

Sustainable ECU remanufacturing

Retaining value in automotive electronics

November 24, 2025

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AUMOVIO Engineering Solutions

Sustainability at AUMOVIO Engineering Solutions

Aurélien Groussard

Building the future of sustainable automotive electronics



Circular Economy and Remanufacturing Responsible

@ AUMOVIO Engineering Solutions



🎓 Background: Engineer with over 20 years of experience in automotive electronic systems (ECUs).

🔧 Expertise: Repair of automotive ECUs, System engineering, Cybersecurity, Safety

🚗 Industry Focus: Automotive electronics

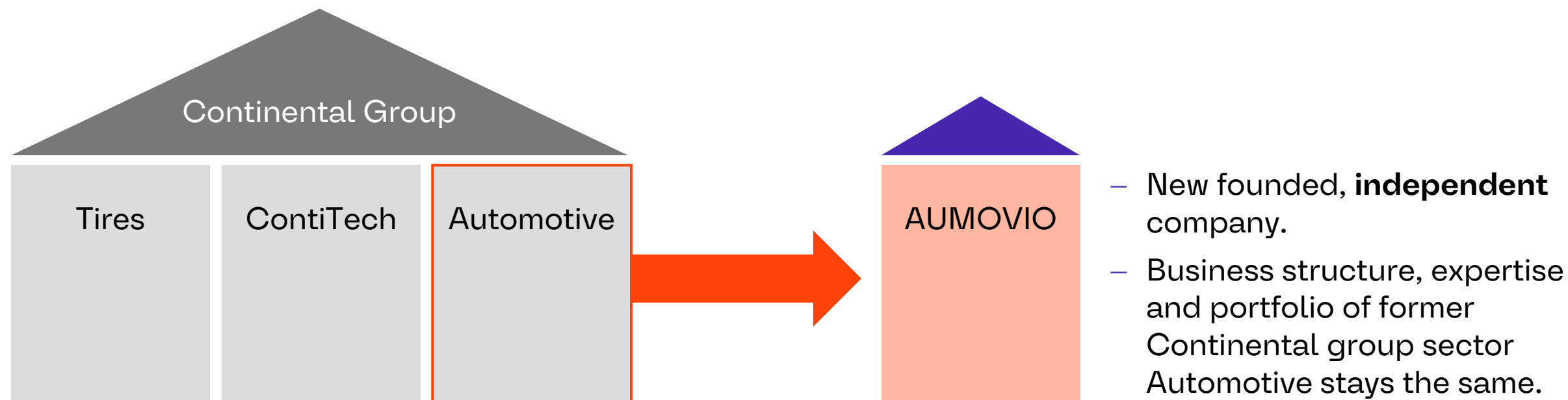
🌍 Location: Toulouse, France.

- 💡 Key Strengths:
- Deep technical knowledge of ECU architectures.
 - Proven experience in industrial process optimization.
 - Commitment to sustainable and profitable remanufacturing.

 [Aurélien Groussard | LinkedIn](#)

Sustainability at AUMOVIO Engineering Solutions

Result of Continental group sector Automotive spin-off



The Supervisory Board and the Continental annual shareholder community approved the Automotive spin-off.

Comprehensive portfolio

Overview

Autonomous Mobility (AM)



Radar

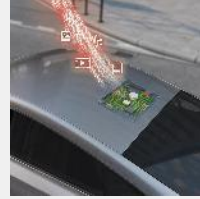


Systems and services



CSV⁴

Architecture and Network Solutions (ANS)



Telematics



Vehicle compute (BCM¹, HPC²)



Edge ECUs³

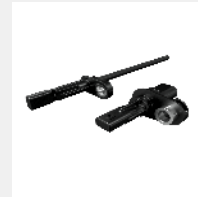
Safety and Motion (SAM)



Brake systems



Integrated safety systems



Sensor systems

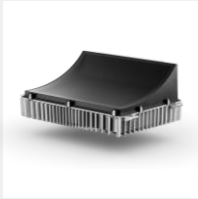


Electronic air suspension

User Experience (UX)



Display solutions



Head-up display

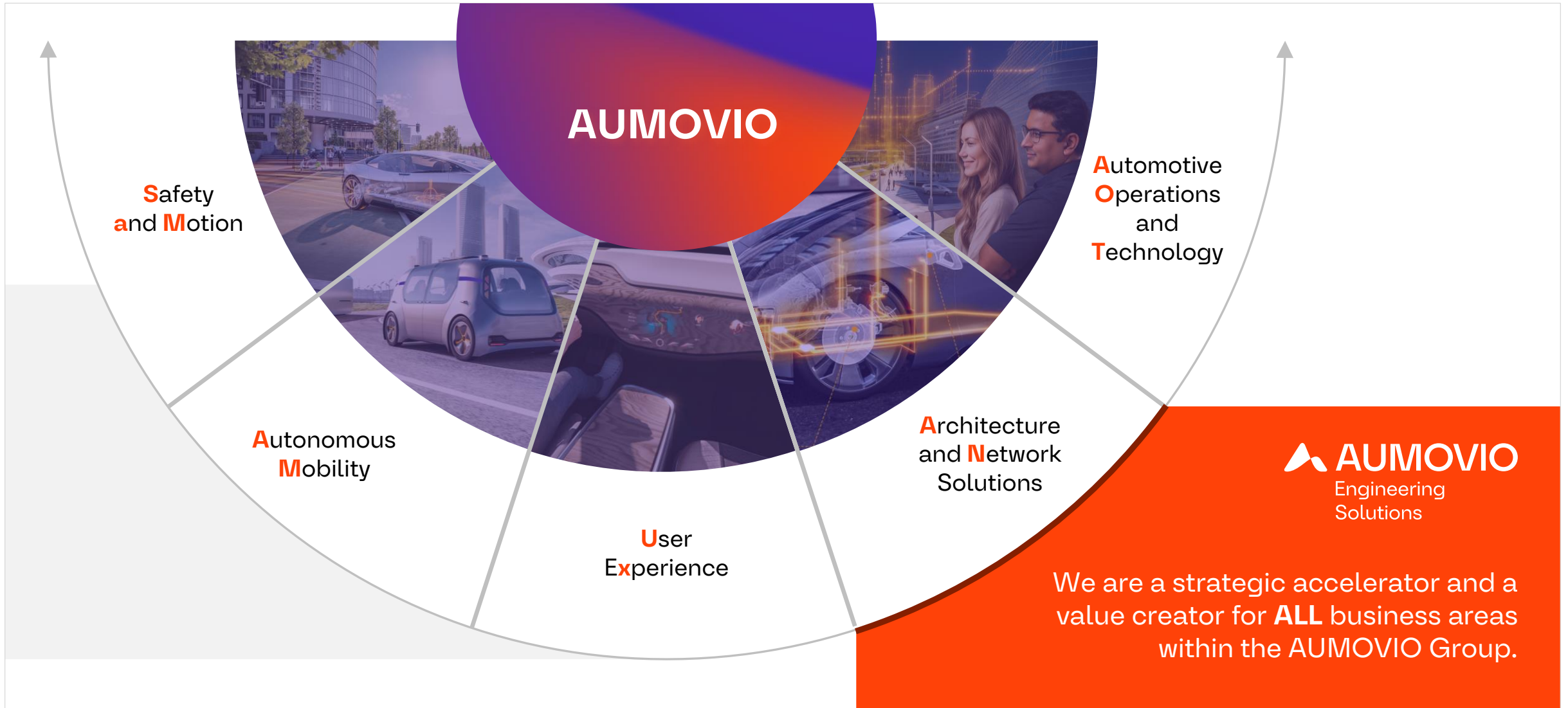


Digital cluster

Expertise in hardware, software and services.
State of the art for today – Innovative for tomorrow.

