) motor systems
- Identification of next steps for transition toward efficient motor systems for the next 1–3 years

The program is split into a pilot audit program, including 30 audits and an assessment of potential of the next 120 audits, and the viability of the start of a voucher system for this audit series.

The audit consists of four audit steps (see Fig. 2).

The audit methodology is directly derived from the EMSA publication "Energy Audit Guide for Motor Driven Systems" [5]. This guide is structured along the Energy Audit Standard ISO 50002 and includes organizational and technical tasks. For each step the relevant standards and tools are specified. The designated tools are brand independent and include calculations which are based on IEC standards and objective research data. The tools are made available through the Swiss Topmotors' program (SOTEA, ILI, and STR - adjusted for Dutch purposes), through IEA 4E EMSA (the Motor Systems Tool), and through the Dutch program management (TCO calculation tool for business cases and the standard format for the Audit report) [6, 7].

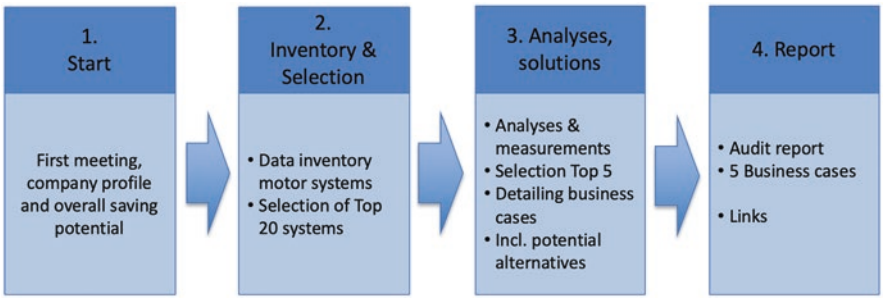


**Fig. 2** Audit steps 1 to 4

## 2.1 Organization, Roles, and Stakeholders

The knowledge network is the initiator of this pilot audit program and provides the audit program's project management. The audits will be conducted by members of the network partners, i.e., service companies, consulting services, and suppliers. The industrial companies, the targeted auditees, are identified as the top 800 of energy-consuming industrial companies in the Netherlands. For the marketing and communication of the program, a number of sources and approaches will be used, e.g., governmental digital newsletters, specific digital networking groups, specific meetings for selections of companies (workshops), and direct consulting by the network partners themselves.

The auditors will all participate in a start-up training consisting of two dedicated workshops on the methodology, the communication, and available tools and audit report format, thus delivering capacity building to the network partners and creating a level playing for the customers, the industrial companies.

In collaboration with the Ministry of Economic Affairs and Climate (EZK) and the Dutch Enterprise Agency (RVO), research will be done into financial instruments for supporting the investments into efficient electric motor-driven systems. Focus will be on the Energy Investment Allowance (EIA), as well as into the potentials for an energy efficiency investment fund. The latter is currently under development by different stakeholders among which several Dutch pension funds, banks, and financial institutions. This fund could actually deliver an important contribution to the "conversion" from saving measure (building the business case, step 1 to 4) into realization (the engineering and implementation) (see Fig. 3).

The audit program has a small subsidy available (for the auditor) per completed audit.

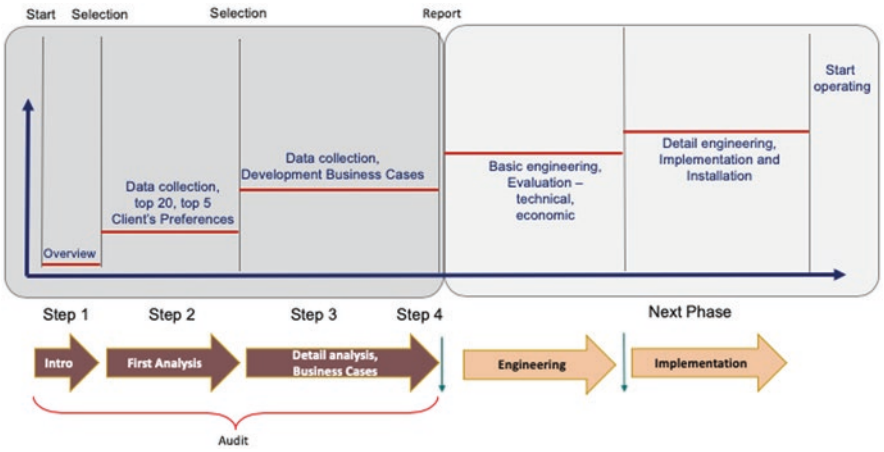


**Fig. 3** Audit steps 1 to 4 and next phase: engineering and implementation

A successful audit requires a close cooperation between the auditor and the auditee, for obtaining the necessary data, granting access to the installations (operation), selecting measures, making analyses and taking measurements, etc. Depending on the available information, manpower, and expertise, the audit can be carried out effectively and efficiently.

