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EU-MORE EUropean MOtor REnovation initiative

Promoting the accelerated replacement of old electric motors in the European Union

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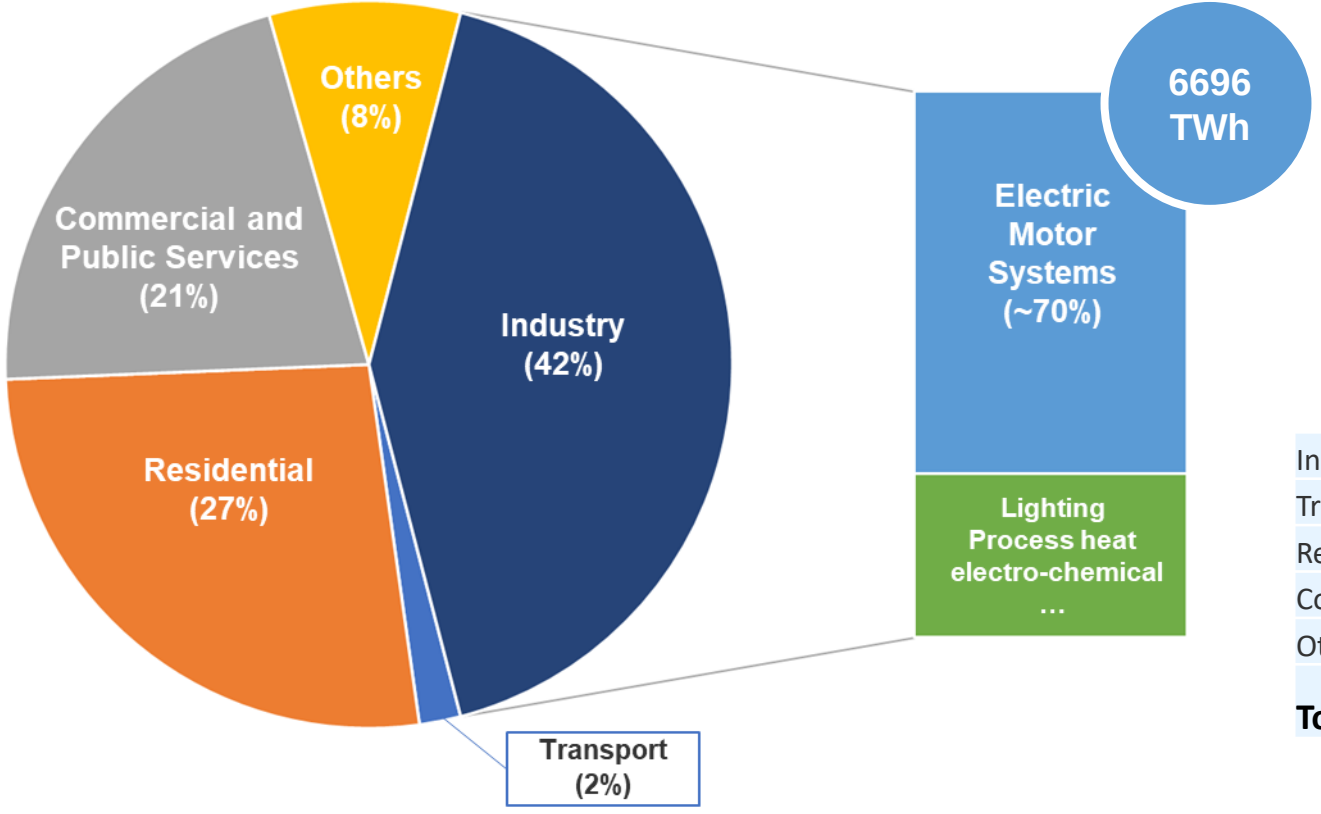
Worldwide electricity use