1. Body control module | 2. High performance computer | 3. Electronic control units | 4. Commercial and special vehicles.

AUMOVIO Engineering Solutions within AUMOVIO



Sustainability at AUMOVIO Engineering Solutions

Developing sustainable solutions

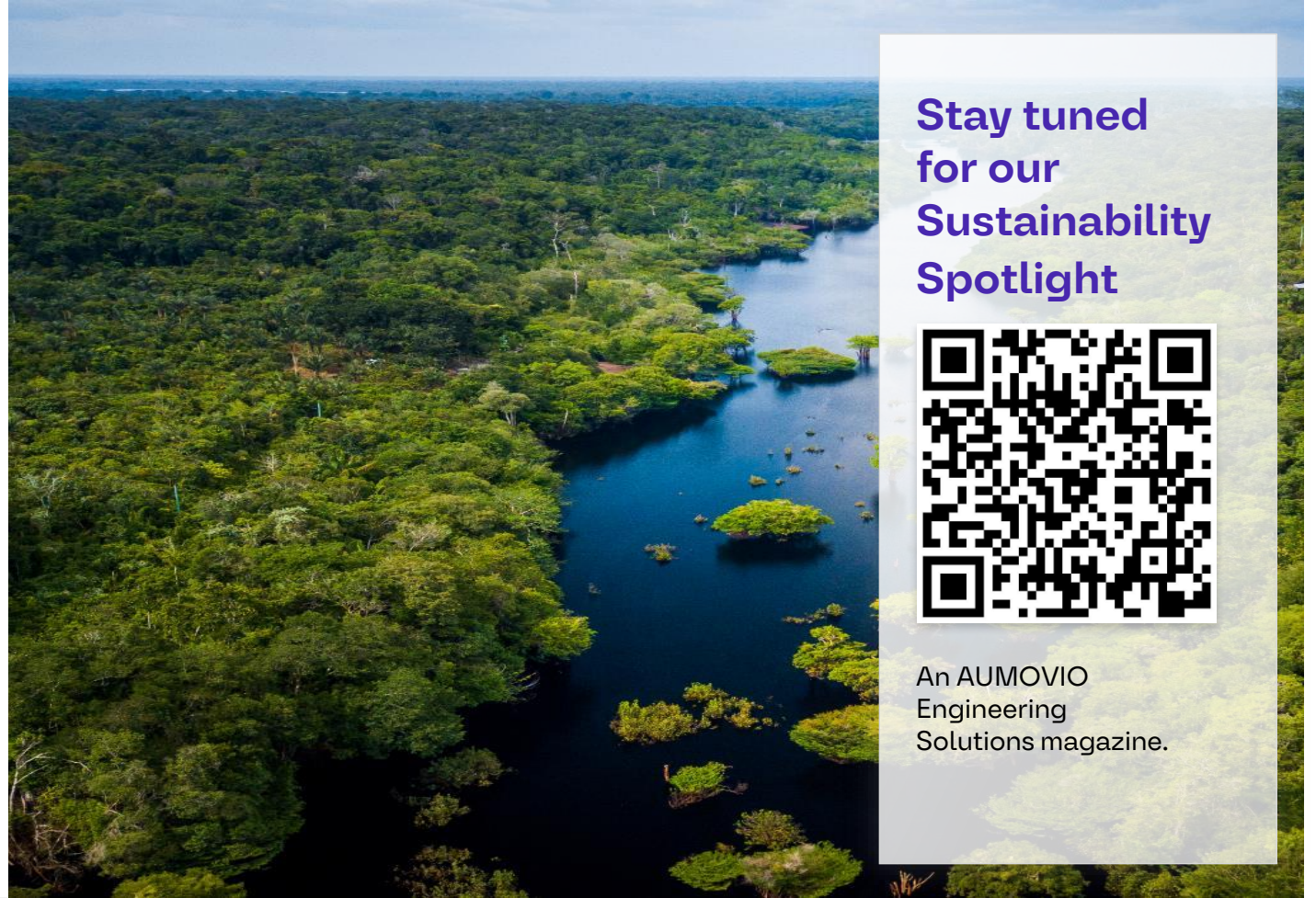
- Intelligent glass control
- 3D printing
- Ac2ated Sound
- Remanufacturing

Custom engineering for sustainability

- AI-based plant detection
- Lifecycle assessment
- AI4energy
- Tree seeding robot

Embracing a sustainability mindset

- Green plant label/green office label
- Corporate citizenship initiatives worldwide



**Stay tuned
for our
Sustainability
Spotlight**



An AUMOVIO
Engineering
Solutions magazine.

Agenda

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Remanufacturing, or how to retain value	17
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Remanufacturing challenges and solutions	30
A first step towards a sustainable industry?	42

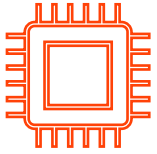
Sustainability at AUMOVIO Engineering Solutions

Why do we need sustainability in electronic automotive industry?

Automotive industry is highly dependant on critical materials



Permanent magnet extraction and refining dominated by China
Néodyme (Nd) / Dysprosium (Dy) / Terbium (Tb)



Silicium (Si) foundries mainly based in Taiwan with high geo-political risk
Gallium (Ga) / Germanium (Ge) / Indium (In) refined in China
Tantale (Ta) extraction in RDC and Rwanda

Critical Raw Materials Act



Setting clear priorities for action:

10% of the EU's annual needs for extraction; 40% for processing and 25% for recycling



Promoting a more sustainable and circular critical raw materials economy

Sustainability at AUMOVIO Engineering Solutions

Why do we need sustainability in electronic automotive industry?

Answer to crisis and VUCA world

Rare earth elements
in China



Permanent
magnet



Brake system



EOL product

Extraction of Permanent magnet from brake system
to supply production line.



Volatility

A key aspect of your work is subject to major, unpredictable peaks and troughs.



Uncertainty

The future is unknown, but external events are likely to be impactful.



Complexity

Many interconnected factors influence one another, in ways that are challenging to model confidently.



