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Policy Recommendations to Accelerate the Replacement of Old Electric Motors in the EU

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Abstract. EU-MORE (EUropean MOtor Renovation) is an EU-funded LIFE project that aims to accelerate replacement of old, inefficient motors through the development of new policies. In 2023, the initiative conducted a review of current policies stimulating motor replacement in EU Member States. More than 60 policy measures were identified and analyzed for their approach, impact, and lessons learned, leading to an initial set of general observations.

The report revealed that support systems of a financial nature, including subsidies, loans, and fiscal compensation, constitute the majority of all policy measures. Lack of information is a major barrier much less addressed by current policy measures. Many of the measures identified were part of wider industrial energy efficiency programmes, often with no mention of replacing motors being an eligible measure.

This paper analyses some key aspects of current policy measures, including shortcomings and success factors, and sheds light on policy recommendations derived from this analysis.

Keywords: EU, motor efficiency, motor replacement, GHG emissions, policy making, policy review, policy recommendations

1 Introduction to EU-MORE and its *Policy Review*

1.1 EU-MORE

EU-MORE (EUropean MOtor Renovation) is an EU-funded project under the LIFE (L'Instrument Financier pour l'Environnement) programme that aims to speed up the replacement of old, inefficient electric motors in industry and the service sector and to promote the benefits of optimizing motor systems.

Electric motors account for over 50% of the electricity used worldwide, representing 5.5 Gtonnes CO_{2eq} of emissions each year. Increasing awareness of this consumption among policy makers and stakeholders has led to the introduction of minimum energy efficiency regulations, as well as energy-efficient technologies to meet and exceed these standards. Unfortunately, the penetration of these highly efficient technologies has been slower than might be anticipated because motors tend to stay in service longer than policymakers generally assume, often as long as 30 to 40 years [1].

Old motors mean inefficient motors. Accelerating motor replacement in the EU can free up a yearly saving of 25 TWh in addition to the potential savings resulting from current regulations. If entire systems were to be renovated, not just motors, the total savings potential could rise to 100 TWh per year [2].

The EU-MORE project aims to accelerate motor replacement by proposing new policies for national and EU regulators and by developing tools to predict their impact. It also aims to promote knowledge sharing between stakeholders at Member State level, EU level, and internationally.

1.2 The *Policy Review Report*

In the past year, EU-MORE carried out a review to identify and examine current policies in EU Member States that encourage the substitution of inefficient electric motors in the industrial sector. The review covered more than 60 policy initiatives, ranging from measures directly targeting electric motor replacement to broader initiatives promoting industrial energy efficiency in general.

EU-MORE collaborators garnered initial insight by analyzing publicly available data sources, including national government websites and program evaluation reports. A network of national experts gave their deeper analysis of the identified measures and summarized the information that was available on the subject in their own countries. The experts occasionally conducted semi-structured interviews with local stakeholders to gather additional information.

For each of the identified policy measures, the review provides:

- a general description that also includes the implementing authority, budget, and implementation status of the measure;
- a quantitative outcome including the number of motors replaced and the resulting energy savings and emission reduction; and
- a qualitative assessment of aspects such as the replicability, lessons learned, and barriers.

With this, the review sheds light on the effectiveness, challenges, and opportunities of the initiatives identified. While the focus was on the industrial sector, some measures also encompassed the service sector and municipalities.

The findings of the *Policy Review* represent valuable input for a *Policy Recommendations* report currently under development.

2 Financial versus Non-financial Support Measures

Fig. 1 illustrates the nature of the relevant measures identified in the EU-MORE review. It is notable that support systems of a financial nature, including subsidies, loans, and fiscal compensations, constitute the majority of all policy measures (62%).

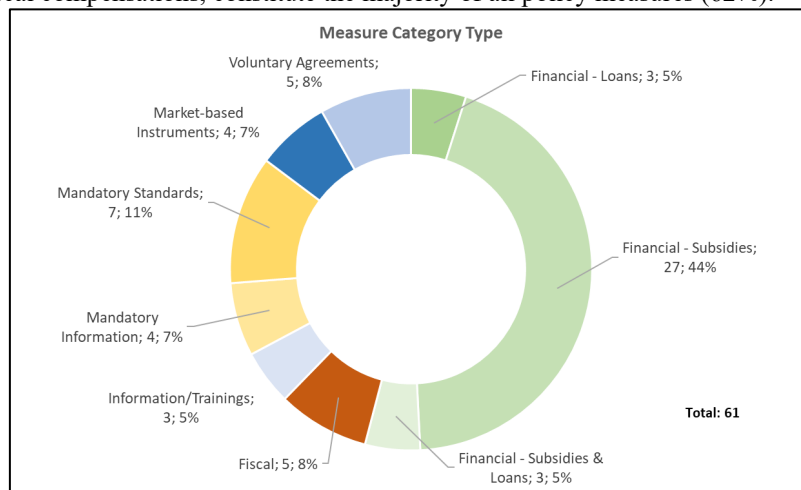


Fig. 1. Types of measures that directly or indirectly incentivize motor replacement in EU Member States.