In communications with the targeted industrial companies, the following arguments for participating as auditee are presented as well as the minimum:

Why?

- Compliance with National Environmental Law and $CO_2$ reduction targets.
- Lowering operational cost (OPEX) through lower energy and maintenance cost, direct effect on net profit margin and profitability
- Lowering (un)planned downtime
- Concrete contribution to companies' sustainability targets

What does it take?

- Commitment by management and employees.
- Effort by employees (s) for delivering data, site visit(s), and analysis in cooperation with auditors.
- No out-of-pocket cost; fiscal allowance scheme (through EIA) applicable.
- Lead time: 2–3 months.
- See further details in "Participation form" Industry (part of audit concept).

## *2.2 Success and Fail Factors*

As the pilot program demands cooperation by a number of parties active in different sections of the supply chain and industry, the pilot aims to identify a number of factors that are critical for success or that ensure failure. For the pilot audit program itself including the audit concept, some of those factors, currently identified, are:

- Communications: being able to communicate clearly the (1) audit proposition to the target industrial companies and (2) the independency of the sender, i.e., indecency of promoting one technical solution, one component brand, and such.
- Data availability: in the very early stage of the audit, auditor and auditee need to assess the actual availability of data on electricity use and especially the electric motor-driven systems. The status has direct effect on the cost of the audit, feasibility, and lead time.
- Split responsibilities between the different entities within large companies: management, operations, procurement, and maintenance. Each entity has its own responsibilities and performance targets which do not always lead to converging interests concerning energy efficiency and lowest TCO in operation. Well-identified "governance" within the audit project is therefore essential.

- The audit results need to be presented in such a way both the technical officials and the financial officials have access to the key data of the business cases.
- Capacity building: as the pilot carries in itself the goal of performing a total of 150 audits in the years ahead, the group of participating auditor companies needs to develop its knowledge and experience. Only then they will be able to serve the large number of industrial companies as envisaged.
- Cooperation: the assessment of the different types of motor-driven systems demands for specific knowledge of, e.g., pumps, fans, motors, transmissions, process automation, and such. Depending on the actual specifics of the production facility, the auditor needs to compose a project team with the appropriate skills and knowledge.

## *2.3 Cost and Benefits*

The audits will lead to the identification of energy savings potential and $CO_2$ emission reduction potential at the participating industrial companies; they will specify a number of business cases ready for direct implementation, and they're aiming to function as a starting point for continued savings for the coming years. The benefits – savings potential – of the 150 audits, including the practical business cases for industrial companies as a start, are estimated to amount to 0.8–1.2 final PJ and 125–190 kton CO2 emission reduction. Note: this is the savings potential at a 100% implementation rate. To achieve the full benefits, the companies need to develop an implementation scheme for the coming 5 years at least. The benefits of the business cases are twofold: the demonstration of sound savings measures within the company and the urge to give these cases a follow-up, by the uptake of next analysis rounds.

The direct savings by the first business cases will be assessed in the pilot, as well as the value of the subsidy for the participating company, i.e., does the subsidy actually add to the decision by industrial companies to participate in this program, and is the subsidy a sufficient benefit for the auditors to actually do their auditing work? One special point of interest in the evaluation of the pilot program will be into the question whether there is a need felt within the industrial companies and the audit companies themselves for, for instance, a certification scheme or register for auditors.

The pilot audit program is executed in the Netherlands. The Netherlands has an industry which is internationally oriented and competes on the world market. The concept and methodology applied in this pilot should be applicable to many other industrial markets around the globe, given a comparable state of development of the "supply chain" and it's interest to cooperate on the subject of industrial energy efficiency.

## 3 Training

In parallel with the development and start of the pilot audit program, a training has been developed for employees from industry, service companies, and manufacturers. The Dutch Knowledge Network for efficient electric motor-driven systems (KEEA) initiated the development of this training course and assisted the Dutch training company NCOI in the actual development of the curriculum and practical cases.

The training covers a technical curriculum on the different fields of a motor-driven system, like mechanics, electrotechnics, energy systems, and automation. A second part has special focus on personal social skills including awareness and training of presentation skills. The program covers a practical assignment in an industrial facility, as well as classical education (5 days) and e-learning modules, in details:

Energy savings section

- Energy management
- Electrical engineering
- Mechanical engineering
- Industrial automation and digitization
- Climate technology and system analysis

Audit section

- Audit method (ISO50002)
- Writing skills
- Presentation techniques

Advise skills

- Communication skills
- Convince and influence
- Dealing with resistance. Personal development plan

Afterward participants will be able to perform expert audits based on the audit methodology according to the ISO50002 standard for energy audits with a specification on electric motor-driven systems.

The first training has started early July 2019.

## 4 Planning

Some first audit results are expected to be available for presentation in September/October 2019. The overall assessment of the pilot audit program is planned for end of 2019.

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