Ambiguity

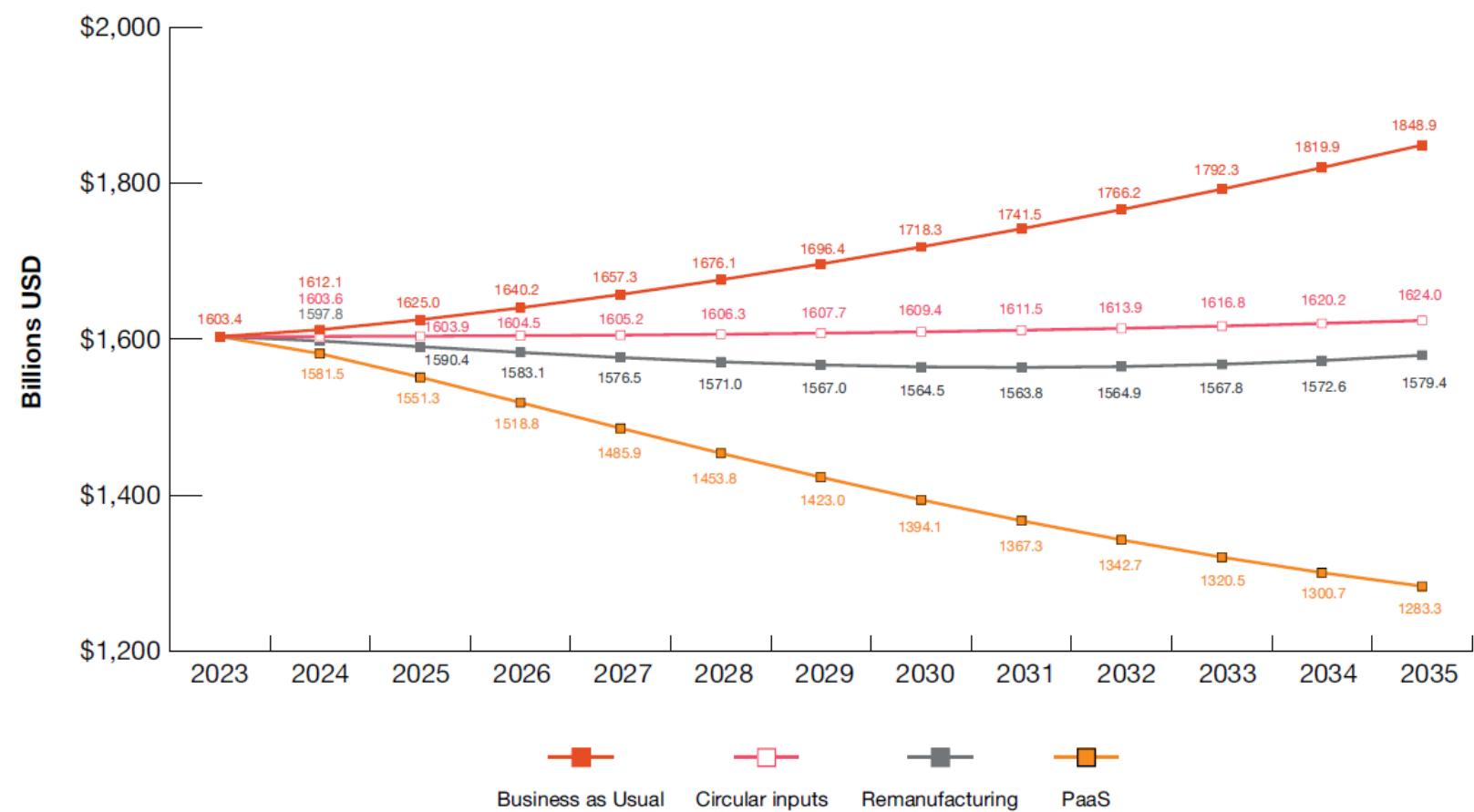
Conflicting, noisy or insufficient data makes it difficult to assess what's really going on.

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Why do we need sustainability in electronic automotive industry?

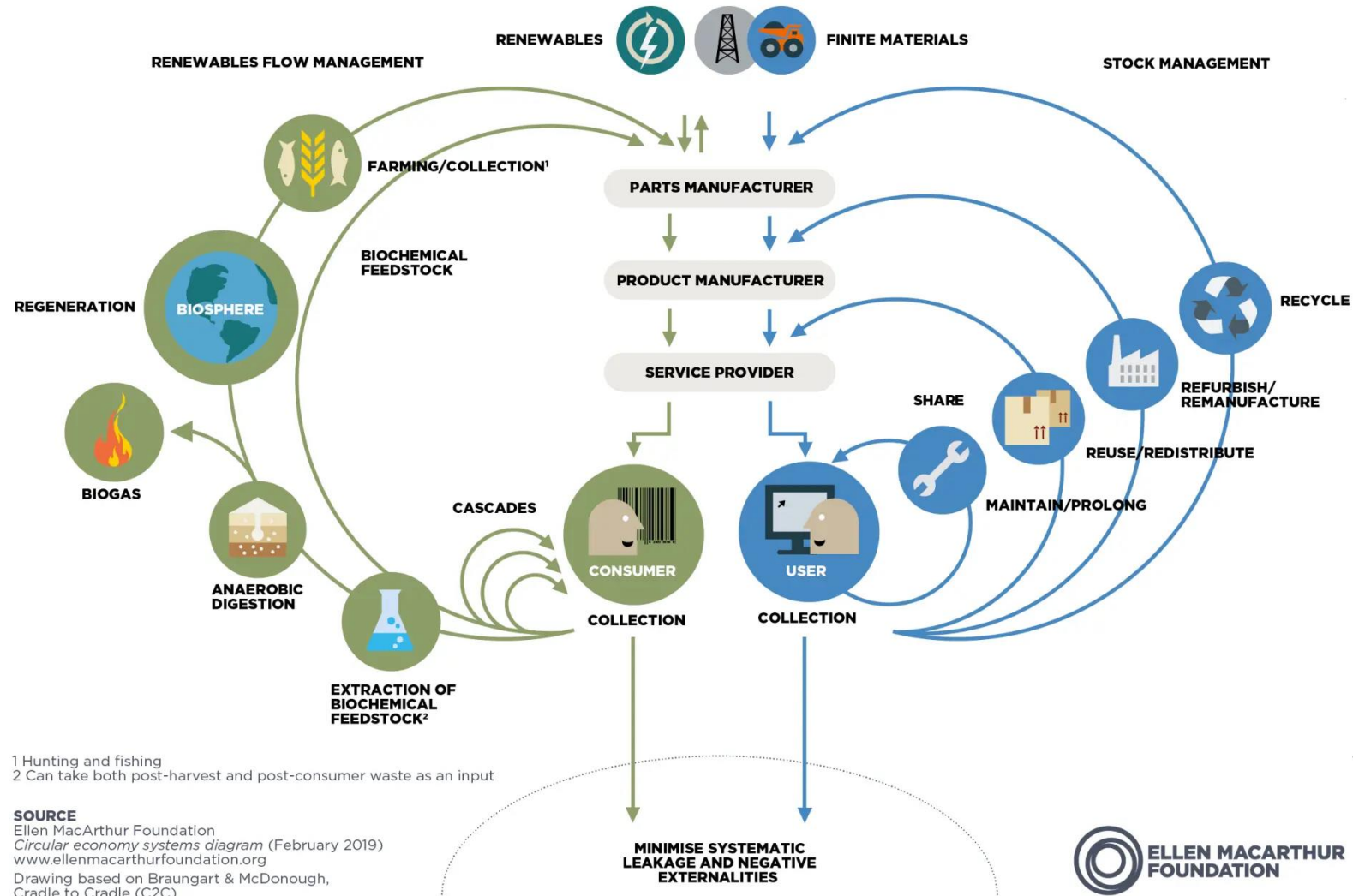
Automotive industry cost will rise dramatically

Figure 1: Cost over time for the electronics sector



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Circular economy



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Remanufacture, repair, or recycle?