It could be questioned whether financial measures are still the most effective in times of high electricity prices. Electricity prices rose dramatically along with gas prices and, even though they have seen recent decreases, they are still at about twice the level they were before the Russian invasion of Ukraine. Prices over the medium term are hard to predict, but it is unlikely that they will return to pre-war levels. With higher electricity prices, the financial rate of return of replacing old motors with more efficient types improves and, with this, the leveraging effect of financial incentives diminishes. The fact that the process of motor replacement in the EU remains slow, despite high electricity prices, demonstrates that other barriers—informational, technical and organizational—also play a role, and should receive sharper focus from policy support programmes. There are information barriers even in the context of energy audits, which often fail to identify electric motor replacement as a viable measure [3].

A successful non-financial policy initiative is exemplified in Learning Networks for Energy Efficiency in Germany [4], which involves networks of 10 to 15 companies supporting and stimulating each other to improve energy efficiency in their premises.

The 2022 monitoring report for the Learning Networks includes data from over 2000 companies organized into 212 networks, which implemented a total of 9070 energy efficiency measures.

Of these measures, 8328 were quantifiable in terms of energy savings, while the remaining were primarily organizational, such as training courses and information campaigns. The quantifiable measures led to annual savings of 6,743 GWh of final energy, 8,452 GWh of primary energy, and a reduction of 2,451 kttons of CO₂. Additionally, 583 measures (7% of the total) focused on motors and drives, involving either replacement or optimization of existing technology [5]. Non-financial barriers for motor replacement can be tackled effectively through mutual support and training programs organized in the context of these learning networks. The networks also help to spread awareness of the indirect benefits which come from motor replacement, such as better safety, lower maintenance costs, reduced noise, and increased customer satisfaction.

The *OekoBusiness Vienna* program in Austria [6] proved to be successful in raising initial awareness of energy efficiency measures that are often overlooked, including motor replacement. The program offers a free initial check-up to identify the hidden energy savings potential of industrial and commercial sites. Such highly accessible initiatives could help small and medium size companies take their first steps towards motor replacement and motor system optimization.

3 Generic vs. Motor-specific Measures

In-depth analysis of the Policy Review discovered that a significant proportion of the identified policy measures address industrial energy efficiency in general rather than motors specifically. Such “technology-neutral” policies are often praised for focusing on outcomes rather than process, guiding decision-makers to the most profitable measures, and for remaining relevant over time despite technological and market evolutions. While these are valid points, these kinds of initiatives also come with disadvantages. They tend to lead to low-hanging-fruit measures requiring no substantial investment or which do not interfere significantly in production process, such as relighting projects. They also depend on industrial decision makers having the insight to make judgements based on the full picture. Measures that could bring multiple benefits, but which stay hidden or come with organizational complexity, are rarely addressed, as is often the case with motor replacement. These drawbacks of technology-neutral policy measures, combined with the fact that motors represent at least 70% of the industrial electricity demand in Europe, could justify developing motor-specific initiatives.

The *Energy Efficiency Promotion Plan* (PPEC) [7] in Portugal is one of the initiatives identified that explicitly addresses motor replacement. In its 6th edition (2017-2018) it incorporated a measure to encourage the installation of high-efficiency motors (IE3 or IE4) within the 0.75-400 kW power range. The measure provided financial incentives covering 51% of the total installation cost, with an allocated budget of 900 thousand euros. The initiative contributed to the replacement of 420 motors, generating 115 GWh of electricity savings and GHG emissions reduction of 43 thousand tCO₂eq.

In generic energy efficiency policy mechanisms, it can be helpful to explicitly reference motor replacement as an eligible investment and to specify the eligible power ranges and efficiency classes. An example of this approach can be found in the Dutch *Energy Investment Allowance* (EIA). The EIA enables companies to receive a tax deduction for investments listed on the Energy List that lead to significant energy savings. Companies can deduct 45.5% of the investment costs from their taxable profit, in addition to the standard depreciation. In the Energy List, detailed specifications are provided for measures relating to IE3, IE4, and IE5 motors for industrial use [8].

