streamSAVE+ Dialogue Meeting #03

Streamlining Energy Savings Calculations

Energy savings in companies: technology-focused vs. system approach

MINUTES OF THE MEETING

Date: 6 March 2025 **Duration:** 11:00 – 12:15 CEST
Online

Short summary

This third dialogue meeting of streamSAVE Plus discussed calculation methods and policy design for energy savings in companies, and differences between technology-focused and system approaches.

This was first illustrated through the practical case of a typical action type: replacing electric motors.

- Electric motor systems represent 50% of the EU total electricity use. The renewal of the stock of motors is slow, while the replacement of inefficient motors could deliver annual energy savings of 25 TWh/year in the EU.
- When considering improvements in the whole motor systems (e.g. correct sizing, variable speed drive, system digitisation), the savings potential would amount to 75 TWh/year. A system approach (e.g. through system-level audits) could therefore deliver three times more savings than an approach focused on replacing motors only.
- Assessing energy savings from whole system improvement is difficult with standardised calculations, as it requires more data (vs. assessing motor replacement alone).
- The benefits of an enhanced motor system go beyond electricity savings, with increased productivity, improved reliability and reduced global costs. Non-energy benefits are also the main motivation for digitisation, that can in turn provide useful data for a better monitoring of energy consumption and energy savings.

Then it was discussed through a policy example, the German scheme "Energy and Resource Efficiency in the Economy" that includes various modules, from the technology level to the company level:

- Competitive funding scheme with an overall leverage factor of 3.4 in 2023, and a broad scope.
- Importance of the flexibility of the scheme, and to refine it over time. Then major structural breaks require preparation.
- SMEs represent 74% of all projects approved and 54% of the funding allocated.
- Technology-level module = 65% of the number of projects, 12% of the funding, 5% of the emissions saved
- System-level module = 27% of the number of projects, 52% of the funding, 65% of the emissions saved → importance to cover the system level

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- Various modules and funding options help to answer the different needs of the various target groups.
- Useful to complement the data collected in the applications with surveys (e.g. to get missing or complementary data, and to assess additionality).

General conclusion: overall, the most effective is to combine the approaches and types of support. An ideal scheme should incorporate capacity building initiatives and offer various incentive options like in the German example. Simpler modules make it easy for any company, including SMEs, to apply and get into a dynamic to look for energy saving opportunities. These simpler modules then act as door openers for more complex modules that can achieve larger savings, but require more sophisticated assessment and monitoring.

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11:25 – 11:40	Evaluation of multi-measure schemes: Lessons learnt from the German scheme "Energy and Resource Efficiency in the Economy" **Lisa Neusel** (Fraunhofer ISI, Germany)
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Part 1 - Technical viewpoint

From electric motors to motor systems: potentials and challenges to deliver and monitor larger savings | João Fong (ISR – Coimbra University, Portugal, and EU-MORE project)

(see also presentation file available on the streamSAVE+ website)

João Fong reminded the **importance of electric motors** in the total electricity use: 42% of world electricity is used in industry, of which 70% is specifically used by electric motor systems. Moreover, electric motor systems can also be found in buildings and other end-use sectors. Overall, electric motors are responsible for over **50% of the total EU electricity consumption**.

Data on the shares of motor sales per efficiency standard show the **major impacts of the ecodesign regulations** on the efficiency of **new motors**. While 90% of the new motors sold in 2005 met the IE1 standard, about 70% of the new motors sold in 2021 met the IE3 standard (with higher efficiency).

Actual lifetime of electric motors is much longer than what is assumed in theory. Which means that the **renewal of the stock of motors takes much time than anticipated**. This results in motors with efficiency of IE2 or lower still representing about 70% of the stock of electric motors in 2022.

This is why the EU-MORE project looked more specifically at the replacement of old inefficient motors: this represents a **major energy savings potential**. EU-MORE estimated that replacing existing motors of efficiency IE2 or lower would deliver annual savings of **25 TWh/year**.

The motor is the core of the motor system that also includes other elements: power equipment, controls, coupling and mechanical transmission, driven equipment. **Considering the whole motor system** can increase significantly the savings potential, compared to replacing the electric motor only. João showed an example of how improving the whole system results in energy savings of up to 58%.