Remanufacturing

Restore products to **same-as-new** condition using a standardized industrial process



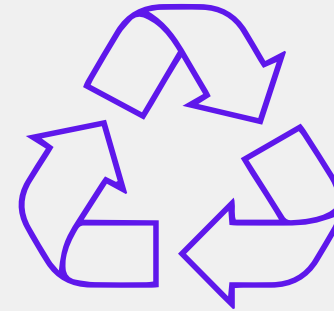
Repair

Return a **faulty** product to a condition where it can **fulfil** its intended use



Recycle

Converts waste materials into new products or **raw materials** that can be used again.



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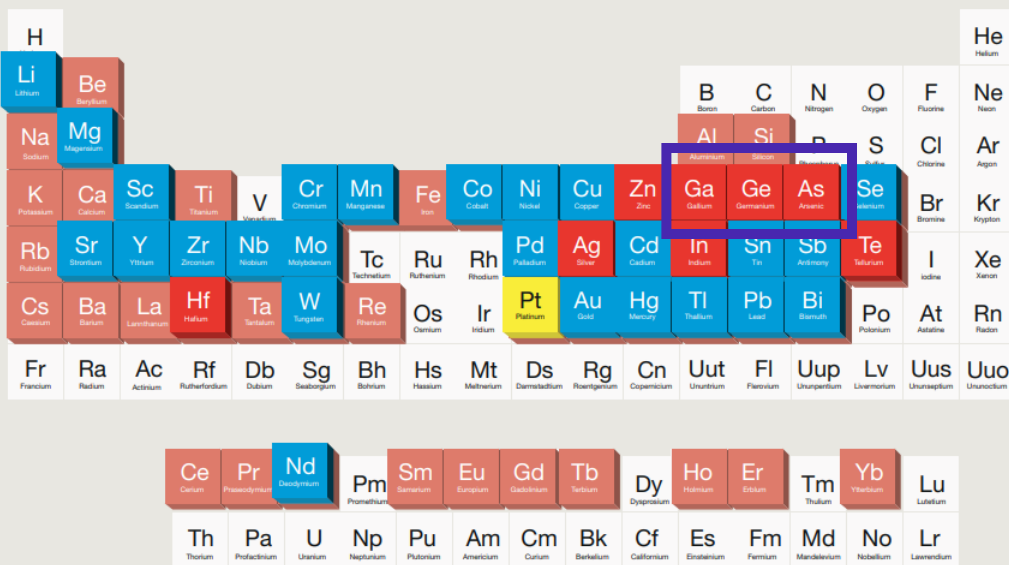
Recycling, only a partial solution

A PERIODIC AND ELEMENTAL PROBLEM

He Periodic table element Elements found in e-waste

Scarcity

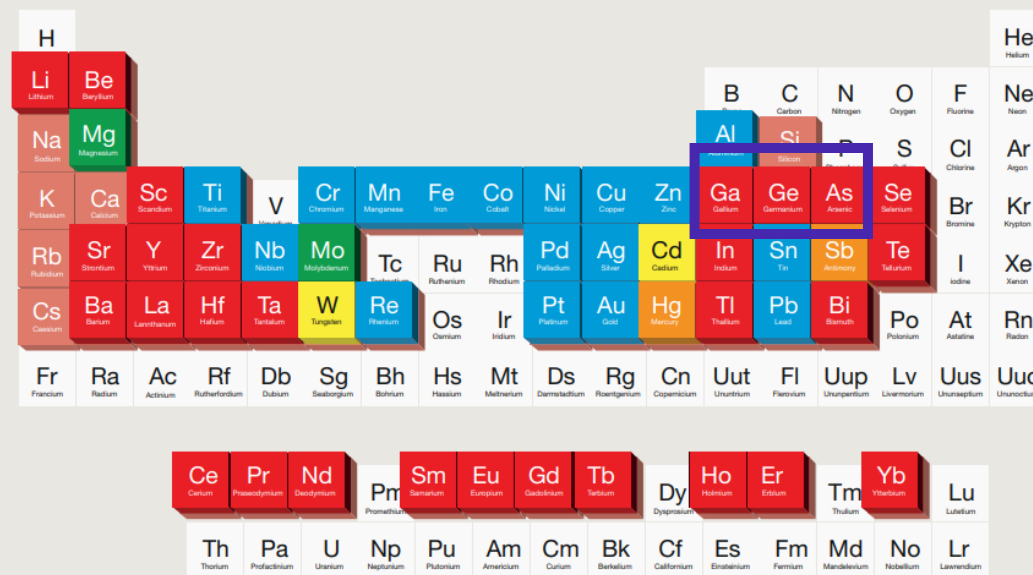
Limited availability, future risk to supply	Rising threat from increased use	Serious threat in next 100yrs
--	-------------------------------------	----------------------------------



Demand >> Extraction capacity

Recycling rates

■ <1%
 ■ 1-10%
 ■ >10-25%
 ■ >25-50%
 ■ >50%



Technical and profitability difficulties

A New Circular Vision for Electronics, Time for a Global Reboot 2019 : [World Economic Forum](#)

Remanufacturing, or how to retain value

Recycling, only a partial solution

Top submerged lance (TSL) smelting

Input:

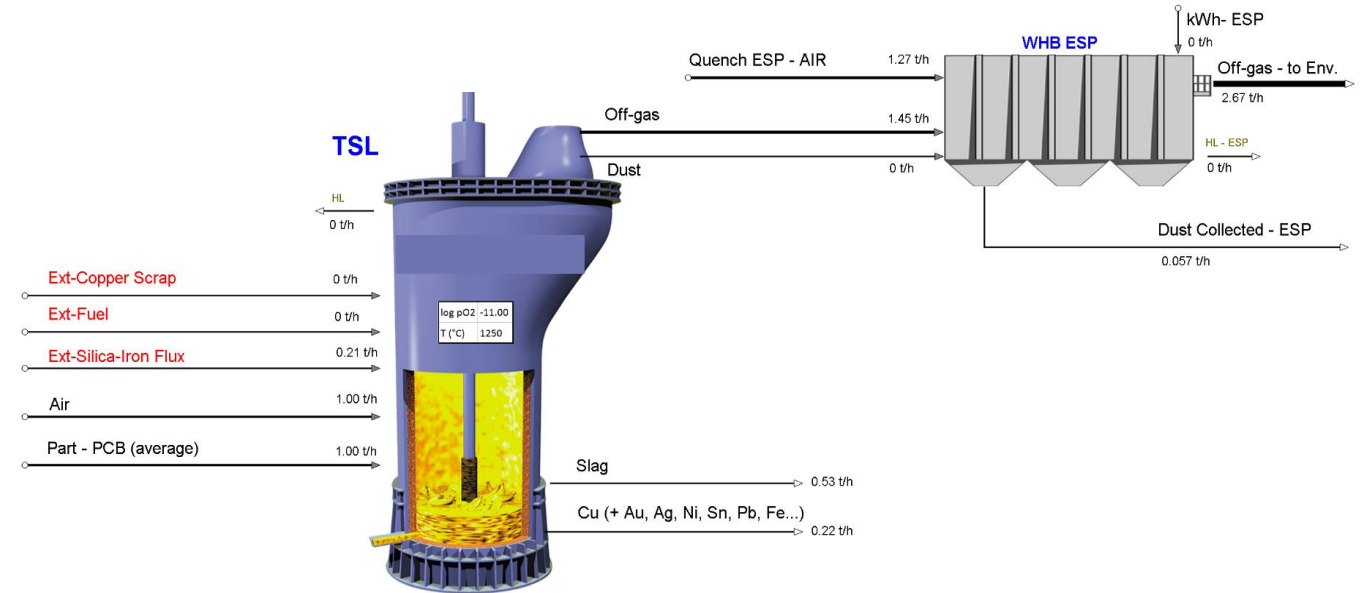
- PCB: 1 t/h
- Energy: 4500 kW

Output:

- Copper + (Au, Ag, Ni etc.): 0,22t/h
- Heat recovery : 800 kW

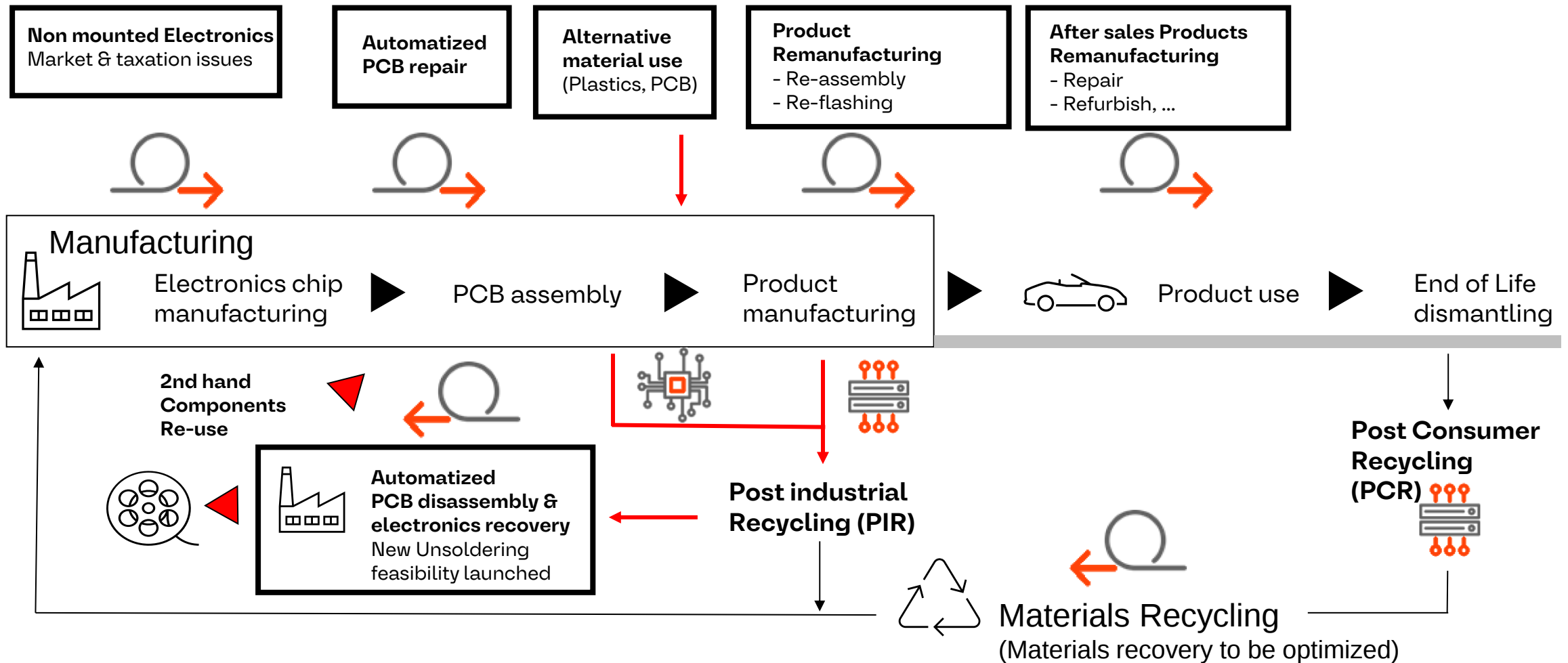
Issues:

High costs in terms energy
Need disassembled PCB



Sustainability at AUMOVIO

Main Overview – Circular economy

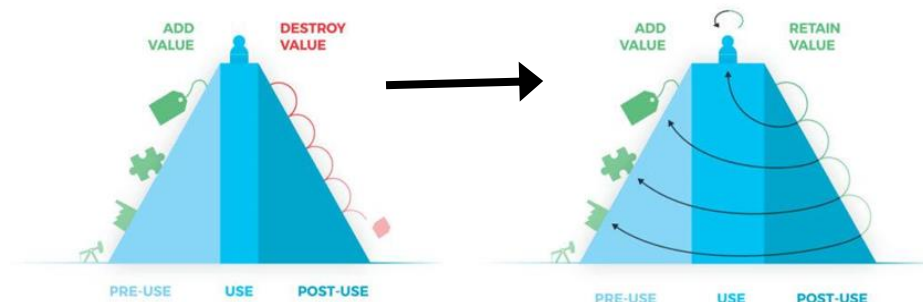


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Sustainability at AUMOVIO Engineering Solutions

From destroying to retaining value

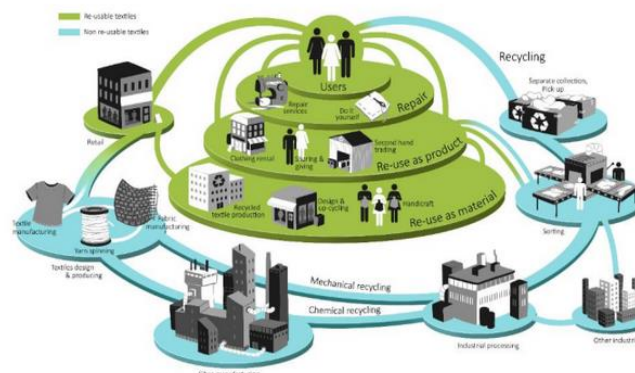
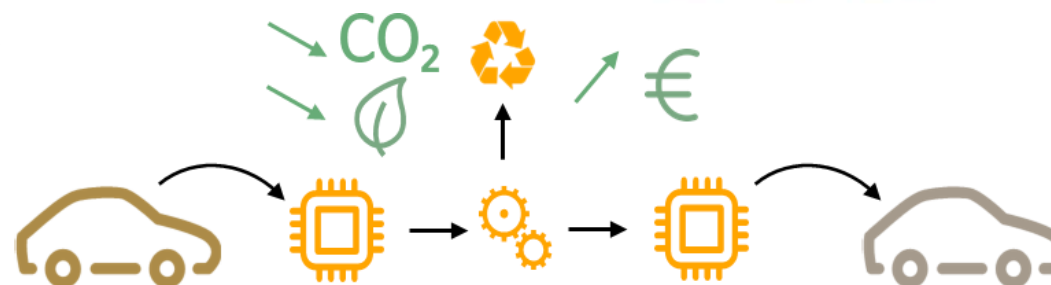