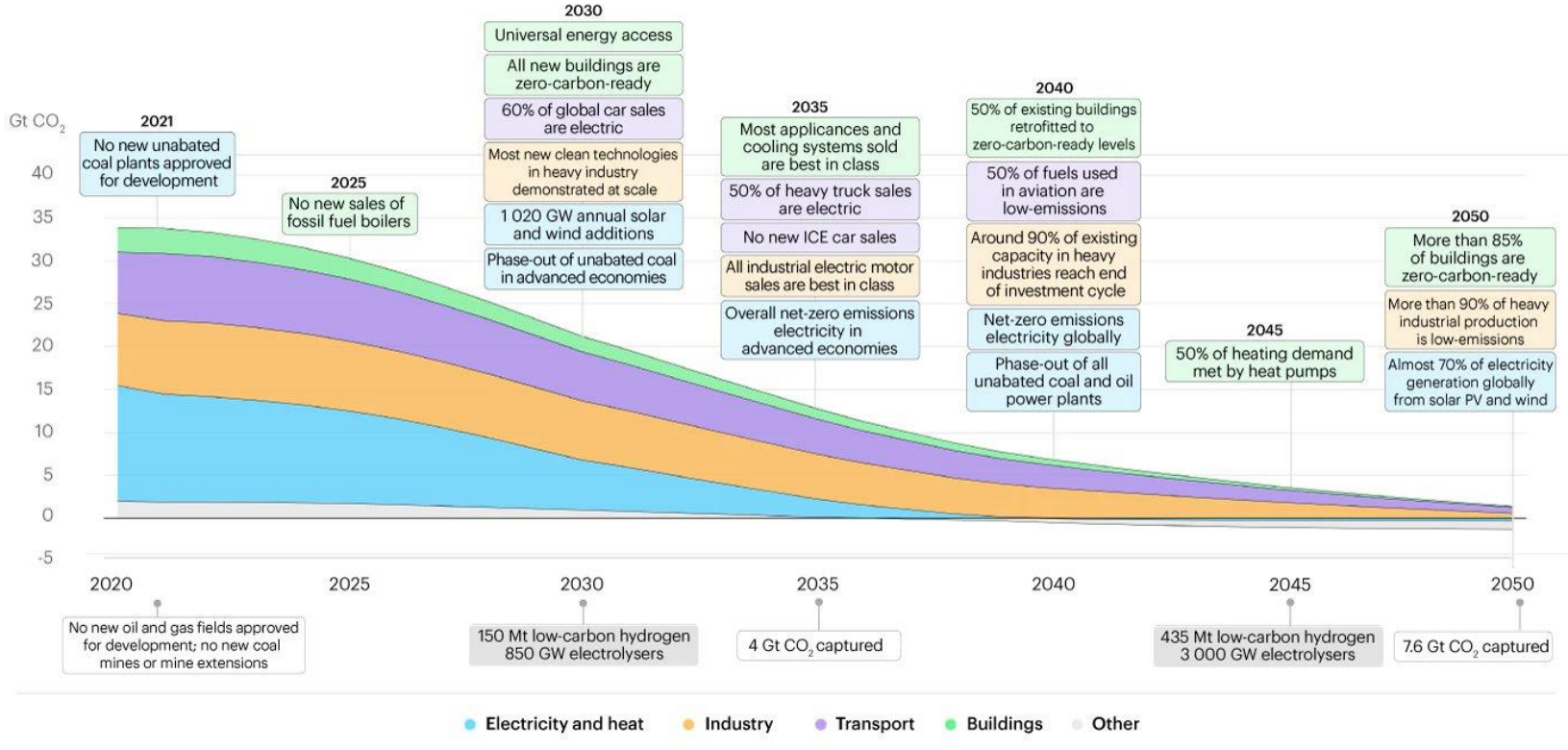
2019 (IEA)



Industry: **9566 TWh**
Transport: **420 TWh**
Residential: **6072 TWh**
Commercial and public services: **4849 TWh**
Others (agriculture and fishing): **1940 TWh**
Total: 22847 TWh

IEA Net Zero by 2050 roadmap

All industrial electric motors are best in class by 2035



Source: IEA Net Zero by 2050 roadmap report

Electric motor systems policies

Awareness of the importance of motor systems energy consumption (and corresponding emissions) by policy makers, manufacturers, service companies and industry end-users has led to the implementation of different policies aimed at increasing the uptake of energy efficient electric motors.

