CWIEME BERLIN

3-5 JUNE 2025
MESSE BERLIN

A Hyve Event

Motors workshop
Summary of findings

International Copper Association Europe

CWIEME BERLIN
Transformers | Motors | Generators
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Motors workshop
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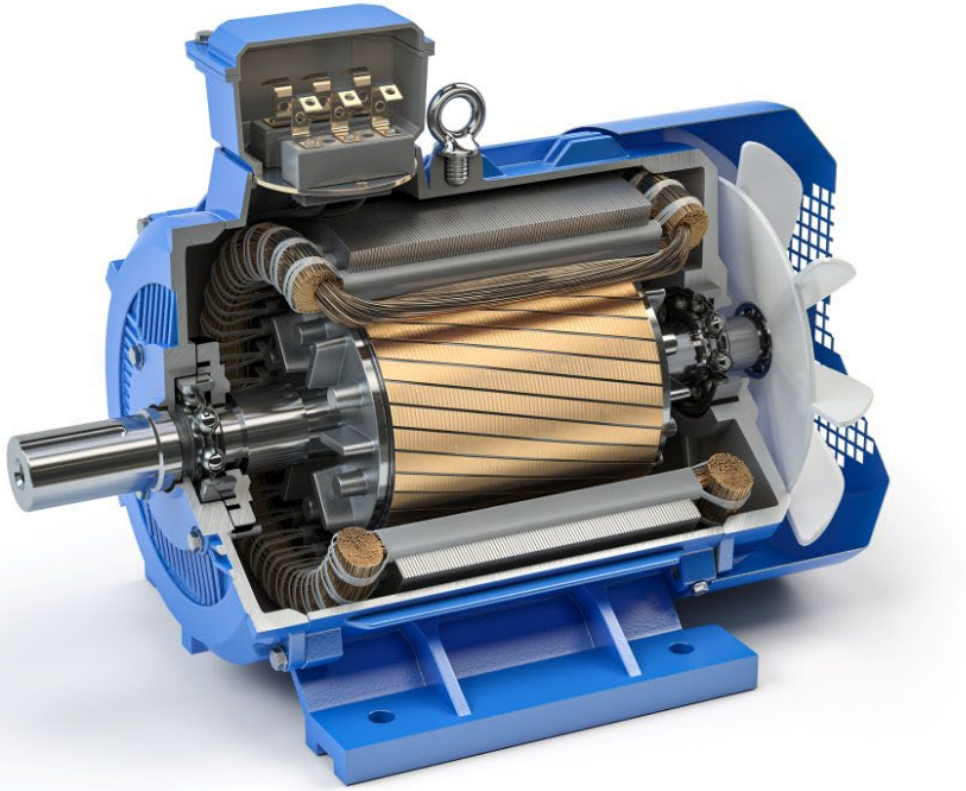


CWIEME – Berlin June 2025

Fernando Nuño

Who we are

Cu **International Copper Association**

50%
of the world's copper production

6
operating continents

32
members

AngloAmerican · Antofagasta Minerals · Antucoya (Antofagasta Minerals) · Aurubis · BHP · Boliden · Buenavista del Cobre · Centinela (Antofagasta Minerals)

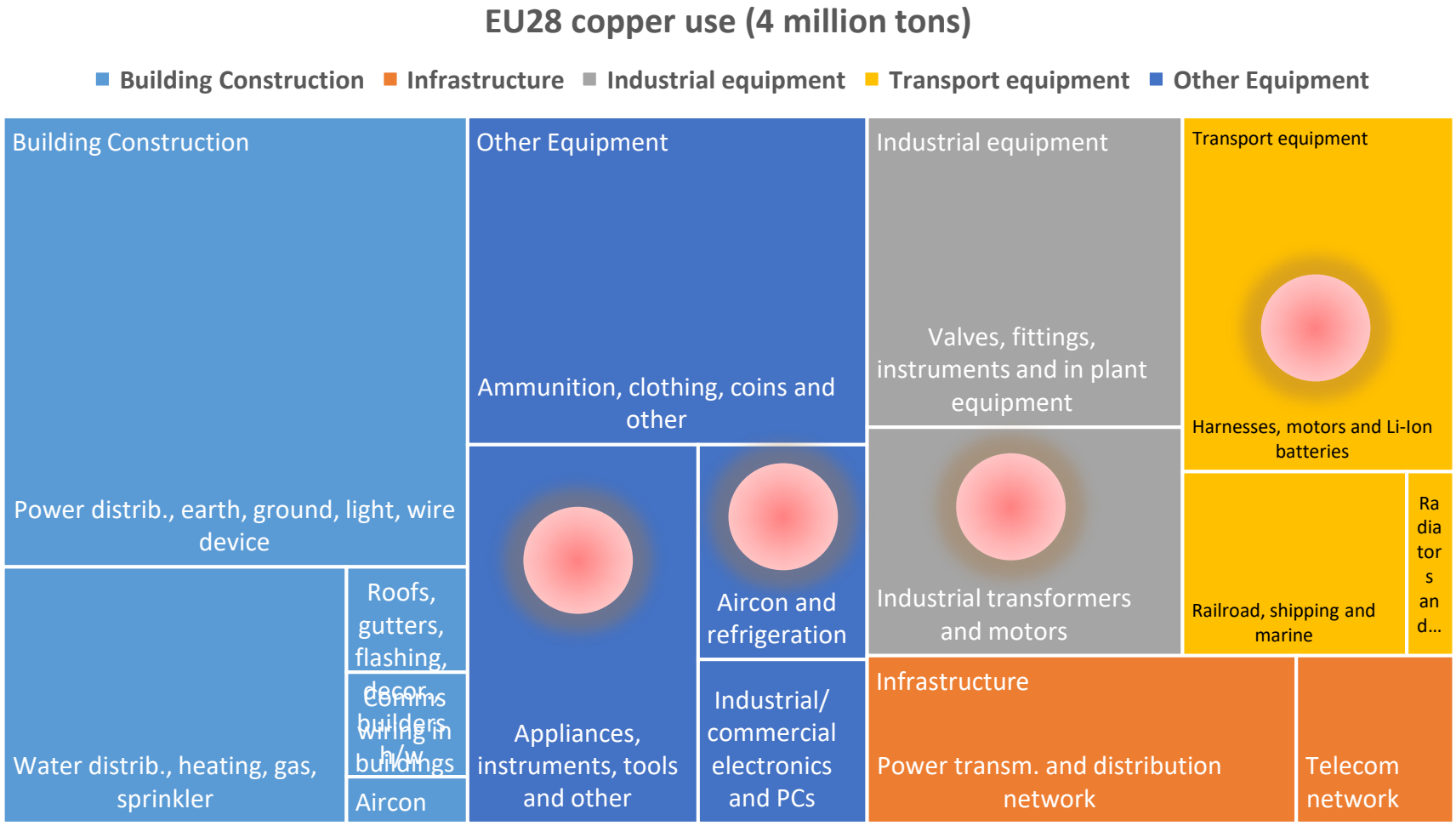
Codelco · Collahuasi · Freeport-McMoRan · Glencore · GrupoMexico · Ivanhoe Mines · JX Nippon Mining & Metals

Los Pelambres (Antofagasta Minerals) · KGHM Polska Miedź · LS MnM · Metso:Outotec · Antamina · Minera Escondida · Mitsubishi Materials · Newmont

Rio Tinto · El Abra · Cerro Verde · Southern Copper / Southern Peru · Sumitomo Metal Mining · Teck · Vale · Zaldívar (Antofagasta Minerals)