New opportunities are brought by sensing and **digitisation** that allows for the detection of defects, suboptimal conditions, and operational anomalies, as well as the facilitation of system integration and real-time energy usage monitoring. This can contribute to additional energy savings.

Altogether, if policies promoting motor replacement would also foster audits dealing with system-level improvements (e.g. correct sizing, variable speed drive, system digitalisation), the savings potential would amount to **75 TWh/year**.

Moreover, the **benefits** of an enhanced motor system go **beyond the direct electricity savings**, and more particularly:

- **Increased productivity and improved reliability** (e.g., better control over process requirements, less breakdowns)
- **Reduced costs** (e.g., lower maintenance and thereby reduced maintenance costs)

Improving energy efficiency might not be a strong enough argument to trigger investments. Showing other benefits closer to companies' priorities can make these investments more attractive to the companies' decision makers.

João concluded his presentation by repeating that there is still much room for progress in this field, beyond the improvements achieved thanks to labelling and minimum requirements on new motors. Tackling the complete motor system results in more energy savings, which can be achieved through

system-level audits or implementing energy management systems. Digitisation can further expand the potential for energy savings.

Q&A

— *Who should be in charge of offering early motor replacements? Should it be an energy auditor, or the company's energy manager?*

Both options may be motivators for an early replacement of motors. Companies are constantly looking for opportunities to save money, and one method to do so is to save electricity. Improving the process can also enhance the corporate image. The replacement of inefficient motors may be suggested by internal energy managers, but the recommendation comes most often from an energy audit. Even when the opportunity is identified, it does not necessarily mean that the replacement will be implemented. In practice, the main motivation to replace a motor is rarely to save energy, but more to improve the production process.

— *You showed the difference between the energy savings from replacing the motor alone (potential of 25 TWh/year) and from improving the whole motor systems (75 TWh/year). Can you elaborate on how this was estimated and what are the differences between both scenarios?*

Both scenarios have the same scope, in terms of number of motor systems and initial efficiency. The first scenario considers the replacement of the motors only. While the second scenario considers the improvement of the whole motor systems, for the same stock of motors. When changing the motor, if an audit or research is done, this can show that it is easier and more effective to improve the entire system. The result of our assessment is that, with improving the entire system, it is possible to save three times more energy compared to replacing the motor alone.

— *Which method would you recommend for calculating the energy savings from replacing the motor system?*

There are numerous parameters to assess. So, the answer is not straightforward. Before making an estimation, we need to examine the efficiency of the motors in place, their operation time, load profiles, and the efficiency of the related equipment. Estimating all of these characteristics is not easy, and goes beyond the analysis of the motor itself. Fo example, for a pumping system, the pumping configuration has a big influence. As a result, there will always be many assumptions made. Assessing energy savings from improvements of the whole motor system is challenging and difficult to do with a standardized calculation (deemed savings). Because a large amount of data is necessary, and available data about the parameters needed is outdated. Data about the efficiency of the motor alone are better documented. Existing data about operation time, load profiles, etc. are less reliable.

— *Do you believe digital technology is an effective method to provide the necessary data?*

Yes, it can be helpful to get metered data and more accurate assessments. The main motivation to develop digitisation is not the monitoring of energy savings. It is other non-energy benefits, like a better control of the production processes. But then, it indeed offers opportunities to collect data for a better monitoring of energy consumption and energy savings.

Part 2 - Policy viewpoint

Evaluation of multi-measure schemes: Lessons learnt from the German scheme "Energy and Resource Efficiency in the Economy" | Lisa Neusel (Fraunhofer ISI, Germany)

(see also presentation file available on the streamSAVE+ website)

Lisa Neusel presented lessons learnt from the German scheme "Energy and Resource Efficiency in the Economy" (EEE). Lisa started with an overview of the EEE's funding opportunities for German companies. The funding includes **numerous modules** covering a wide range of applications. Four of them are **technology-focused** (technology level, including crosscutting technologies, process heating, IT, electrification). Two are about **technology-open systemic measures** (system level: plant and process optimization). And one is about **conceptual measures** (e.g. defining and implementing transformation plans at the company level). The approach is highly flexible, encouraging companies of all sizes and sectors to apply.