These policies include:

- Minimum efficiency regulations
- Financial Incentives
- Energy Management Programs
- Energy Audit Programs
- Raising Awareness and Information Provision

EU existing policy instruments

Ecodesign Regulation: Electric Motors

EC Regulations 640/2009 and 2019/1781

16 June 2011	• **Stage 1**: Motors with rated output 0,75 – 375 kW must meet **IE2** efficiency level
1 Jan 2015	• **Stage 2**: Motors with rated output 7,5 – 375 kW must meet **IE3** efficiency level or **IE2 + VSD**
1 Jan 2017	• **Stage 3**: Motors with rated output 0,75 – 375 kW must meet **IE3** efficiency level or **IE2 + VSD**
July 2021	• Motors (3-phase) with rated output 0,75 – 1.000 kW must meet IE3 efficiency level • Motors (3-phase) with rated output 0,12 – 0,75 kW must meet IE2 efficiency level
July 2023	• Single-phase motors with rated output equal or above 0,12 kW must meet IE2 efficiency level • Motors (3-phase) with rated output 75 – 200 kW must meet **IE4** efficiency level

EU existing policy instruments
Energy Efficiency Directive:

Article 7 obliges Member States to develop an Energy Efficiency Obligation scheme or/and use alternative measures like energy certificates, minimum energy performance requirements etc.

Article 8 Energy audits and energy management systems

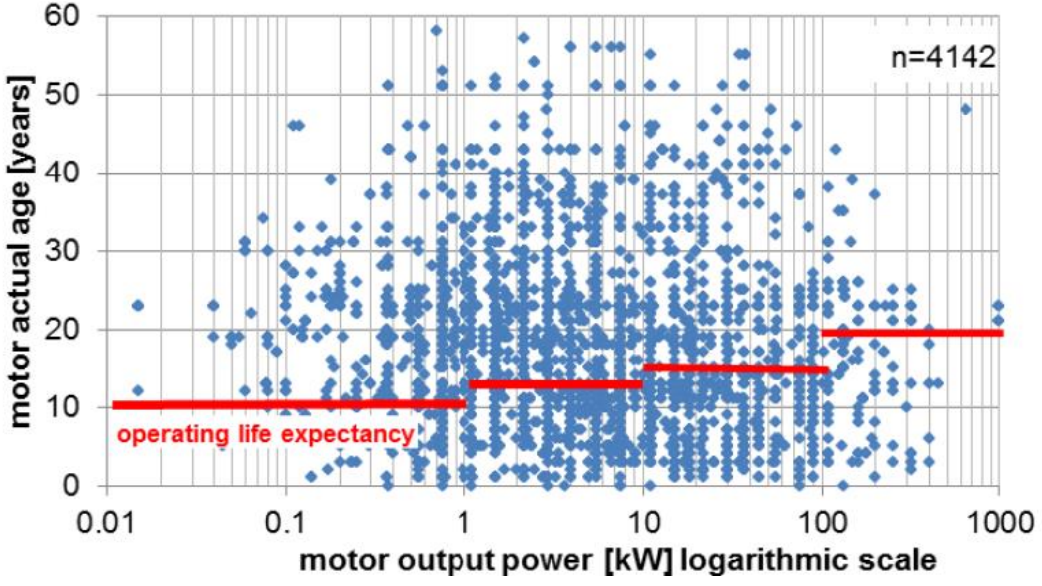
Motor Lifetime
Common assumption

The average lifetime of motors (including repairs) in previous EU studies have been estimated to be:

1.0 – 7.5 kW:	12 years
7.5 – 75 kW:	15 years
75 – 250 kW:	20 years

Motor Lifetime

Swiss Energy Agency S.A.F.E. (2013)