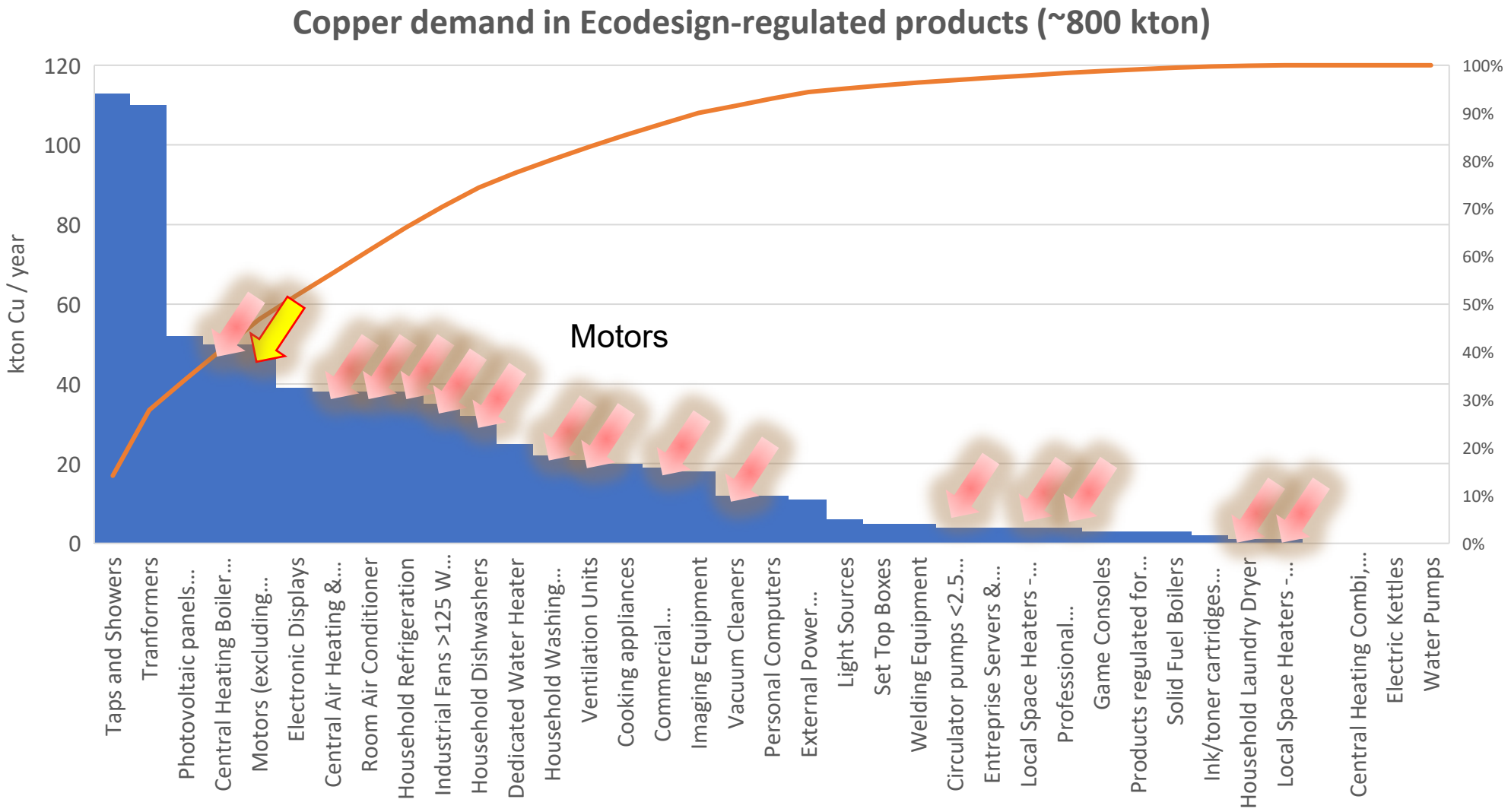
Motors - EU

Motors are present across sectors



Source: Global 2022 Semis End Use Data Set https://copperalliance.org/resource/global-2022-semis-end-use-data-set/

Motos are present in multiple products regulated by Ecodesign



Own graph based on data available at: *Ecodesign impact accounting annual report 2021 – Overview and status report*, Publications Office of the European Union, 2022, **https://data.europa.eu/doi/10.2833/38763**

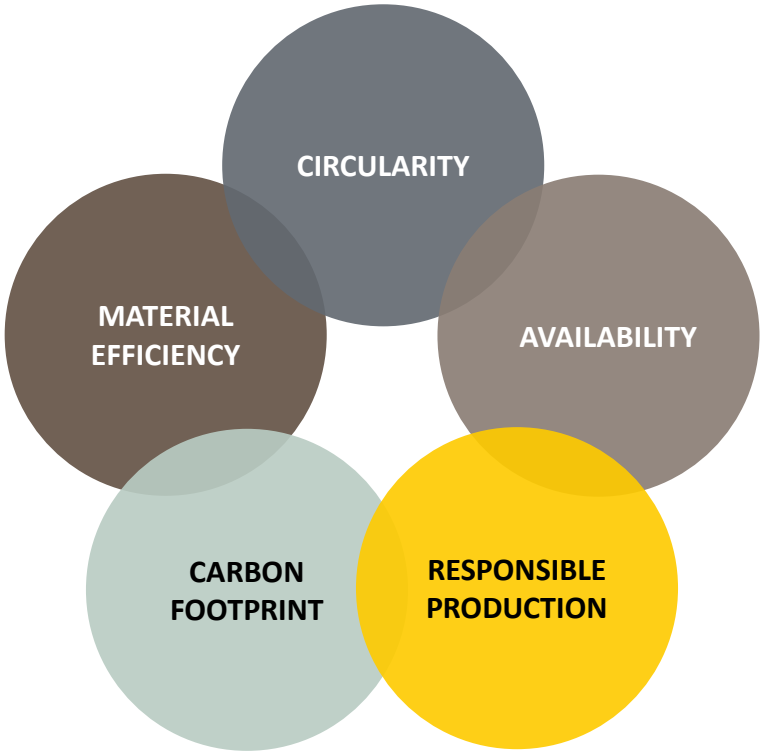
New considerations for raw materials

Before the Energy Transition

Mature, stable
products and technology

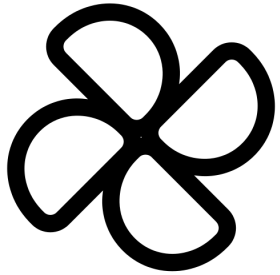
During the Energy Transition

Rapid change
in products and technology

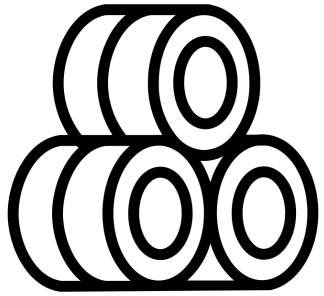


Motors workshop in CWIEME Berlin

Motor OEMs



Motor-driven equipment OEMs



Raw material suppliers

Regulatory bodies

Academia & consultants

Maintenance / service sector

Policy context

Ecodesign for motors

Ongoing revision

European Commission

EN

Search

Energy, Climate change, Environment

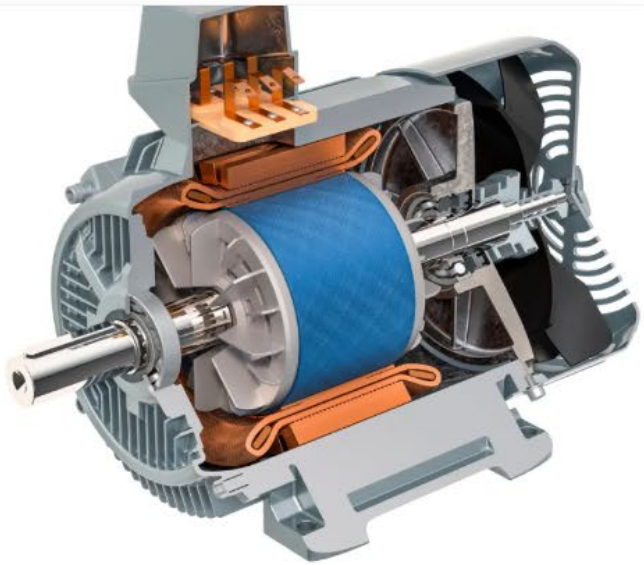
Energy Efficient Products

Home | Product List | Ecodesign and Energy Label | Consumers | Suppliers | Dealers | Policy Making | EPREL | News | FAQs