The implementing agencies include BAFA, KfW, and VDI/VDE-IT, which supported over 55 000 projects between 2019 and 2023, with a public budget over 3 billion euros, triggering **investments totalling 9.7 billion euros**. A strong increase occurred in 2023 (3.7 billion euros investments in 2023 alone).

This is a **competitive funding** scheme, with calls for projects every 2 months. The projects are selected based on their funding efficiency in terms of funding per CO_2 savings. 80% of the applicants with the highest ratings are eligible for funding. Since 2021, the rating considers resource efficiency as well.

The total funding volume has expanded over time, from 100 million euros approved in 2019 to 1,200 million euros in 2023, leveraging investment by 3.4 times.

The **success factors** of this funding scheme are its openness to a wide range of technologies, the various funding options (grants, loans, competition), its availability to SMEs (74% of all projects approved), and that the programme is highly dynamic (i.e. it is refined over time based on the experience gained and feedback from companies).

In 2022, guidelines for the evaluation of energy efficiency measures were developed on behalf of the German ministry (BMWK) (see references in 'Further readings' below, available in German only). This provides a **harmonized framework** to assess energy efficiency and various indicators, to ensure comparability in the results. The requirement to comply with these guidelines has helped to promote a **common understanding** of indicators, values and how energy savings are calculated.

The main data sources used for the evaluation of the EEE scheme include **administrative data** (collected from the funding databases: data about beneficiaries, actions implemented, financial data, savings data) and **extensive online surveys** completed by successful candidates (answer rate of about 20%), providing complementary data and views about how the scheme works and the funding process. Overall, about 100 indicators are monitored and evaluated. In this approach, the BMWK acquires a necessary perspective and ensure the validity of the evaluation results.

As the scheme includes several modules and involves various stakeholders, including several implementing bodies, some work has been needed to harmonize the data used and the monitoring and evaluation methods. BMWK created over 100 indicators, which help to improve the whole funding process.

Lisa provided some examples of **results achieved between 2019 and 2023**:

- Module 1 (cross-cutting technologies) received the most approvals (65% of the total number of projects, followed by 27% for Module 4). But the largest share of funding (52%) has been used for Module 4 (Optimization of plants and processes), because of significantly **larger funding per project for this system-approach** module (and higher funding rate). Module 1 represents only 12% of the funding.
- Similarly, while the projects of module 2 (RES for process heat) and the module 'funding competition' represent only 1% and 0.3% of the number of projects respectively, but they represent 23% and 9% of the funding allocated respectively.
- Module 6 (conceptual module, at company level) has been little used so far. Maybe because it needs more time.
- SMEs represent 74% of the projects and 51% of the funding.
- The various types of finance (load vs grants) attract different applicant groups: it is useful to maintain various funding options.

Customized quantification methods were developed to determine the amount of savings. The results from 2019 to 2023 amount to **more than 7 million tons of CO_2/year saved**. Total gross GHG savings were 6,974 t/CO_{2eq} per year, accounting for 10% of all EED-reported savings.

Module 4 (optimization of plants and processes) accounted for the highest share of CO_2 savings (65%), confirming the **importance to cover the system level**. The second share (19%) comes from the funding competition that also supports large projects. Module 1 that represents 65% of the number of projects and 12% of the funding, represents 5% of the emissions saved.

However, some modules (e.g. Module 5 – transformation plans and Module 3 – I&C, sensors and energy management software) are designed to achieve "conceptualized" savings through follow-up actions rather than direct savings: they serve as **door openers**.

The overall funding efficiency is about **70 euros/tCO_2 saved** (considering lifetime GHG emissions).

Lisa then discussed the **additionality** issue, highlighting that this should consider both, free-rider and spill-over effects. The evaluation found that free-rider effects would decrease the net impacts of the scheme by 33%, whereas the spill-over effects would increase them by 21%. Overall, the net impacts would be 88% of the gross results. This could not be assessed with experimental methods (group comparisons). Instead, a set of specific questions was used in the survey to participants.

About the monitoring of energy savings, the methods used depend on the module. Also, depending on the module, participants do or do not report savings data.

Lisa concluded with a selection of lessons learnt:

- Important to **fine-tune the scheme over time**, for example to simplify the procedures when possible, to build capacity in the implementing bodies, on-going review of the minimum funding requirements to reduce deadweight.
- **Improved funding conditions for SMES**, resulting in higher participation from SMEs, which could be even higher thanks to multiplicators (e.g. energy auditors)
- **Major structural breaks require preparation**. Anticipating that the redesign of a scheme also have impacts on the way it can be evaluated.

