streamSAVE Dialogue Groups

Priority Actions:

- Accelerated replacement of inefficient electric motors
- Modal shift for freight transport

Minutes of Meeting 2

Tuesday 29 November 2022

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Short summary

This meeting discussed calculation methodologies and related issues about energy savings from (1) Accelerated replacement of inefficient electric motors, and (2) Modal shift for freight transport. Key points highlighted in the discussions:

About Accelerated replacement of inefficient electric motors:

- Importance of the electricity consumption from motor systems (53% of the global electricity consumption of all end-use sectors, and 74% of electricity consumption in industry).
- Electric motors tend to be used for much longer than their expected lifetime, showing the relevance to consider policies for accelerated replacement. Several barriers can indeed explain why this cost-effective savings' potential still remain largely untapped.
- Indicative values could be defined from the literature, using conservative assumptions when relevant.
- These indicative values provide useful data for benchmarking or as a first basis to define national methods when assessing a large number of replacements or energy savings potentials. However, they cannot replace a specific assessment (e.g. energy audit) for a particular case or precise technico-economic analysis.
- As the electricity mix can vary significantly from one country to the other, it is strongly recommended to use national values for the primary energy factor and the emission factor, when assessing primary energy savings or CO_2 savings.
- Investment costs vary strongly according to the size of the motor, which makes difficult to define average cost values per power range.
- When considering all the elements of the motor system, a savings' potential in the range of 20-30% can usually be achieved with solutions available today: the experience from the Swiss ProKiloKatt scheme shows that most savings were achieved in other elements than the electric motor itself.

About Modal shift for freight transport:

- Standardizing values at EU level for single actions was not possible for modal shift in freight. Instead the streamSAVE methodology enables to assess the technical and savings' potential per Member State. Moreover, the French example (presented in the previous meeting) showed that defining standardized values at national level is possible.
- The EUROSTAT freight transport statistics are a major data source, but the quality of available data varies among Member States.
- The potentials found are significant for most Member States, with the exception of small (e.g. Luxembourd) or insulary (e.g. Ireland) countries. The largest potentials are found in Germany and Poland.
- The streamSAVE methodology does not aim at assessing economic feasibility. However a literature review enabled to identify indicative values for cost data (from a Dutch study).

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16:00	What's next and open discussion

(All times are in CET)

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Part 1: Accelerated replacement of inefficient electric motors

Complements and updates about the streamSAVE methodology, by João Fong (ISR-UC)

(See presentation file available on the streamSAVE Knowledge and support facility)

João Fong presented an update about the streamSAVE methodology dealing with the case of accelerated replacement of inefficient electric motors, taking into account feedback from experts in several countries.

The scope of the Priority Action was briefly reminded: it is focused on the replacement of old inefficient electric motors before their end-of-life, in industry and services. It deals with 3-phase motors as defined in the Ecodesign Regulation 2019/1781, in the range of nominal power between 0.75 and 1000 kW (excluding the 'small' and 'large' motors).

The methodology is based on a simple calculation formula: the main calculation parameters include the efficiency of the replaced and new motors, the nominal power, load factor and duration of use.

The methodology can be used for monitoring a large number of replacements, or assessing energy savings' potentials. However, the indicative values cannot replace a specific assessment (e.g. energy audit) for a particular case or precise technico-economic analysis.

Nevertheless, indicative values are provided in the methodology for benchmarking purposes or when the use of average values is relevant (e.g. when assessing a large number of replacements). These values have been defined based on the literature, per power range (about average power/capacity) and efficiency class (for motor efficiency).

Indicative values also provide average load factor (0.6), lifetime of savings (10 years), annual operating hours per type of activity (in terms of work shifts), and default savings factor for VSD (Variable Speed Drive). The lifetime value of 10 years can be considered conservative (as also discussed in the next presentation, based on data from Switzerland).

The methodology provides calculation formula about the reduction in primary energy consumption (Article 3 EED) and in GHG emissions, both elaborated from the difference in final energy consumption calculated with the formula about final energy savings. This Priority Action deals with the use of electricity, which makes that the additional parameters are the primary energy factor and emission factor for electricity.

As the electricity mix can vary significantly from one country to the other, it is strongly recommended to use national values for the primary energy factor and the emission factor.

Q&A

- *In cases where the motors run most of the day (2 or 3 working shifts per day), would it be needed to differentiate the primary energy factor and emission factor compared to cases where the motors run mostly during day hours (1 working shift)?*

In the methodology, the same average factors have been defined, whatever the type of activity or number of shifts. Depending on the country (and the electricity mix), the difference might be significant or not.

- *Was it possible to define cost data?*

The main difficulty when reviewing cost data is the very large difference in investment costs between the motors according to their size. The power ranges similar as in the ecodesign regulation remain broad when considering the variation in cost according to the motor capacity.