4 Policy Measures Promoting a System Approach

The benefits of replacing an old motor can be significantly enhanced by addressing the entire motor system rather than the individual motor alone. Measures acting at system level include appropriate sizing of the motor, digitalization, sensorization, eliminating unnecessary transmissions, and equipping motors with variable speed drives (VSDs).

Few countries investigated by EU-MORE have developed policy instruments specifically promoting a system approach to motor replacement, but two positive examples deserve a mention. In the Netherlands, a new legislative framework in 2023 obliges large companies to analyze all motor-driven systems above 15 kW in the context of the mandatory energy audit, and clearly specifies that this analysis must address the entire motor system. In Germany, *Federal Funding for Energy and Resource Efficiency in the Economy* explicitly mentions motor systems, and a systemic approach is encouraged.

An excellent introduction to the subject can be found in the policy paper ‘A system approach to maximise energy savings potential in electric drive systems’ [9] by the industry association CEMEP (European Manufacturers of Electrical Machines and Power Electronics). The paper also discusses newly developed industry standards to address electric drives at system level.

5 Initial Policy Recommendations

As discussed in earlier chapters, the *Policy Review* identified success factors in current policy measures. This provided crucial input for a policy recommendations report currently under development. The following are some elements from the first draft.

1. Mutual trust between policy makers and industrial decision makers is key. To ensure this, programmes should remain in place for at least ten years and information should be disseminated in a clear and transparent way to all potential beneficiaries. Beneficiaries should report on the results they obtain, but it must be established that this can be done without an excessive administrative burden.
2. Motor replacement could be made mandatory if an energy audit identifies it as an economically beneficial energy savings measure. In general, every measure identified by an energy audit as having a high internal rate of return (IRR) could be made

mandatory. Replacing old industrial motors is often highly cost-effective in the EU, with a median payback time of around four years [10]. On average, motor replacement becomes profitable at a median electricity cost of 4.63 eurocent per kWh, while non-household electricity prices in the EU currently range between 8 and 25 eurocent per kWh (2023) [11]. A positive example of this can be found in the *Energy Policy Agreement 2015-2020* in the Belgian Flanders Region, where companies joining the voluntary agreement commit to carrying out every measure identified with an IRR greater than 14%.

3. Voluntary programs might benefit from a carrot-and-stick approach, which could take different forms. Incentives for participation could be combined with penalties for non-participation, or participants can be given incentives on condition they can demonstrate compliance within a certain time frame. In the Voluntary Agreement on industrial energy efficiency in the region of Wallonia, Belgium, a tax deduction for reaching the targets is combined with penalties for non-compliance.
4. Energy efficiency obligation schemes (EEOS) have proved successful in achieving substantial energy savings in industry with a low direct cost for policy makers. Unfortunately, they also come with the typical drawbacks of generic, technology-neutral initiatives, as discussed earlier. Obligated parties tend to give priority to energy efficiency measures with a low capital cost, including soft measures such as public information campaigns. More costly projects, such as replacing old motors, consequently miss out. The current EEOS could be improved by including motor replacement in the list of eligible activities and by measures to improve the balance between technical and behavioral actions. The impact of EEOS could be further enhanced by combining them with tradeable white certificates.
5. Policy makers at national level should take the requirements of the *EU Sustainable Finance Framework* into account. This legislation includes an EU Taxonomy [12] to help investors identify environmentally sustainable activities. Linking motor replacement measures to this taxonomy will facilitate their being financed by commercial banks at lower interest rates. While motor replacement is not explicitly covered, efforts could be made to link it to domains which are included in the EU Taxonomy. The listed activity ‘Renewal of water collection, treatment and supply systems’, for example, could include the replacement of motors for pump systems. At the level of EU policy making, motor replacement could be considered for inclusion as an eligible intervention in the EU Taxonomy.

6 Further Development at National Level

The policy review revealed that some types of policy measures are not equally successful in every EU Member State. Geographical and cultural criteria as well as previous regulatory history seem to play a role in the success of these measures.

To take this into account, EU-MORE is further developing its policy recommendations at national level, with a major focus on the initiative's partner countries, spread across the continent's various cultural regions. The project is organizing a series of national workshops and co-creation workshops in every partner country, allowing stakeholders to be consulted and to take part in developing country-specific recommendations.

The final EU-MORE report with recommendations for national and EU policy measures to accelerate the replacement of old electric motors is expected to be published by March 2025.

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