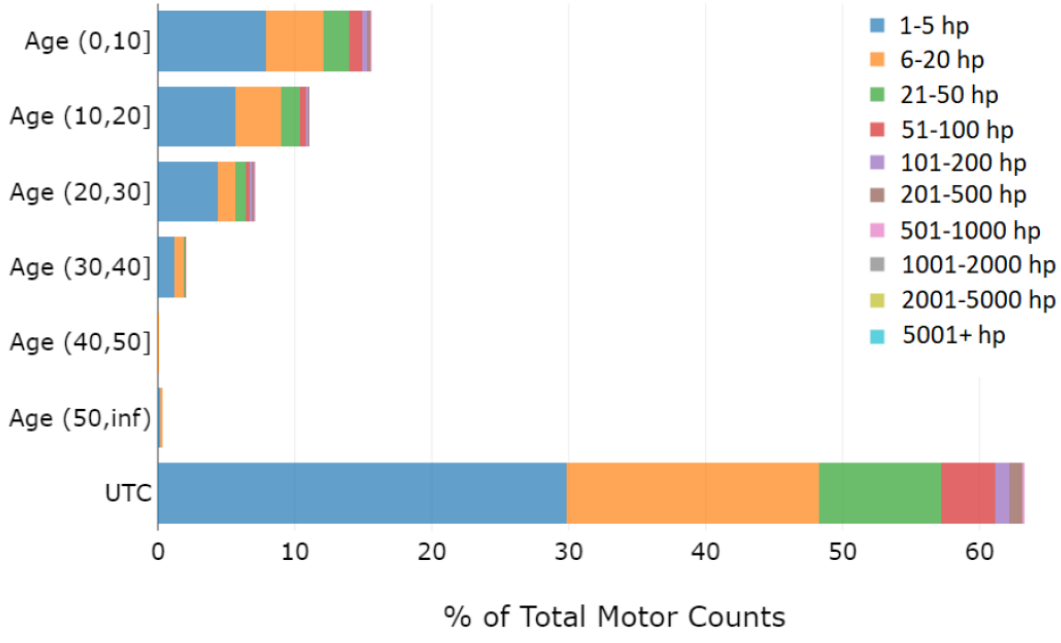
Source: Impact Energy, Switzerland, 2014

- In 2013 the Swiss Energy Agency S.A.F.E. assessed 4124 separate motor systems in 18 factories.
- The analysis shows that 56% of all motors and their respective systems were older than their expected operating life time (some were twice the expected age).

Motor Lifetime

US Motor System Market Assessment

Age of industrial motor systems broken down by size



Source: (DoE, 2021) US Motor System Market Assessment

The 2021 US MS Market Assessment found that the majority of motors is over 10 years old, even for small motors under 20hp

*** UTC - Unable to Collect**

Barriers to motor replacement

- **Efficiency perceived low importance.** When considering options for efficiency improvements in a company, motor efficiency is seen as being of low interest.
- **Economic barriers.** Low budget for energy efficiency; relatively long paybacks.
- **Higher upfront costs.** Companies often decide based on purchase cost instead of life cycle costs.
- **Lack of awareness about the co-benefits of energy efficient motors.** The advantages of higher efficiency motors, such as lower maintenance due to lower operating temperatures, process improvements, are often not taken into account in the decision-making process.
- **Split goals between different company departments.** Different departments within a company (production, energy, maintenance, financial, etc.) may have different immediate goals. Sometimes, miscoordination between these departments, in addition to the low budgets for energy efficiency projects, may lead to inaction.