- *From a lifecycle viewpoint, when does an early replacement become beneficial?*

"early replacement" could mean before the end of expected lifetime, but the focus should be on the oldest motors, where the largest potentials lie.

The Ecodesign preparatory study has shown that the impacts are much larger during the operating phase, assuming a standard lifetime, and even when only considering the energy losses (as the electricity is converted in the motor to useful mechanical energy), not the whole electricity consumption: the energy losses due to the conversion from electricity to the final energy service (e.g. movement) represent about 98% of the GHG emissions of the motors' lifecycle. Moreover, most materials can be recycled. Which makes that overall, the environmental gains of replacing an electric motor are higher than the impacts due to production of the new motor.

Energy savings in motor systems – experience from Switzerland, by Maarten van Werkhoven (TPA adviseurs, the Netherlands) on behalf of Rita Werle (Impact Energy, Switzerland)

(*See presentation file available on the streamSAVE Knowledge and support facility*)

(note: Maarten van Werkhoven presented on behalf of Rita Werle)

Maarten van Werkhoven reminded the importance of the electricity consumption from motor systems, representing 53% of the global electricity consumption of all end-use sectors (IEA Energy Outlook 2016), and 74% of electricity consumption in industry (IEA Energy Outlook 2019). This shows that the efficiency of motor systems should be a priority topic for energy efficiency policies.

The presentation is then focused on the experience from Switzerland.

A survey done by the Swiss Agency for Efficient Energy Use in 2012 covered more than 4000 motors and showed that some motors have been in use for more than 30 years, and in any case much longer than their expected operating life (that would be 10 to 20 years, depending on the motor capacity). This shows the importance to consider accelerated replacement to improve the efficiency of the stock of electric motors.

Energy savings potentials can be found in each part of the efficiency of the motor system (also called 'electric driven machine unit'): the motor itself, but also variable frequency drive, related mechanical equipment (e.g. gear, belt) and the driven application (e.g. pump, fan, compressor). When considering all the elements of the motor system, a savings' potential in the range of 20-30% can usually be achieved with solutions available today.

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Various challenges were identified, explaining why this savings potential still remains largely untapped. From technical complexity and lack of know-how, confidentiality issues (making it difficult to identify where potentials are and how big they are), fear of interruption in production or production problems, dependence on few equipment suppliers, to biased economic assessment (e.g. investment cost vs. lifecycle cost) and non-energy benefits considered more important than energy efficiency.

Switzerland implements the same Minimum Energy Performance Standards(MEPS) as set by the EU Ecodesign Directive. In Switzerland, these MEPS are complemented with financial incentives (competitive tenders since 2010) and information and training measures (e.g. Topmotors and other programmes).

The backbone programme for subsidizing electricity efficiency in Switzerland is ProKilowatt[1], implemented since 2010, with competitive tenders for projects (directly by large final consumers) or programmes (for third-parties gathering various energy saving projects). Applications are selected based on cost-effectiveness criteria, and the public subsidy can cover up to 30% of the investment costs.

Over 2010-2021, the programme achieved 915 GWh of annual savings (or 12 TWh of energy savings cumulated over the lifetime of the newly installed equipment), with an average cost of 2.8 eurocents/kWh saved and 333 million euros of subsidies (current budget of about 50 million euros per year) that have supported more than 800 projects or programmes[2].

The results confirm the importance to consider the efficiency of the whole motor systems, and not only the electric motor itself. The electricity savings that could be achieved depend largely on the type of technology deployed and the success rate of the individual programmes. Another interesting result is the diversity of the projects supported by ProKiloWatt, covering all the major types of applications using electric motors.

The Swiss calculation method is a bit more straightforward compared to the streamSAVE methodology, using directly the difference in electricity consumption.

The average lifetime is assumed to be 15 years, or 25 years for motors larger than 20 kW. A special factor of 0.75 is applied to take into account that part of the savings (assumed to be 25%) would have occurred later through 'natural replacement'. This factor can also be considered as a safeguard to avoid overestimated savings.

Only motors more efficient than MEPS can be eligible to subsidies.

The Swiss experience is that early motor replacement does not happen by itself, hence the added value of dedicated policy measures. Recommended measures include:

1. Understanding the motor stock and its characteristics: an EU wide study would bring useful knowledge.
2. Awareness raising among end users, in particular about the multiple or non-energy benefits of efficient motors

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[1] Official website (available in French, German and Italian): https://www.prokw.ch/
Summary presentation in English (Workshop of the ODYSSEE-MURE project): https://www.odyssee-mure.eu/events/workshops/helsinki/ProKilowatt-Switzerland.pdf

[2] Source: https://www.bfe.admin.ch/bfe/de/home/foerderung/energieeffizienz/wettbewerbliche-ausschreibungen-prokilowatt.exturl.html/aHR0cHM6Ly9wdWJkYi5iZmUuYWRtaW4uY2gvZGUvcHVibGljYX/Rpb24vZG93bmxvYWQvODQyMA==.html

3. Create alliances with different stakeholders (manufacturers, service companies, end users, policy makers, etc.)
4. Capacity building for qualitative energy audits, so that the audits consider properly the savings potentials from electric motors
5. Subsidies to help with the extra investment cost of higher energy efficiency, providing incentives for system optimization (to go beyond low hanging fruits) and rewarding early replacement

About the free-rider effect, it has been evaluated by Navigant-Guidehouse[3] to be about 25% in the case of the ProKilowatt programme (which is in line with the factor used to take into account that part of the savings would have occurred later anyway).

