

The Circular Economy And The Electric Motor Repair Industry

The Association of Electrical & Mechanical Trades

Presented by

Thomas Marks

The Association of Electrical and Mechanical Trades
Secretariat



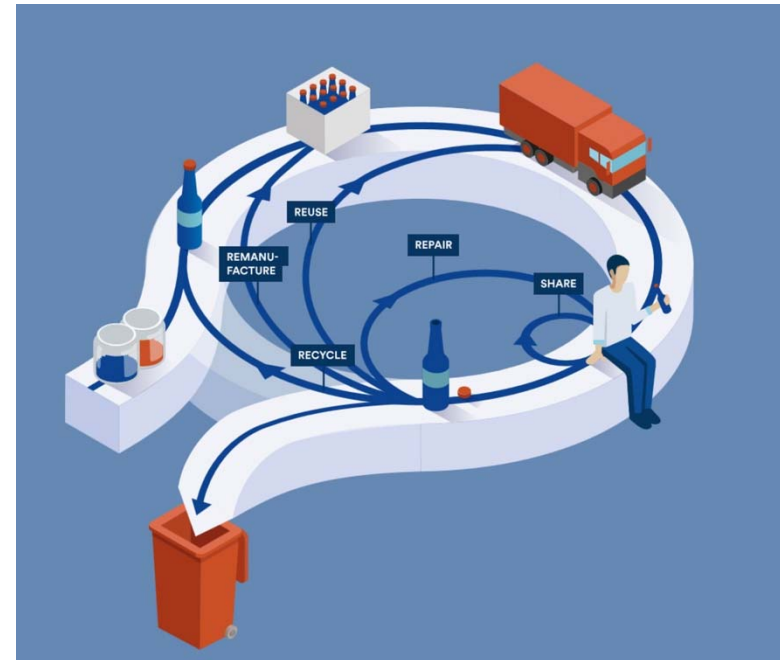
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What is the Circular Economy?

The Linear economy is one where goods are produced, used, and then disposed of.

In the Circular economy, products are in some way re-purposed to extend their useful life. They may go around this loop many times before being scrapped and recycled.

“Tighter” loops are better because they preserve more of the original content and value of the goods.



The hierarchy of options for products that have failed:

Repair / remanufacture to extend life

1. Repair/remanufacture of plant and domestic appliances.

Re-use parts to remanufacture and exchange.

1. Bosch & Lucas have led the vehicle electrical industry by exchanging faulty starters, alternators and now drive motors to remanufacture them. Exchange items are common across the vehicle industry.

Re-use in less critical application

1. 2nd life EV batteries with reduced capacity in non-weight critical applications.

Recycling of materials - Least good option*

1. Scrap metal saving the cost of mining, extraction & transport.
2. Wood & paper saving trees,
3. Plastics saving the oceans,
4. Electronics extracting valuable materials.

*But still better than waste to energy or landfill.

What are the benefits to the national economy of the circular economy?

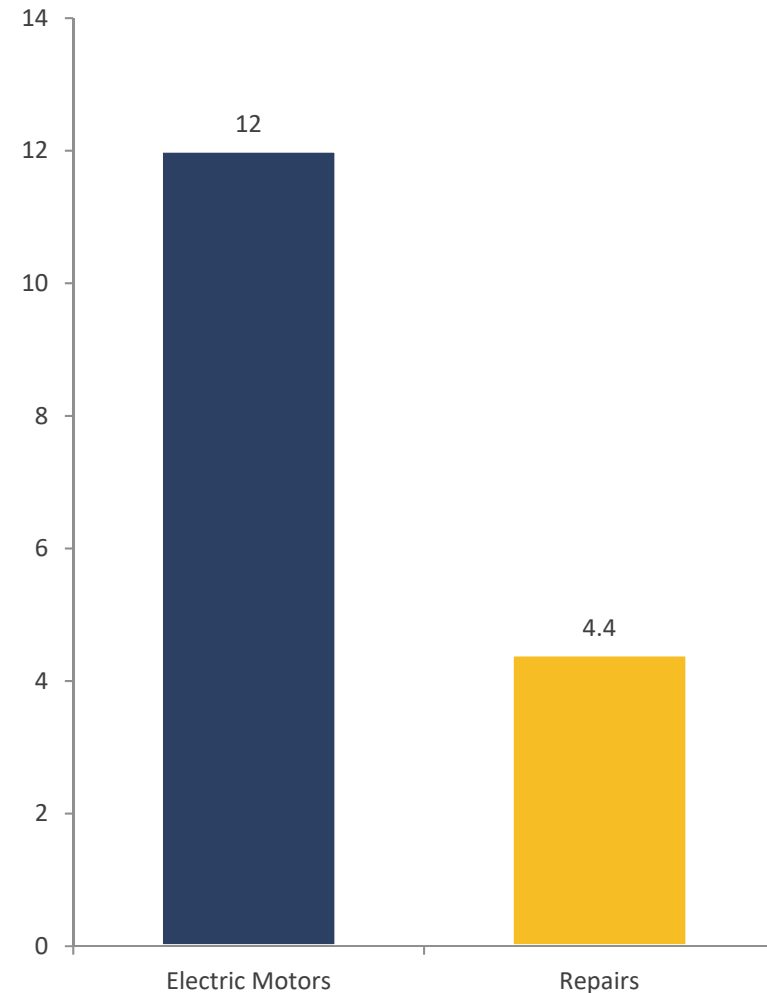
- + Extends the life of the world's limited resources.
- + Less exposure to fluctuating material prices or material scarcity.
- + Less transport costs and lower price of ownership.
- + More skilled and local jobs
- + Improved balance of payments:
 - Less imports of new products.
 - Lower cost of high grade recycled materials.
 - Increased exports of remanufactured parts.