Post-Use

Retaining value in
post-use phase

From car to car

Collecting parts
from car

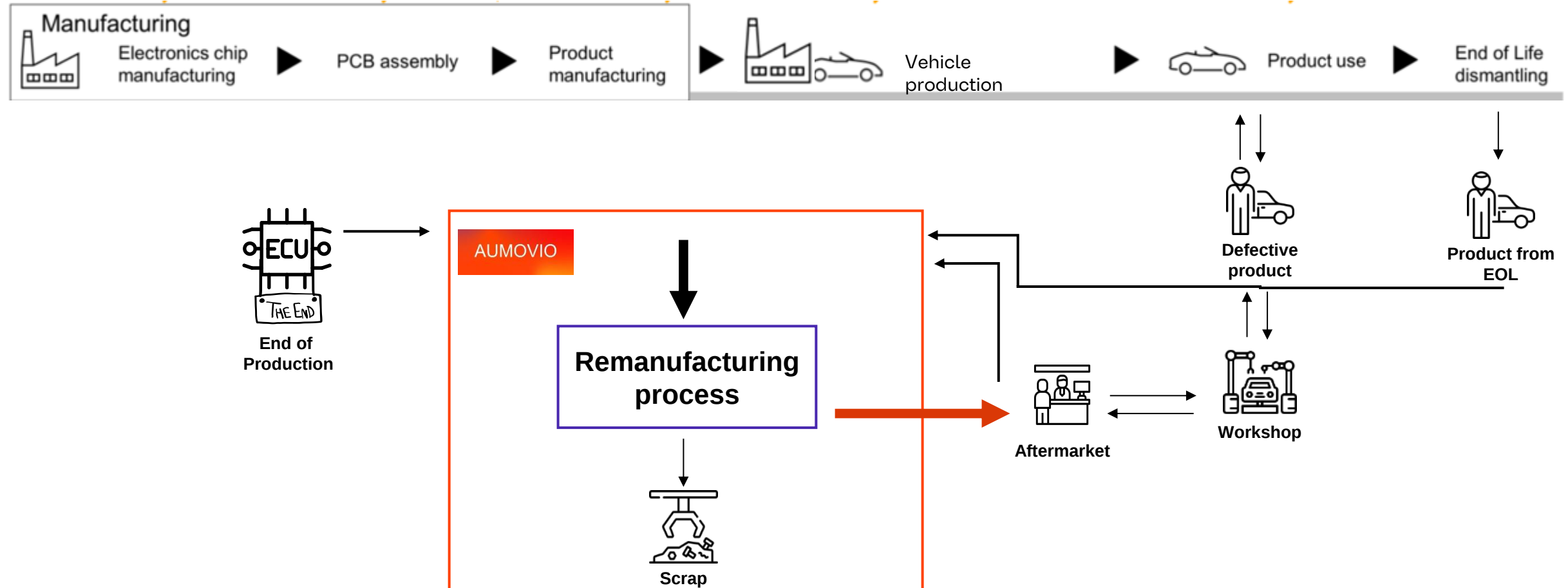


Eco-system

Foster collaboration to
develop business

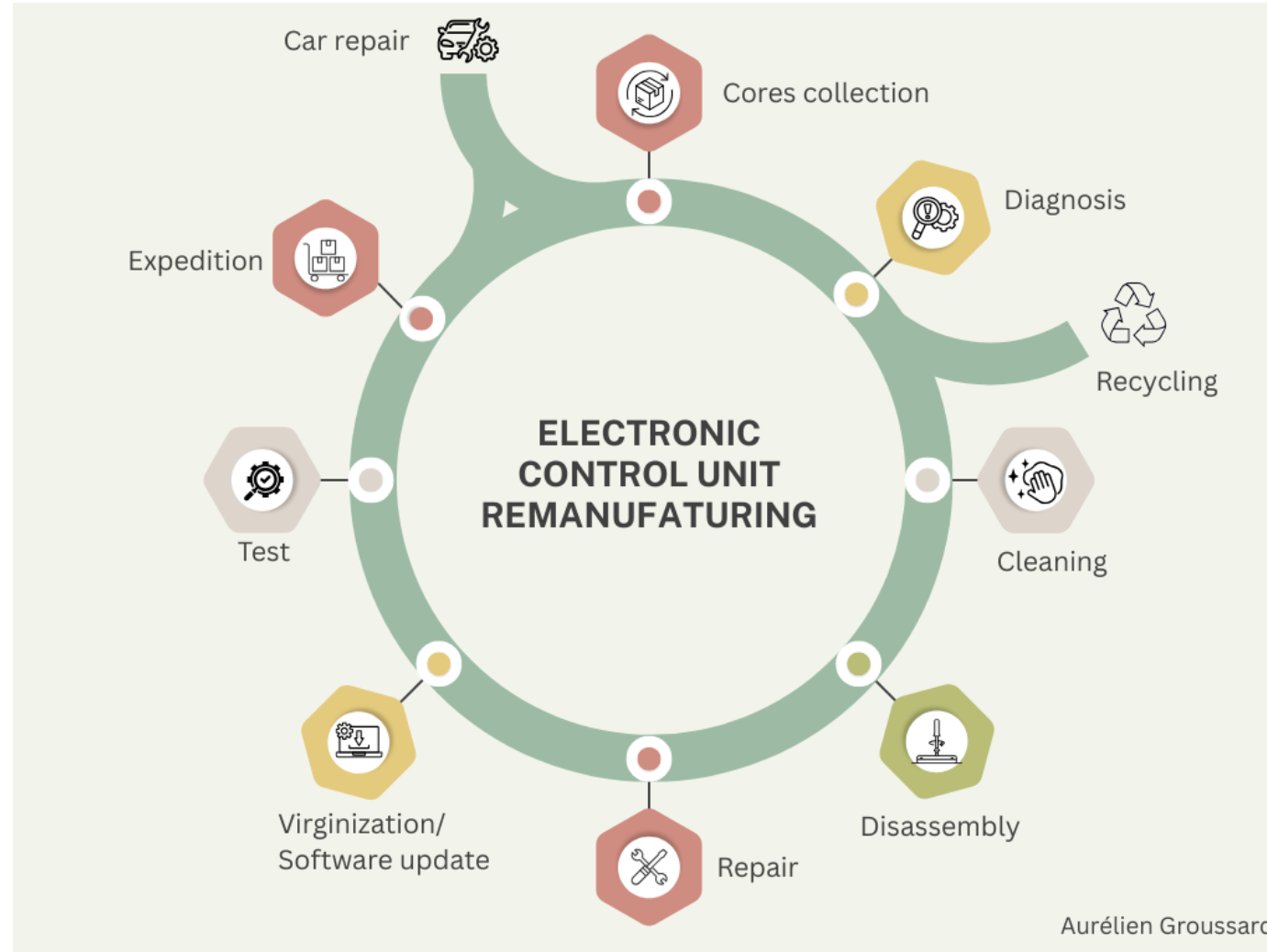
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Multiple "R" solutions – remanufacturing