Q&A

- *Did the increase in electricy prices change the situation about challenge mentioned on low cost of energy?*

Yes, but the electricity prices are still low in Switzerland. In the Netherlands, the effect can be seen in particular for medium-size companies, changing their attitude and looking more for energy savings. Larger companies are more in a “freeze” attitude (where to start, what to do first) due to the uncertainty about what comes next.

The Swiss companies got more aware of their energy consumption in light of the potential threat of lack of electricity supply which at the moment is considered as a moderate threat.

- *What is the data collection in the Swiss method? Are the data of energy consumption based on measurements?*

The calculation is based on estimated/deemed savings and there are further stipulations for calculating the savings for specific systems (e.g. circulators), including data requirements[4]. At the same time, whenever possible and sensible, measured data is used.

- *Is the share of 53% of the global electricity consumption considering all sectors and end-uses?*

Yes. It may change a bit with electrification of buildings and transport. But in the meantime, the total use will grow (doubling by 2050 was expected by the IEA), so the absolute potential of energy savings from motor systems will remain large.

[3] https://guidehouse.com/-/media/www/site/downloads/energy/2019/navigant-efk-2019-evaluation-foerderprogramme.pdf

[4] Source: ProKilowatt requirements for programmes in 2023: https://www.bfe.admin.ch/bfe/de/home/foerderung/energieeffizienz/wettbewerbliche-ausschreibungen-prokilowatt.exturl.html/aHR0cHM6Ly9wdWJkYi5iZmUuYWRtaW4uY2gvZGUvcHVibGljYX/Rpb24vZG93bmxvYWQvMTExNTY=.html

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Part 2: Modal shift for freight transport

Complements and updates about the streamSAVE methodology, by Elisabeth Böck (AEA)

(See presentation file available on the streamSAVE Knowledge and support facility)

Elisabeth Böck presented the streamSAVE methodology that is meant for assessing overall energy savings potentials, instead of assessing single actions (as standardizing values at EU level for single actions is not possible for modal shift in freight, as too many variables depend on the indivdual action implemented). Nevertheless, the French example (presented in the previous meeting) showed that defining standardized values at national level is possible.

The streamSAVE methodology also includes an option to enter the share of the total potential that would be shifted (in terms of transport modes) due to an implemented action, either of total freight transport or a specific sector or distance class.

The methodology starts with collecting data on road freight transport volume per type of good and class of distance, for each Member State. The data comes from the EUROSTAT freight transport statistics. It should be noted that the data quality varies among Member States.

The potential for modal shift is differentiated according to the type of good and the class of distance (e.g. higher potential for longer distances).

The methodology also takes into account the rail network density, to define a maximum technical potential. The assumption that the share of rail (in freight volume per Member State) could be at maximum doubled by 2030 was used. It should be noted that the network density varies very significantly according to the countries. The technical potentials per Member State were compared with the current share of rail in freight transport.

The energy savings' potentials are then derived from the technical potentials of modal shift, by considering the difference in energy consumption per transport mode, and the parameters previously mentioned (cf. factors for types of goods, distance classes, network density). Moreover, a special factor is used for long distance travel to take into account that only the savings achieved within the national territory are eligible to Article 7 EED.

Germany and Poland stand out from the assessment, with the largest energy savings' potentials (respectively about 16.3 and 14.5 TWh/year).

For primary energy savings and CO2 savings, standard values for the share of diesel and electricity in the energy consumption of rail have been defined, also assuming that road freight runs 100% with diesel by default. It is however recommended to use national values (especially for the shares per energy type in rail consumption).

While the methodology does not assess the economic feasibility of modal shift for freight, it has been complemented with indicative cost values, covering fixed costs (Asset leases, Insurance, Interest, Maintenance), variable costs (Fuel, Bunkering, Stores & supplies, Maintenance), staff costs (Wages, Social security and pension contributions, Accomodation), mode-specific costs (Usage of Infrastructure, supporting services, permits & certification), and general operating costs (Administration, Real estate & infrastructure, Wages for other personnel, IT & communications, Overhead). All the cost data have been defined in terms of euro/ton.km. The main source was a study from the Netherlands. Therefore, the values might need to be adapted to other national contexts.

List of participants

18 participants

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