Home > Product List > Electric Motors

Electric Motors and variable speed drives

Ecodesign requirements apply to these products



Ecodesign for motors: the new regulatory framework, ESPR

Ecodesign for Sustainable Products Regulation (ESPR) EU 2024/1781

- ✓ In force since July 2024, it replaces Ecodesign directive on energy-related products.
- ✓ Indicative timeline for adoption for motors: 2029
- ✓ Wider range of requirements considered:

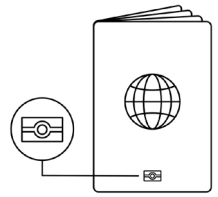
Energy efficiency

Resource efficiency

Product durability, reusability, upgradability and repairability

Recycled content, remanufacturing and recycling

Carbon and environmental footprints

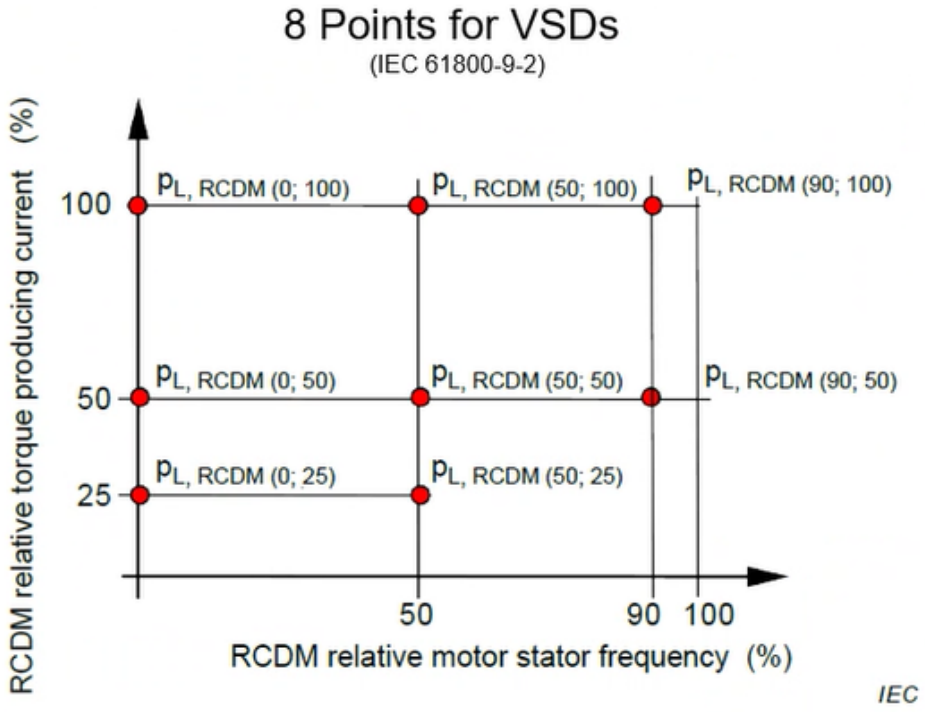


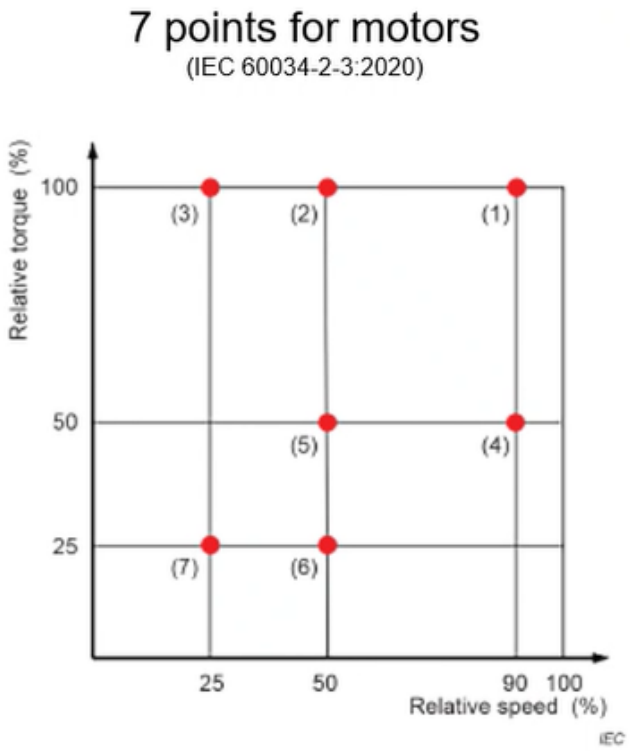
Information requirements, Digital Product Passport

Ecodesign for motors: further specific measures for consideration

- ✓ Provisions for spare parts (motors and VSDs)
- ✓ Link to Critical Raw Materials Act: provisions related to rare earths in permanent magnets
- ✓ Specific requirements per technology
- ✓ Consider innovative technologies
- ✓ Information requirements at partial load / speed to be extended

Ecodesign for motors: current information requirements at partial load / speed





Enables calculation and **optimisation of electric motor systems** efficiency at different loads and speeds.

Motor system optimisation has the potential for **important energy savings**.

Ecodesign for motors: stakeholder engagement routes

June 2025 → **2026**

Written consultation

✓ Call for evidence

Evaluation

✓ Qualitative consultation
✓ Targeted data review of quantitative data

Impact assessment

Stakeholder meetings

✓ Stakeholder meeting I

✓ Stakeholder meeting II

✓ Ad-hoc exchanges with stakeholders

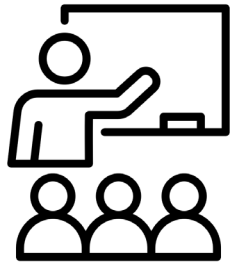
https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14250-Energy-efficiency-ecodesign-for-electric-motors-and-variable-speed-drives-review_en