Q&A

- *Could you explain a little more about the granting institutions and whether their evaluation processes differ?*

VDI/VDE-IT primarily covers modules 4 and 5 on transformation plans, which are typically more complex projects. The related projects necessitate expert review and verification, which also takes a significant amount of time or requires specialized technological knowledge. In practice, this means that the verification of the projects is done by engineers. While it may not be needed for other modules, where the projects are more straightforward (e.g. standard cross-cutting technology). That is why different implementing agencies are involved according to the type of module. There is also a need for regular exchanges among the implementing agencies, to coordinate about the validation of funding or eligibility criteria for example.

- *You showed that module 1 (technology focus) attracts significantly more applicants, but module 4 (system approach) receives the majority of the funds. Could you elaborate a little more on this?*

Indeed, it clearly demonstrates the importance of both forms of modules: for technology-focused projects and for system-approach projects. Previous to the current umbrella scheme that gathers various modules, there were different programmes, with different scopes and funding options. The advantage to have various modules under an umbrella scheme is that it creates connections between them. Companies may first apply for technology-focused projects, as they are simpler to develop. Then they see other options, and may identify further savings opportunities that will fit in other modules. The simpler modules clearly act as door openers for more complex projects.

It is also important to follow the trends in the applications. For example, at the beginning, most projects were from large companies. The scheme was therefore refined to provide a better access to SMEs, which can be seen in the results now.

- *Could you specify a bit about the projects that have been selected via the competition rounds so far?*

It is quite a wide range of projects. Recently a lot of resource efficiency projects (material savings, water savings etc.), as well as a large amount of waste heat recovery, measures regarding process heat, heat pumps and biomass plants as well.

Part 3 – Open discussion

- *Q to João: Have you observed any difference in the policy schemes/support for replacing the electrical motors and the whole motor system?*

We conducted an extensive review of policies concerning electric motors and the system in Europe. We can definitely distinct these two ways. The subsidy schemes mostly cover the cost of replacing the stand-alone motor. The system approach is usually promoted with energy audits, and more specifically due to the mandatory audits required by the Energy Efficiency Directive. A few countries like the Netherlands, have specific methodologies for the auditing of electric motor systems.

Then, there is indeed a trade-off. It is more straightforward to replace the motor alone. Therefore, the implementation rate of projects dealing with the whole motor system is smaller.

Another concern raised by stakeholders during the policy development analysis was a lack of professional competence to conduct a thorough audit of motor systems. This could be addressed by training energy auditors about the specific issues and potentials of motor systems.

Overall, the most effective is likely to combine the policy measures. The general scheme should incorporate capacity building initiatives and offer various options like presented by Lisa in the German example. Then companies may first be in contact with the scheme for simply replacing a motor, and learn about larger savings they could make if considering the whole system. As Lisa said, simpler options can be door openers for more ambitious projects.

— *Q to Lisa: What are the monitoring procedures under the German scheme, and how are the audits conducted?*

For the competition funding, the application files must include a savings concept, with the calculation of the expected energy savings according to the guidelines of the scheme. The guidelines for example specify how to define the reference situation and new situation.

External technical assistance from consulting companies is frequently required, as this would usually be complicated for the applicants to prepare this concept and calculations.

The technical part of the application file is then checked in detail by the engineers of the implementation bodies.

Further readings

- EU-MORE website: https://eu-more.eu/
- Presentation about assessing the potential from early replacement of electric motors: http://ee1st.eu/wp-content/uploads/2025/02/04_ElectricMotors_EU-MORE_RBarkhausen.pdf
- BMWK Annual Evaluation report 2023 (long version, in German): https://www.bmwk.de/Redaktion/DE/Evaluationen/Foerdermassnahmen/241217-evaluation-eew-jahresbericht-2023.pdf?__blob=publicationFile&v=6
- BMWK Final evaluation report 2019-2023 (short version, in German): https://www.bmwk.de/Redaktion/DE/Evaluationen/Foerdermassnahmen/250130-evaluation-eew-abschlussbericht.pdf?__blob=publicationFile&v=10

List of participants (38 participants):

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