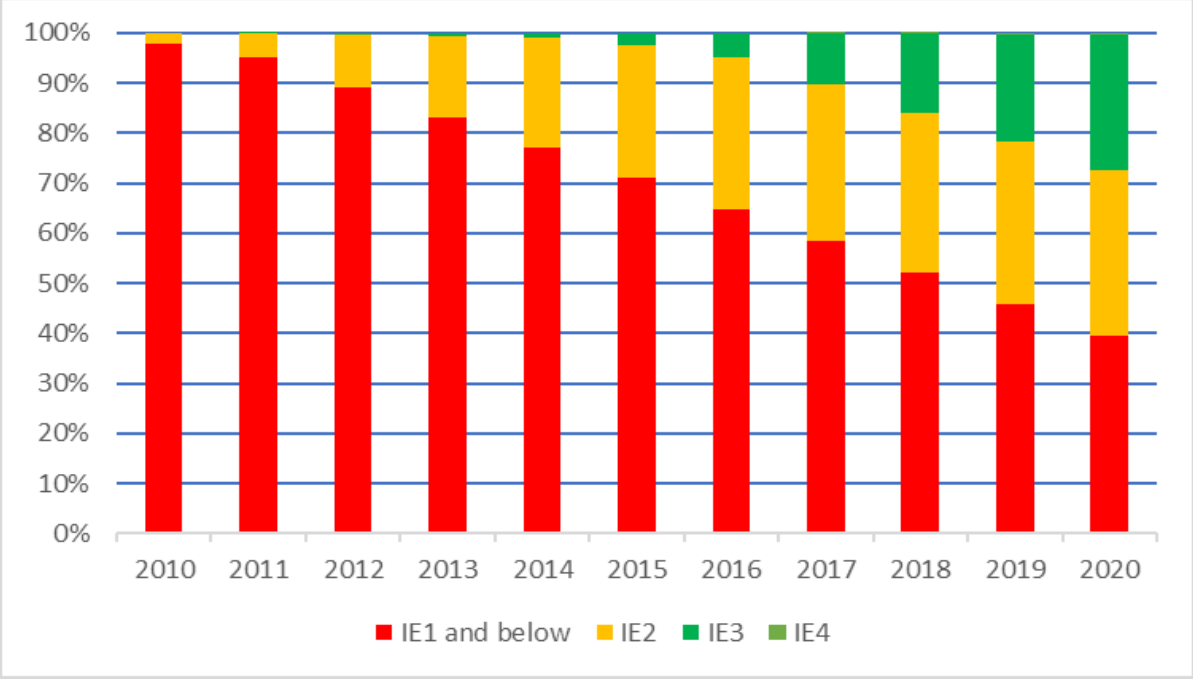
Barriers to motor replacement
(cont.)

- **Quick availability.** The need for vital plant equipment to be brought on-line again as soon as possible, will mean that when a motor fails they will do whatever is quickest. This often means repairing the motor or replacing it with an old motor in stock. Repairing a motor is seen as the lowest risk option too.
- **Stocks of old motors.** Many sites have stocks of older motors, and there is a natural tendency to use these “free” motors rather than purchase new motors.
- **Increase in length/frame size.** Higher efficiency motors will generally have more active material than less efficient motors, and may need an extended stator frame. Longer motors may not fit into all applications.
- **Energy audits.** Energy audits are, sometimes, not anchored in the reality of installations leading to recommendations that are not practical.

Stocks of old motors

Motor Stock by Efficiency Class

Preliminary estimate



Even when taking the values of 12, 15 and 20 years for the average lifetime, depending on motor power range, it can be seen that, despite the Ecodesign Regulation in place, over 70% of the motors installed in the EU-27 were still IE2 efficiency class or below in 2020

Accelerate the replacement of old inefficient motors
Estimated impact

- Replacing motors with IE2 Class or below.
- Assuming an average 4% gain in efficiency, equal to the average difference between IE1 and IE3

The savings triggered in the EU would equal **25 TWh/yr.**

The savings would be even larger if the replacement is made with:

- IE4 or IE5 motors
- correct sizing of the motor,
- equipping the motor with variable speed drive
- digitisation / sensorisation,
- removing unneeded transmissions,
- …

Accelerate the replacement of old inefficient motors

Estimated impact

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Correct sizing of motor at the time of replacement

- Motors are most efficient at between 70% and 80% of rated output, with efficiency dropping sharply below 50% of rated output.
- Correct sizing of the motor can bring efficiency gains of up to 5%.