Ecodesign for motors: discussion points

Enforcement

Market surveillance

Education & training



Policy context: Energy Efficiency Directive

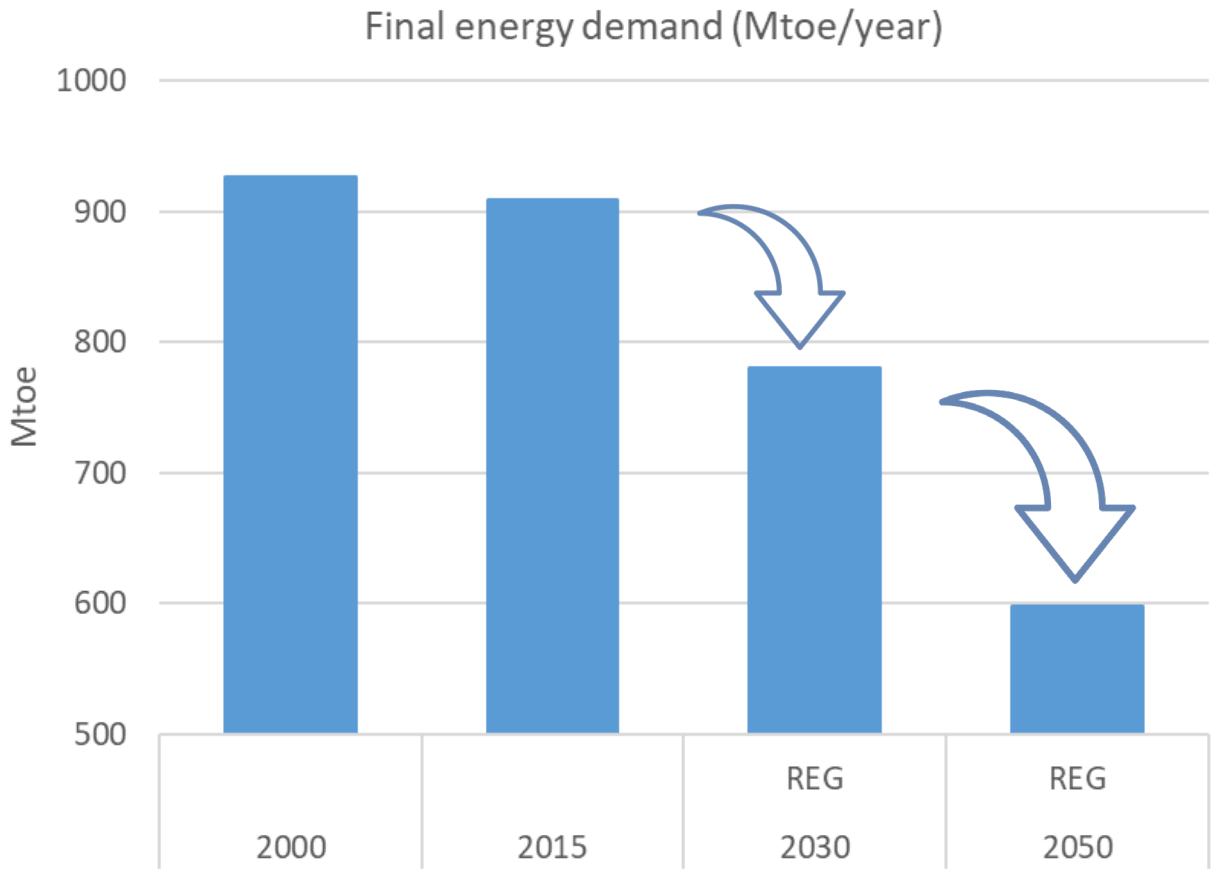
Despite an increasing share of renewables in the mix, further efforts in energy efficiency are required to reach 2050 goals

Doing more with less

- ✓ Despite the economic growth, final energy consumption will have to go down.
- ✓ The reduction in final energy demand between 2022 and 2030 equals the consumption of the whole Germany!
- ✓ Moving forward, an even more drastic reduction is to be implemented till 2050.

Each kWh saved matters

Energy efficiency matters even more than in the past



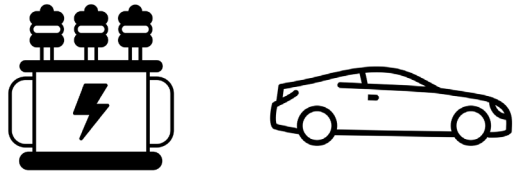
Source: Impact Assessment EU Green Deal – Part 2, Figure 37
https://eur-lex.europa.eu/legal-content/EN/TXT/DOC/?uri=CELEX:52020SC0176

The manufacturing phase

Sustainable sourcing of raw materials: the market pull is not yet there for stationary motors

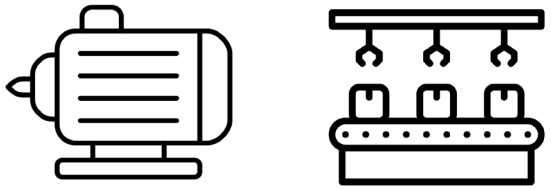
- ✓ Relative weight of **manufacturing phase** in Life Cycle Assessment remains minor
- ✓ Though this situation is changing fast following the greening of the electricity mix

- ✓ **Varying landscape for specifications**: from no requests at all in terms of use of sustainable raw materials to some users asking for Environmental Product Declarations and Life Cycle Assessments
- ✓ **Certain regions** more advanced (Nordics and those with public tender rules)

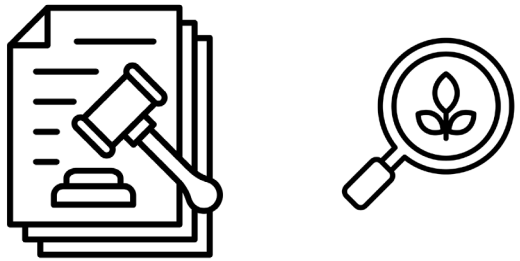


- ✓ **Automotive and transformer** sectors are today more demanding in terms of sustainable sourcing

Sustainable sourcing of raw materials: the way forward



- ✓ **OEMs** could play a role, however this is subject to **customers pull** and **regulatory push**



- ✓ Carbon and environmental footprints are part of the **requirements to be established by the regulation (ESPR)**

Transparency through EPDs

PCR (Product Category Rules) =

The PCR gives instructions

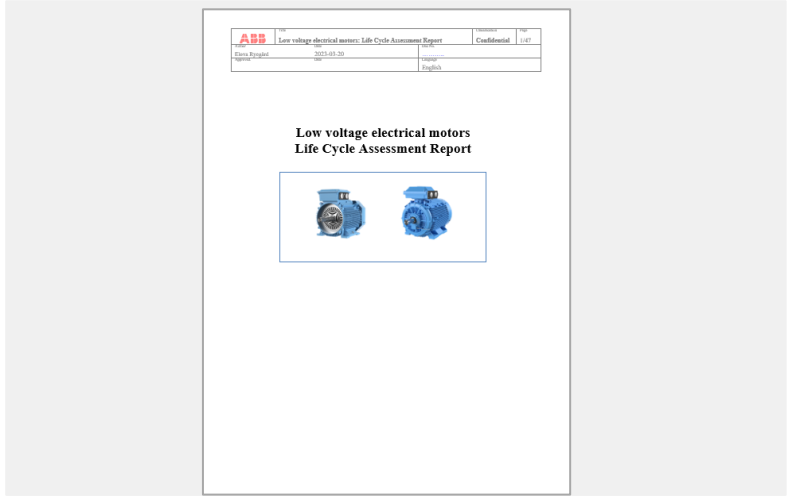
LCA (Life Cycle Assessment)=

Methodology for assessing environmental impacts

EPD (Environmental Product Declaration) =

Quantifies environmental impact of a product, enables comparisons

PCR → LCA → EPD



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How we close the loop
Resource efficient operations

ABB Motion plant in St. Louis, Missouri (USA), identified a way to reuse scrap from the manufacture of motors, recovering more than 26,000 metric tons of electrical steel per year.

In 2022, the plant's primary electrical steel supplier purchased a local recycling company, which now allows us to **sell all electrical steel scrap** produced during the manufacturing process **back to the primary steel supplier**.

The supplier pays ABB an **above-standard price** for the scrap because they can be certain that the **material is of the highest quality**. Such material is reprocessed and procured again by ABB, thus **closing the loop**.

26,000+ tons

of electrical steel scrap recovered each year

100%

of electrical steel used or sent back to high-grade recycle

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Sustainable sourcing of raw materials: considerations for future regulatory requirements

Market surveillance

- ✓ **Challenging for imports**

Simplicity

- ✓ Requirements should be **simple and easy to implement,** otherwise these risk to be not enforceable

Interaction with other regulations

- ✓ Some raw materials such as steel and aluminium are subject to Cross Border Adjustment Mechanism (CBAM), which already covers their embedded carbon footprint.