EU Motor repair industry

€12 billion – Value of electric motor market in EU member states

€4.4 billion – Value of electric motor repair market in EU member states

*Prodcom Eurostat data 2016



Motor Material Content

+ **110kW IE2 motor: weight 900kg**

- Steel: Stator Laminations: (396kg) 44.0%
- Cast iron: Frame & Stator body (329kg) 36.6%
- Steel: Bearings & Shaft (76.5kg) 8.5%
- Copper: Stator Windings: (68.4kg) 7.6%
- Aluminium: Rotor: (21.6kg) 2.4%
- Insulation, Varnish, Paint: (8.1kg) 0.9%

Motor repair: Bearing replacement

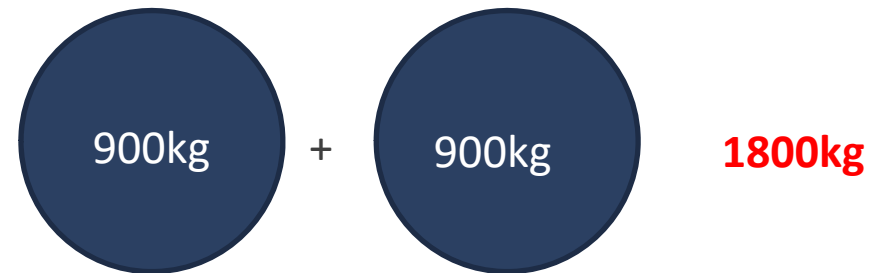
- + Bearings = 51% failures: Often replaced by maintenance engineers, they are the only wearing part.
- + Good maintenance leads to around 20,000 hour life.
- + Planned bearing changes double/treble the life of the motor.
- + Old bearings: weight for weight returned as the “greenest” high grade steel scrap to reprocess. Saving the worlds resources.

How motor repair reduces material use – bearing replacement

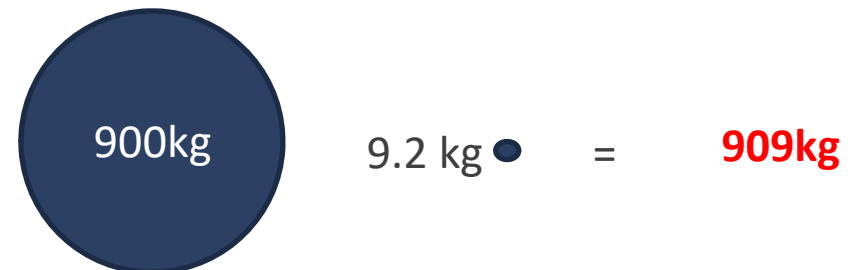
- + A 110kW motor typically comprises 900kg of metal.
- + Doubling the motor life halves the *per annum* energy and environmental costs to produce and distribute the motor, and the financial cost of buying it.
- + By using new bearings of 9kg, a net 891kg of material and related energy and environmental costs is saved over 25years.
- + Often repaired by user.

Material use over 25 year life of a motor , based on needing new bearings at 12.5yrs.