A conservative gain of 2% from correcting sizing when replacing old motors would bring additional savings of **12 TWh/yr.**

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Accelerate the replacement of old inefficient motors
Estimated impact

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Equipping motor with a Variable Speed Drive

- Savings are typically in the range 15-35% (average 25% considered).
- Applications with variable load profiles represent approximately 50 to 60% of all applications.
- Estimates for the market penetration of VSDs to be approximately 45% in 2020 (CEMEP).
- This means that 5 to 15% of the new installed motors with variable loads are operated under inefficient control methods.

If VSDs are installed in these motors alongside motor renovations, the savings would amount to between **7,9 TWh/yr** (in the worst case) and **23 TWh/yr** (in the best case).

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Accelerate the replacement of old inefficient motors
Estimated impact

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Digitisation / Sensorisation

- The Preparatory study for the Ecodesign and Energy Labelling Working Plan 2020-2024 identified electricity savings from digitisation of electric motors to be of around 5-10%.

Using the same rationale as above the savings from digitisation of motor systems would be of **31 to 63 TWh/yr.**

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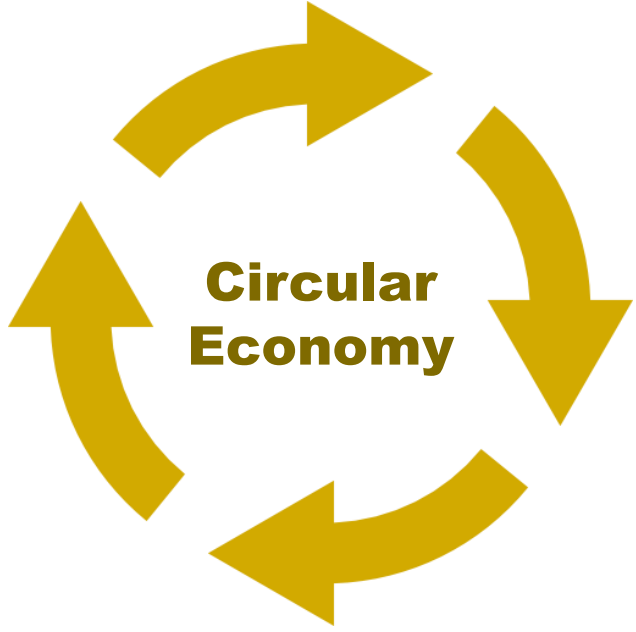
Recycling of old electric motors project -Sweden

- Motors are made of large amounts of recyclable valuable metals.
- Recycling of aluminium, copper and iron provides an energy-saving of between 75 and 95 per cent compared to new production of these metals.
- In Sweden, ABB and Stena Recycling recently signed a long-term agreement on the recycling of old electric motors, replacing them with modern high efficiency motors (estimated 4 TWh of savings, about 3% of all Sweden electricity consumption).



Accelerated Replacement of Electric Motors
Conclusions

- Despite the recognition of the importance of electric motors as major consumers of electricity, both in industry and in the the tertiary sector, and of the consequent efforts to promote energy efficient electric motors by policy makers, manufacturers and other stakeholders, the rate of replacement of old inefficient motors seems to be far lower than expected.
- The large savings identified mean that motor replacement represents an opportunity for savings that cannot be forsaken.

- IEA identified as a milestone in its Net Zero Roadmap that all industrial electric motors are best in class by 2035. Purposeful action must be considered.

LIFE Project

EU-MORE –European Motor Renovation Initiative

Actions - Accelerated Replacement of Electric Motors

- Assess current EU motor stock (age, power, load, efficiency class) and trends.
- Review past and existing policy options for the acceleration of electric motor renovation identifying best-practices and shortcomings.
- Foster the discussion and knowledge exchange between stakeholders dealing with the promotion of energy-efficiency technologies and energy efficiency policy implementation.
- **Develop new policies** (adapted best practices or new concepts).

EU-MORE Partners

- ISR – University of Coimbra
- ECI – European Copper Institute
- IEECP – Institute of European Energy and Climate Policy
- AEA – Austrian Energy Agency
- CRES – Centre for Renewable Energy Sources and Saving
- Fraunhofer Institute for Systems and Innovation Research

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