Compensation rules

- ✓ EU production which is **exported** may need compensation

Standards for measurement

- ✓ For comparability reasons, well established standards need to be developed

The use phase

Use phase: efficiency trends, market pull

Efficiency requirements

- ✓ Higher efficiency than regulated demanded by certain sectors, notably **ventilation, heating, air conditionning**
- ✓ **Total Cost of Ownership** is well understood by certain motor users
- ✓ Other users focus on **minimal investment cost** for varied reasons

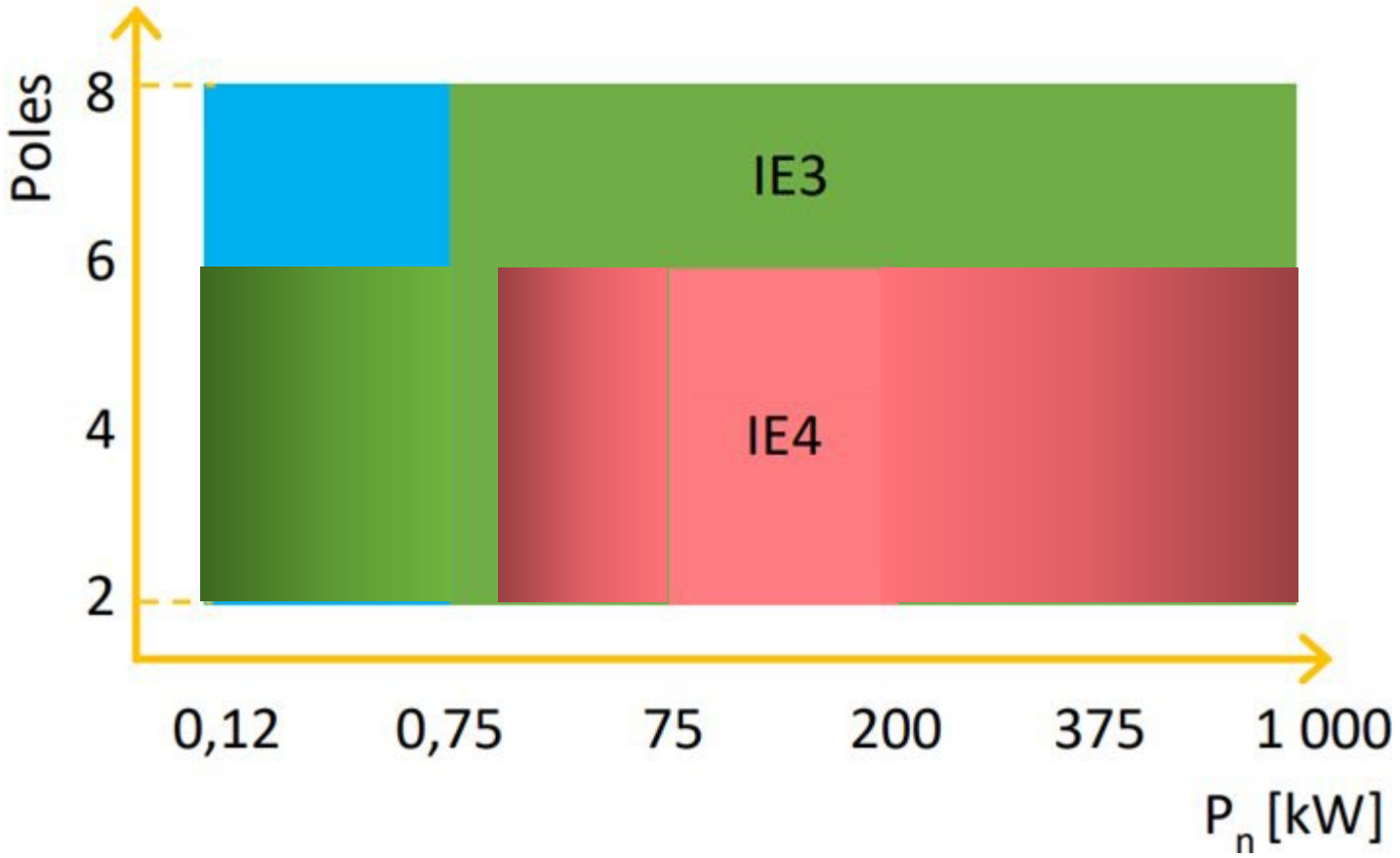
What are the reasons behind? Split incentives, alternative optimisation routes more economically efficient…

Has regulation a role to play here?

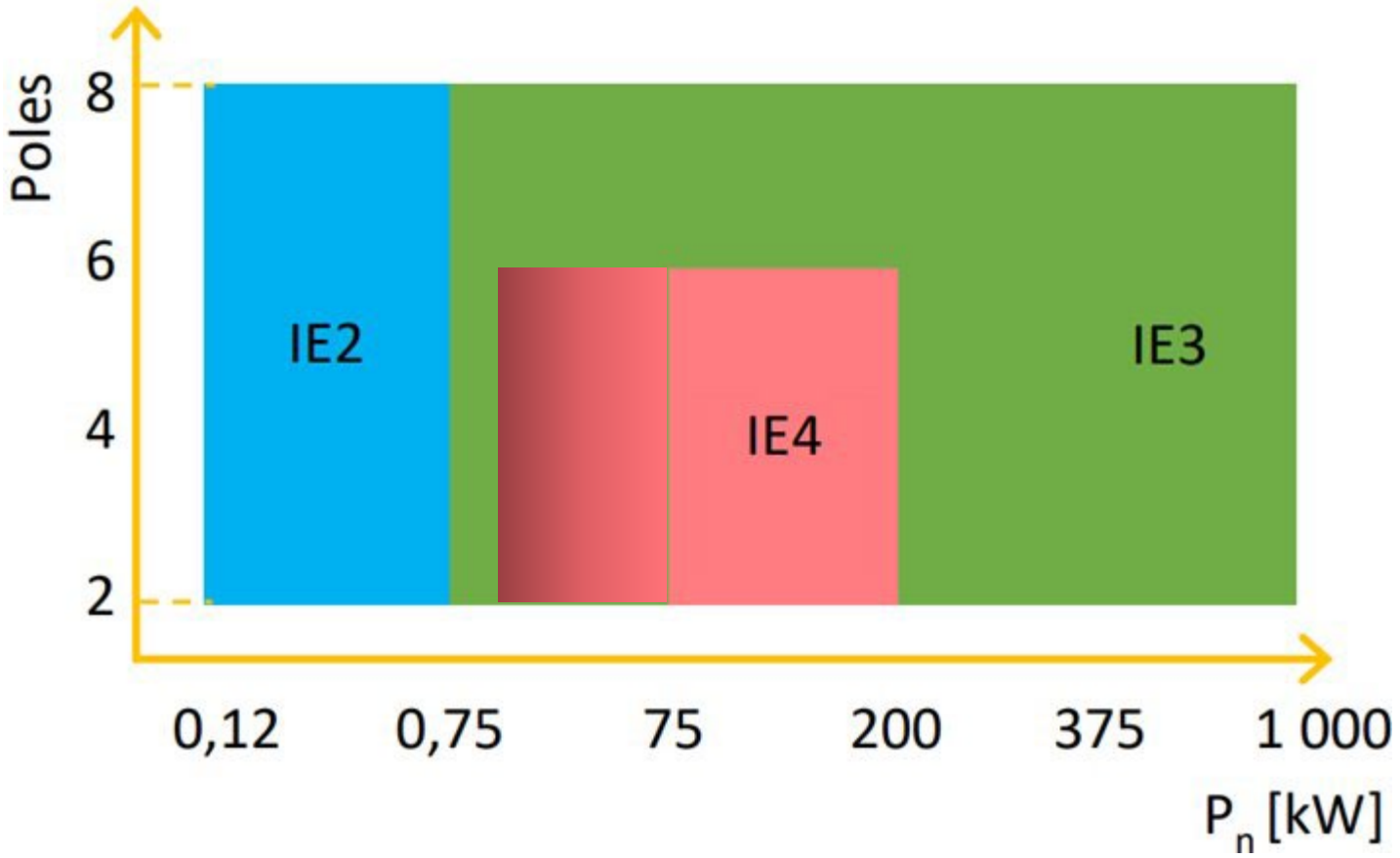
Current landscape

The EU was pioneer in the efficiency race, but nowadays other regions are catching up and even outpacing