Lifetime material – Replacing with new motor



Lifetime material – Repair before failure



Stator winding replacement

- + Stator rewinds = 16% of failures, all sent to a repair facility.
- + Copper wire and insulation required to carry out repair, generally no stock of special motor parts required.
- + Rewinding stators: A cost effective way of doubling or tripling motor life.
- + The motor may be special, the materials required to rewind are not.
- + The weight of rewind copper used = weight returned for scrap.
- + Returned to the refinery as high grade “green “ scrap.
- + This saves the worlds resources, and is refined into more high quality copper.
- + With just over 60 years of known copper reserves to be mined:
- + ***This is the circular economy in action.***



Re-used during repair/remanufacture

- + 110kW: Energy efficient motor Reused:
- +
 - Bearing replaced (51% of failures) reused: 99.0%
 - Weight for weight “Green steel Scrap”: 1.0%

 - Bearings & Rewind (16% of failures): 90.5%
 - “Green Scrap” Copper Wire & Steel: 8.6%
 - Burnt off during repair, not recycled: 0.9%
(Varnish, insulation, paint, grease)

How does the motor repair industry perform?

The Ellen MacArthur foundation suggests a series of **indicators** of a well-functioning circular economy sector.

The motor/pump/compressor & fan repair sectors scores highly against most of these.

Circular product design and innovation

- + Product design promotes:
- + standardization and modularization,
- + Enabling easy disassembly,
- + Resources retained within 'tight' reverse circles.

Innovative business models

- + Creating value-added business around better-designed, long-lasting products. Business opportunities based on performance, shared ownership, hire and leasing, and pay-for-use models.
- + These can compete successfully against low cost, ownership-based linear models-*Purchase-Use-Discard*.
- + They also enable much closer interaction with customers ('users') and increased personalization and customization.

Effective supply chain and cross-sectoral collaboration

Circular economy requirements to drive collaborative solutions.

Policy alignment, industry standards, education, infrastructure, incentives, and access to finance, are all vital elements.

- Suppliers of new motors work hand in hand with motor service centers –
- Service Centres often sell more motors than they repair.
- A symbiotic relationship with shared long term incentive to do what is best for the customer.
- Rapid turnaround times to reduce financial and environmental costs of motor failures.
- A highly developed infrastructure that provides local 24hour service.

**The AEMT has established [best repair practices](#) in the industry;
giving the user high quality repairs.**



Circular Economy Standardisation Activity

Standardisation activity from European Commission mandate M543

Item	Title of deliverable	Planned Publication Date	Lead (CEN or CENELEC)
1	Guide on how to use generic material efficiency standards when writing energy related product specific standardisation deliverables.	2019-03	CENELEC
2	Definitions related to material efficiency.	2019-06	CENELEC
3	General method for the assessment of the durability of energy related products.	2019-03	CEN
4	General method for the assessment of the ability to repair reuse and upgrade energy related products.	2019-03	CEN
5	General method for the assessment of the ability to re-manufacture energy related products.	2019-03	CENELEC
6	General methods for assessing the recyclability and recoverability of energy related products.	2019-03	CEN
7	General method for assessing the proportion of re-used components in an energy related product.	2019-03	CEN
8	General method for assessing the proportion of recycled material content in energy related products.	2019-03	CEN
9	General method to declare the use of critical raw materials in energy related products.	2019-03	CENELEC
10	Methods for providing information relating to material efficiency aspects of energy related products.	2019-03	CENELEC
20	Overall coverage for a specific product group (ICT network infrastructure goods).	2016-11	ETSI
21	Overall coverage for a specific product group (ICT network infrastructure goods). Including aspects such as product durability, upgradability, reparability, reusability, recyclability, and re-manufacture, as well as re-use, recycling, recovery of materials and relevant metrics, indexes or criteria.	2018-12	ETSI

New Industry Standard:

- A new international standard chaired by the AEMT for Publication Autumn 2018.
- The first standard to incorporate the circular economy requirements.
- Ensures that repaired machines meet their original rated standards, and satisfying the requirements of the circular economy.

IEC 60034- Part 23 : 2018

***Rotating Electrical Machines: Repair, Overhaul
and Reclamation.***

Summary: The Circular economy and the electric motor repair industry

- + The Circular economy reduces material consumption by finding ways to extend the use of products / materials before they are finally discarded.
- + Electric Motor Repair: a good example of how the repair industry can greatly extend product and materials useful life.
- + The EU has mandated CEN / Cenelec to produce a suite of standards to support the adoption of the circular economy.