Going further in efficiency levels? Techno-economic feasibility



Going further in efficiency levels? A concrete example for the introduction of IE4 in the 7.5 – 75 kW segment



Savings potential in the 7.5 – 75 kW segment if IE4 were introduced

Electricity consumption

Table 7.10. Electricity consumption, in TWh/yr for the four scenarios examined

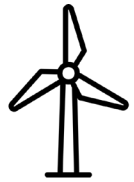
		ELECBAU (without effect of CR 640/2009)						ELECBAU2 (with effect of CR 640/2009 on SML3±v)			
	Lot	1990	2010	2015	2020	2025	2030	2015	2020	2025	2030
0.75-7.5	S3	109.4	138.6	146.8	150.7	149.9	146.1	141.0	126.1	111.0	108.6
7.5-75	M3	164.6	214.5	227.3	233.6	231.9	224.4	218.9	195.1	167.0	159.2
75-375	L3	334.2	427.8	445.1	453.8	445.2	420.7	429.8	395.1	346.8	299.0
0.75-7.5	S3v	7.4	16.8	20.7	24.9	29.3	34.1	21.6	34.4	46.8	50.5
7.5-75	M3v	13.3	32.2	40.1	48.9	58.2	68.2	44.3	70.3	94.8	104.3
75-375	L3v	38.0	94.2	117.6	144.9	174.4	206.5	126.2	179.2	231.6	276.8
	sum SML3±v	**666.9**	**924.2**	**997.6**	**1056.8**	**1089.1**	**1099.9**	**981.9**	**1000.1**	**998.0**	**998.3**
	share VSD	9%	16%	18%	21%	24%	28%	20%	28%	37%	43%
								for types below, ELECBAU2=ELECBAU			

264 TWh/year

4 poles	Average efficiency		
Power (kW)	IE3	IE4	**Delta**
7,5 - 75	93,1%	94,6%	**1,5%**

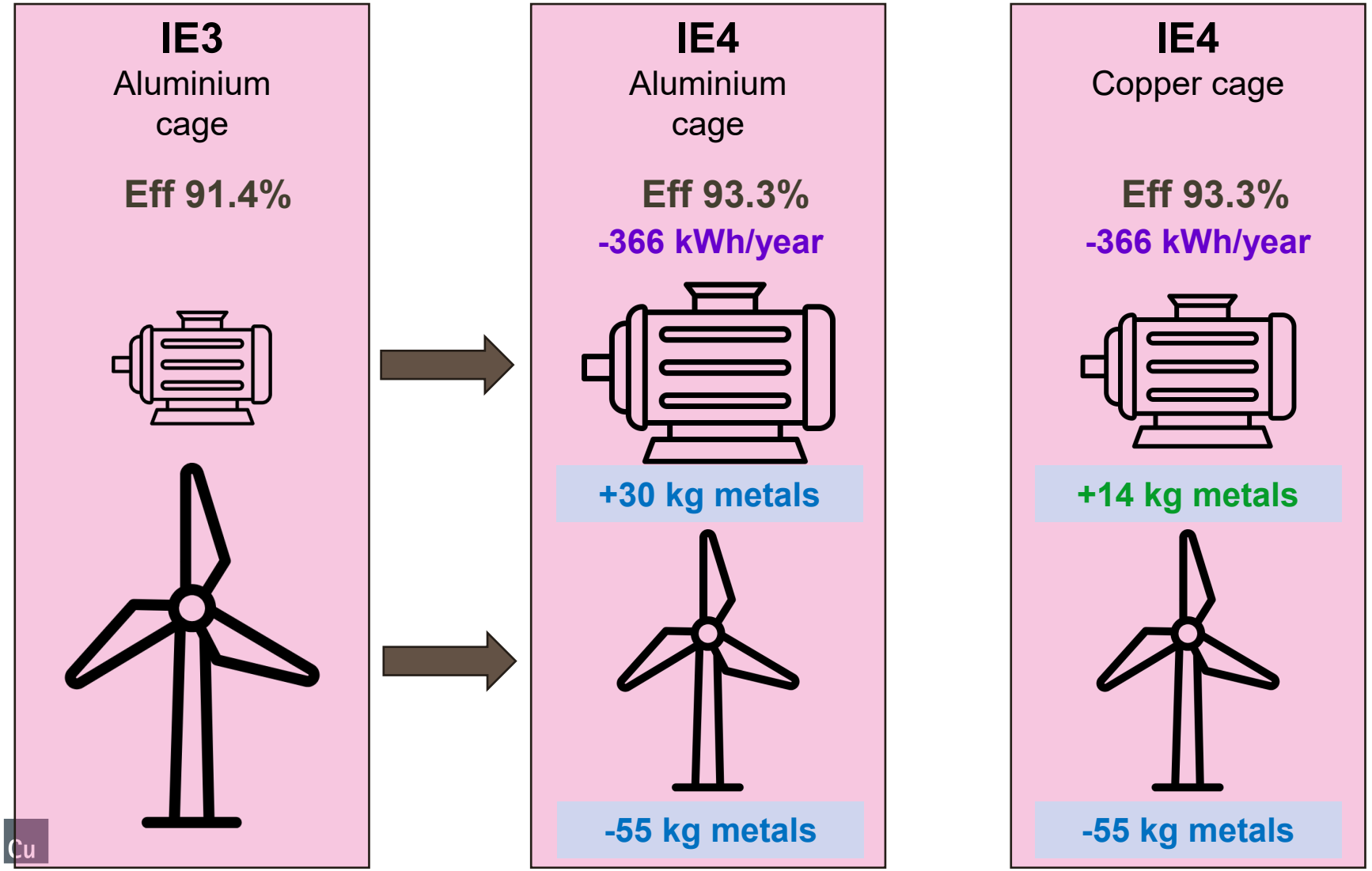
Annual savings 4 TWh/year

Several offshore wind parks



Source: SWD(2019) 343 final – Impact Assessment ecodesign requirements for electric motors and variable speed drives

Material efficiency: strong interrelation with **energy performance** at energy system level



Net saving: 25 kg

Net saving: 41 kg

Higher efficiency levels save not only ENERGY,

but also MATERIAL: 25 to 40 kg of metals saved at system level (motor + generation assets) in this example.

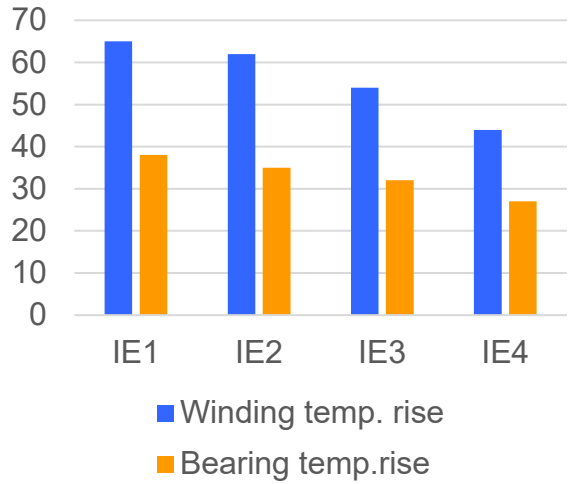
Example given for an **11 kW motor**
Use assumption: 1750 hours/year full load equivalent

Source: https://easychair.org/smart-slide/slide/JscJ#

IE4 comes with multiple benefits beyond energy savings

Drastic decrease of motor failures

- Bearings and windings are behind **2/3 of motor failures**

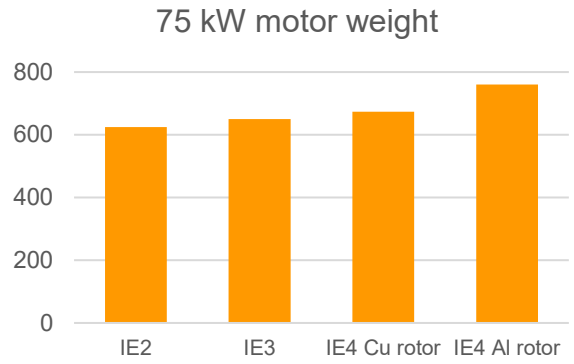


Increased motor performance

- Higher **overload** capability (20-30%)
- Higher maximum and starting **torque** values
- Higher resistance to **voltage dips**

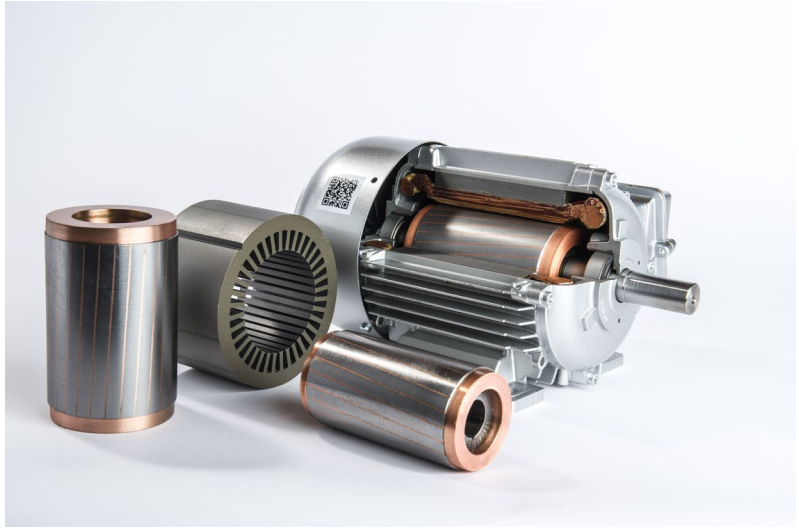
No bigger use of raw materials

- No need for extra-sizing saves materials
- Copper rotor saves significant amount of steel
- At system level, energy savings avoid generation facilities, which saves materials



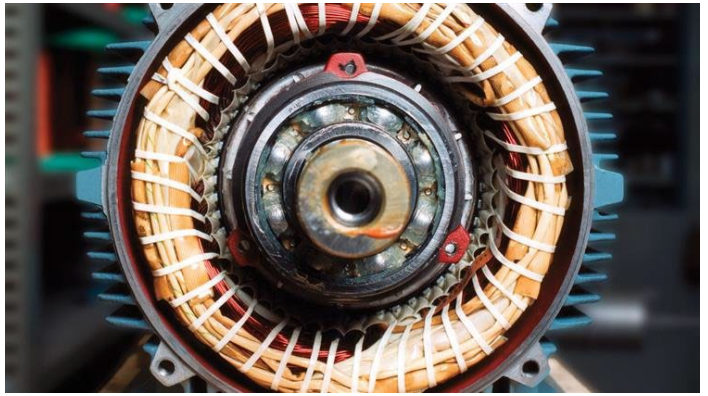
Technical feasibility

Copper rotors



Cooling optimisation

Winding optimisation



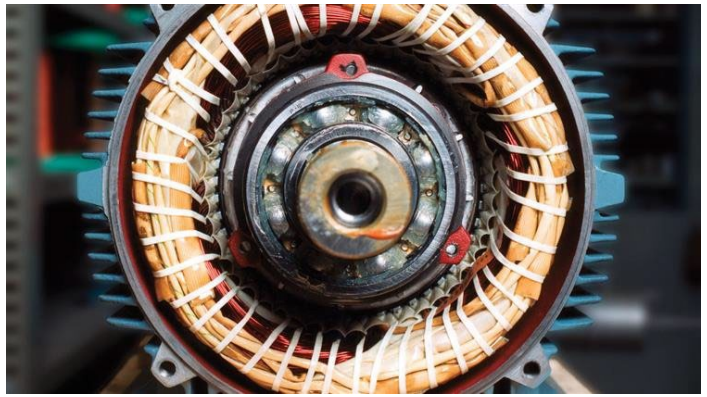
Refurbishment with efficiency upgrade: alternatives

Replacement of the rotor with a new copper rotor

On top of rotor replacement:

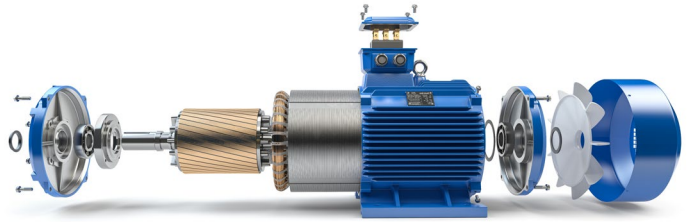
- Optimised air gap
- New cooling fan

Rewinding with efficiency upgrade



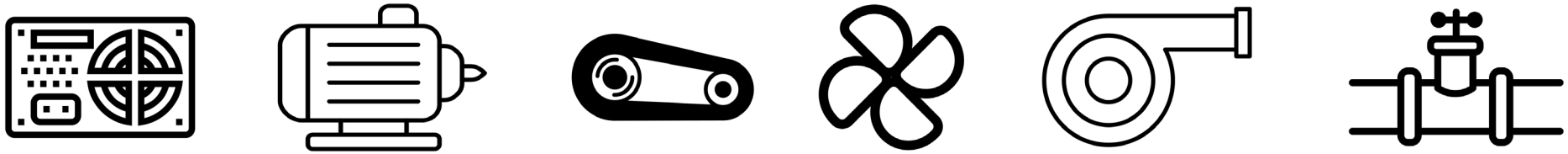
Optimising the number of turns

Combinations



Cost-benefit analysis and complementary options for efficiency

Motor system considerations



- ✓ Motor-driven systems have multiple components that can be optimised
- ✓ **Extra investment in components** other than the motor itself could be more effective

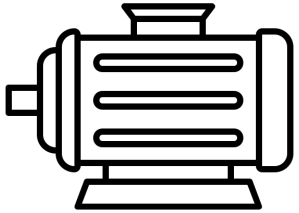
- ✓ **Regulation struggles to address systems**
- ✓ Current Ecodesign provides information on **partial load/speed points** to support system optimisation
- ✓ Energy Efficiency Directive offers supplementary levers to address savings opportunities (e.g. **energy saving certificates, energy audits…**)

Maintenance, life extension

Usual practice on repair or replace

< 30 – 40 kW

- Generally directly replaced



> 40 kW

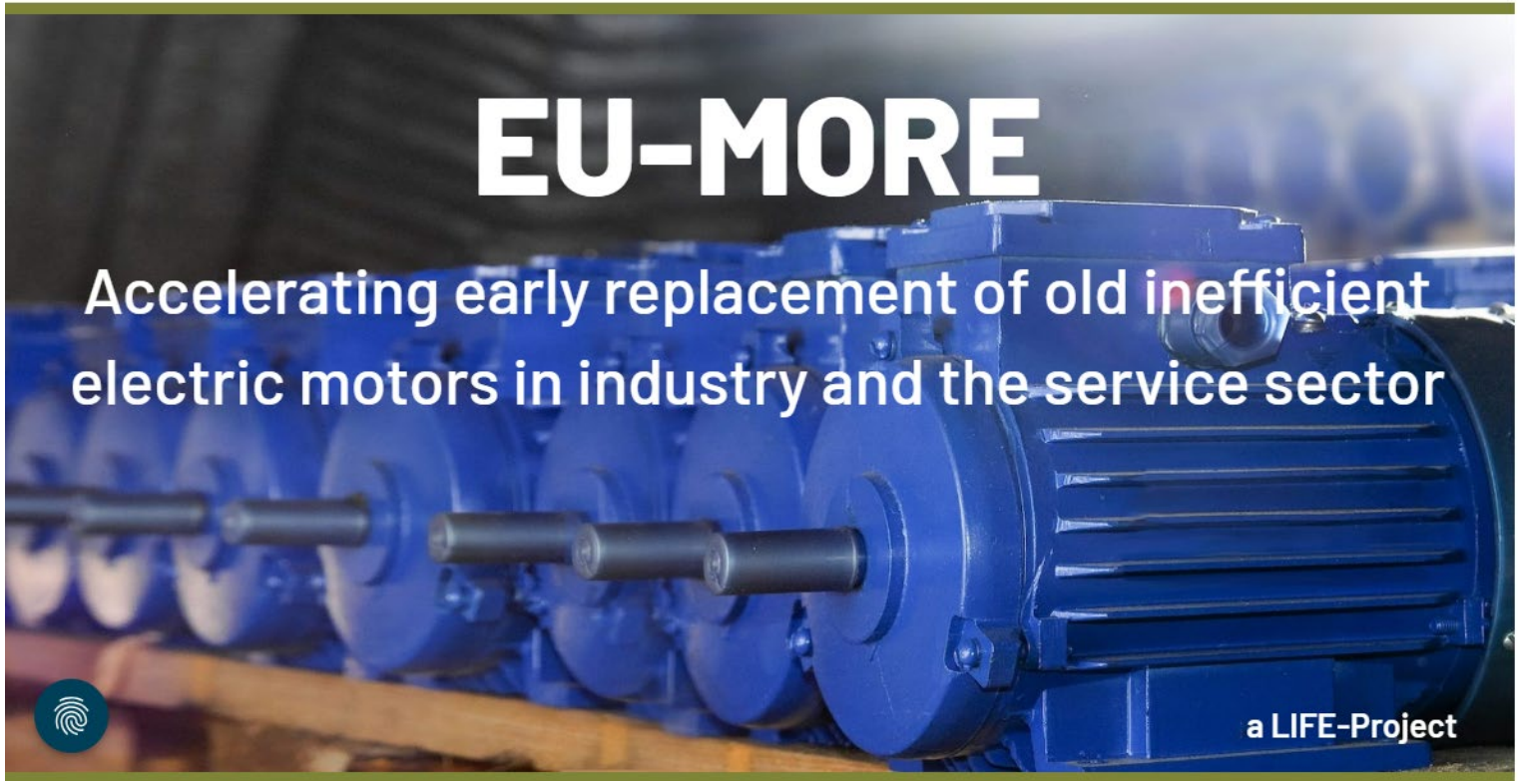
Repair cost > 65% of cost of new motor

- New motor considered
- Gain in efficiency factored-in

Repair cost < 65% of cost of new motor

- Generally repair

Replacement of old motors

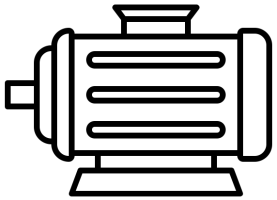


Source: www.eu-more.eu

When does replacement typically occur?

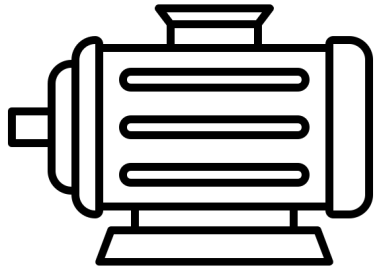
Small

- Less than 10 years for lower quality motors
- 10 – 20 years for higher quality motors



Mid and large

- 20-30 years



Larger, special

- 40 years and above
- Rewound twice in their life

Maintenance: multiple considerations

Higher energy efficiency = longer life

- ✓ The lifetime of a motor is directly related to **operating temperature** (windings, bearings…)
- ✓ The higher the efficiency, the lower the temperature, the longer the lifetime

Redundancy and spare units

- ✓ **Critical installations** (e.g. data centers) have high degree of redundancy and/or spare units
- ✓ But a large share of installations don’t have it.

Monitoring and predictive maintenance

- ✓ Monitoring is feasible notably through the variable speed drive
- ✓ Data is owned by the motor user, which can limit access to information
- ✓ Predictive maintenance is expensive and only justified under certain conditions

End of life

Management of motors at the end of life

Smaller
< 150 kg
(< 11 kW)

- No dismantling
- Usually exported as mixed scrap outside the EU

> 150 kg
(> 11 kW)

- Rotor and stator separation
- Recovery of copper windings, sold separately

All metals from motors can be recovered

Shredding and sorting for metal separation

Copper — >98% purity

Steel — Recovered, but no dedicated closed-loop for e-steel, yet
Electric arc furnace: limitation in the % of e-steel it can process

Aluminium — Housing made of aluminium sold to secondary aluminium facilities

Take-back service
Responsible end-of-life

Take-back services are key enablers of a circular economy in order to guarantee a responsible end of life of the products.

ABB Motion is piloting different **local take-back services in Sweden, Netherlands and the US**, together with well-established **recycling partners** that are able to optimize logistics and recycling, extracting the highest value possible from scrap materials.

Customers conferring old equipment will receive **monetary benefits** (e.g., a discount on a new high-efficiency product), as well as a **certificate of end-of-life** directly from our recycling partners. This model boosts **circularity** and **energy efficiency**, by giving **peace of mind** to our customers.

98%

high-value raw material recovery from motors[2]

30,000 tons

avoided CO_2 thanks to taking-back and recycling motors and drives and substituting them with high-efficiency products[2]

80 tons

of motor and drives taken back and recycled in the Netherlands[3]

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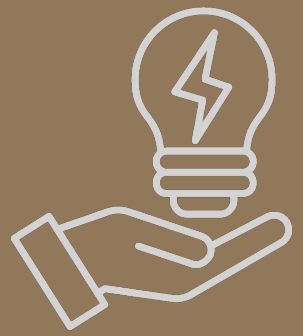
1. Motors in SE, motors and drives in NL | 2. Based on the Netherland best practice; as for drives, our partner can recover up to 90% of scrap materials | 3. May 2023

Manufacturing phase:

- ✓ Carbon and environmental footprint requirements under considerationfor the future regulation
- ✓ Not enough market pull at the moment

Regulation revision under the new ESPR framework

Use phase: energy performance



- ✓ Market pull to some extent
- ✓ Technology is ready
- ✓ Significant savings potential
- ✓ System level opportunities need to be addressed based on cost-benefit analysis

Maintenance, end-of-life:

- ✓ Repair – replace tradeoff
- ✓ High recyclability. Metals fully recovered
- ✓ Labour intensive, small units leaving EU
- ✓ Opportunity for take-back services and recycling specialisation

International Copper Association Europe

Thank you

fernando.nuno@internationalcopper.org