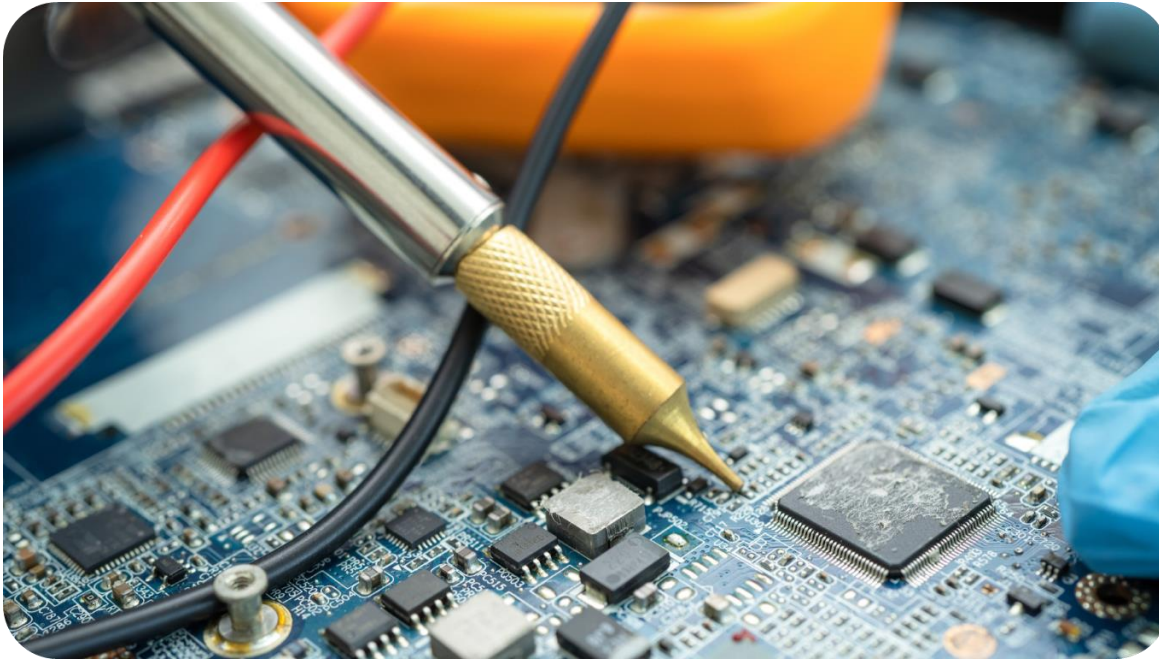
Remanufacturing, or how to retain value

Remanufacturing process



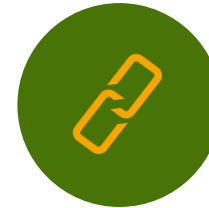
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Remanufacturing services



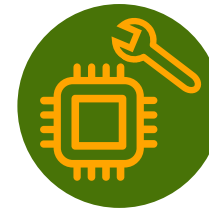
Diagnostic

Cores are diagnosed with a test bench and internal diagnosis



Virginization

Cybersecurity Keys and association to the vehicle are erased



EE/ME reparation

Faulty components are replaced

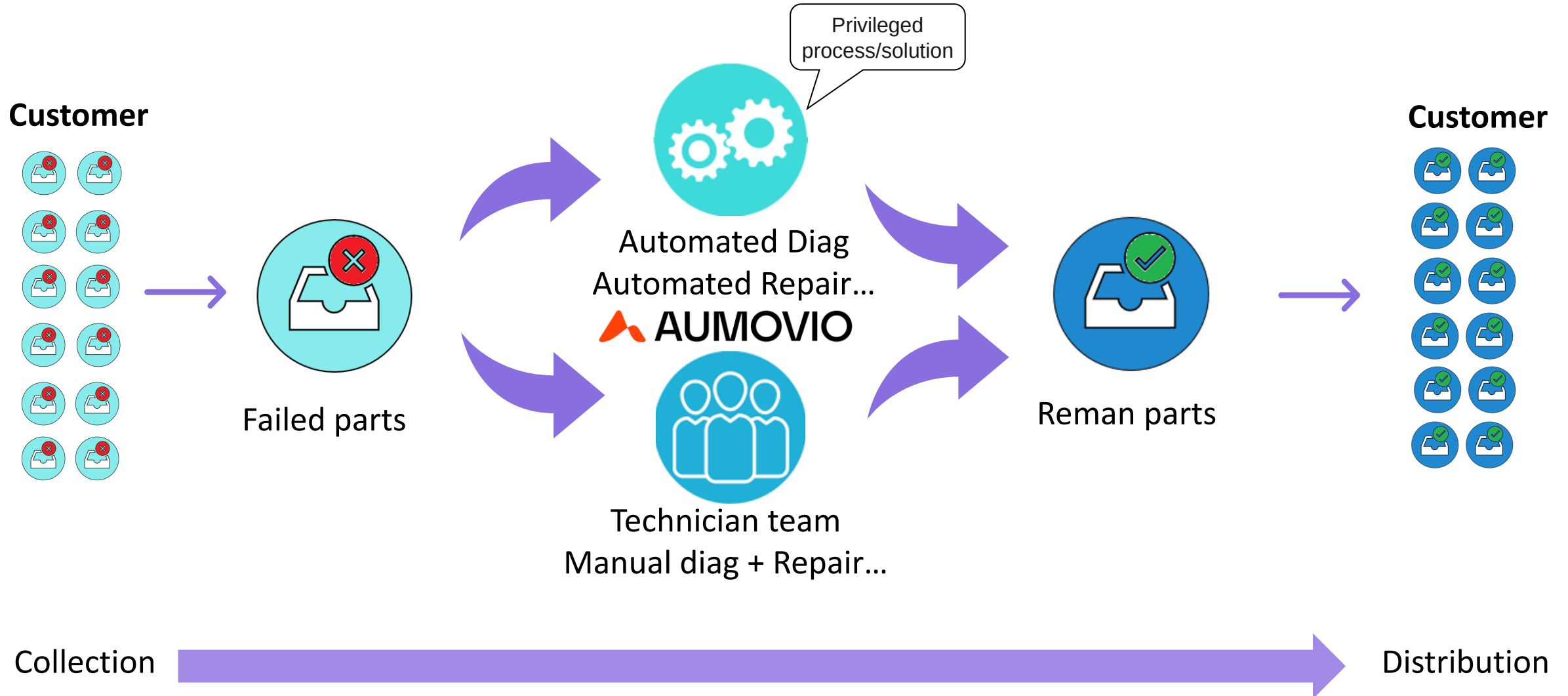


Reverse Engineering

Components are reverse engineered to be repaired

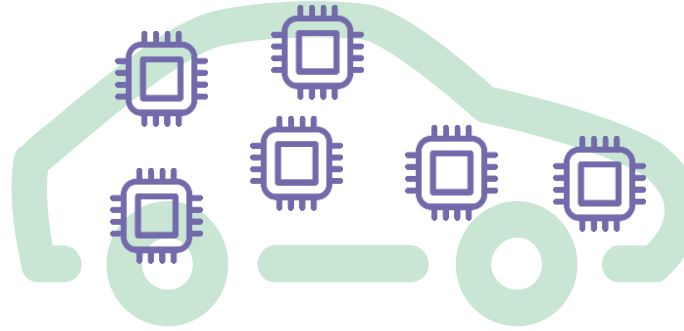
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Business model



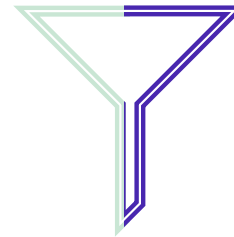
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Product assessment Identification



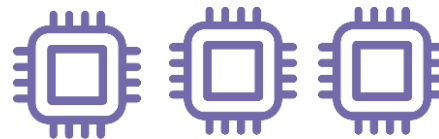
Customer criteria:

- Cores availability/quality
- Product market request



Aumovio criteria:

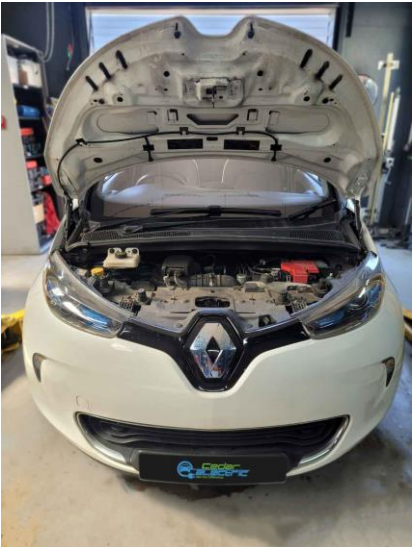
- Aumovio products (preferred)
- PVO (Volume, Part Price)
- Remanufacturing tasks identification



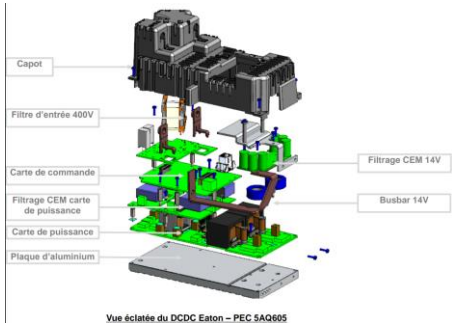
Industrial Remanufacturing

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An example



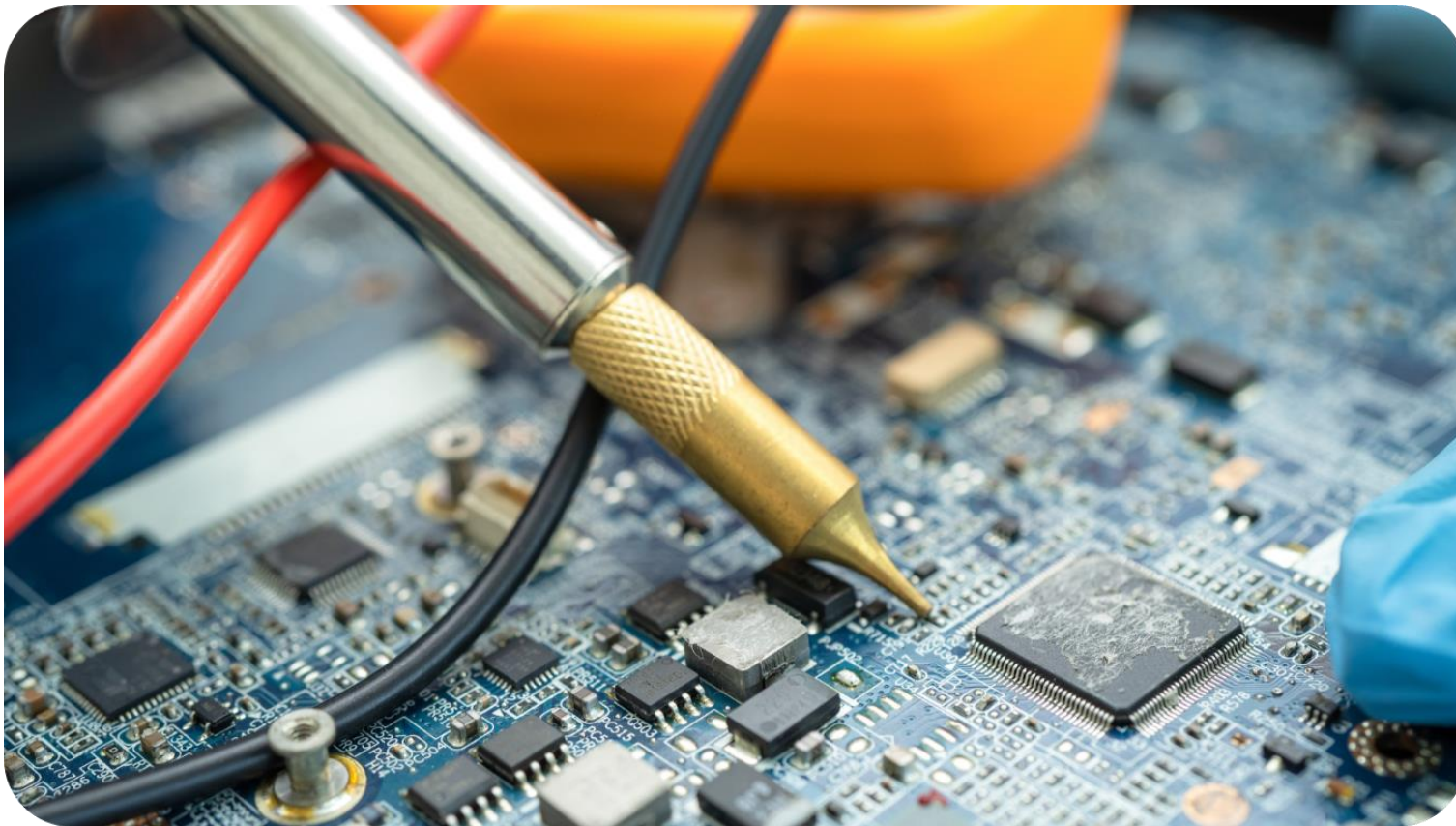
Power Electric Controler (PEC)



DCDC Converter



Power MOSFET



We remanufacture DCDC converters

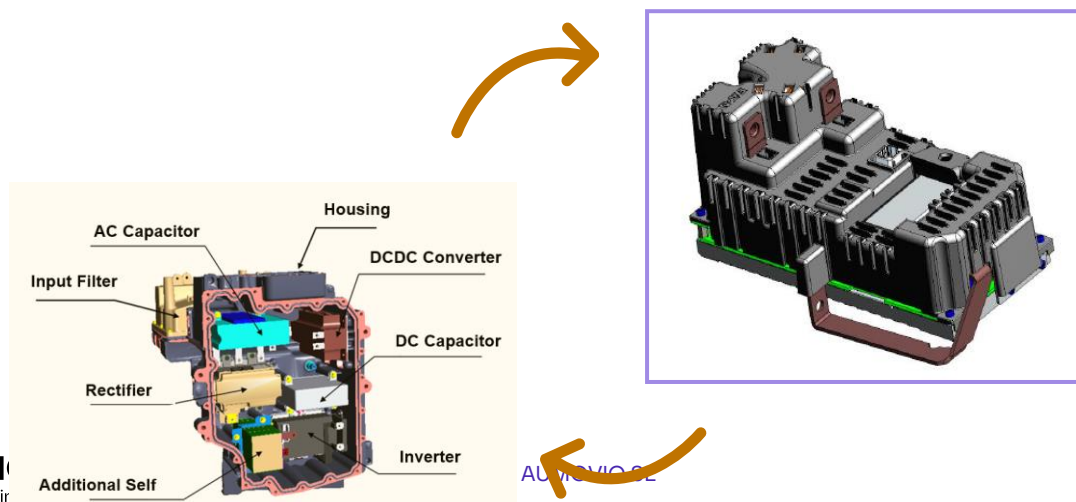
Diagnose the cores

Dismantle the DCDC converter

Replacing faulty components

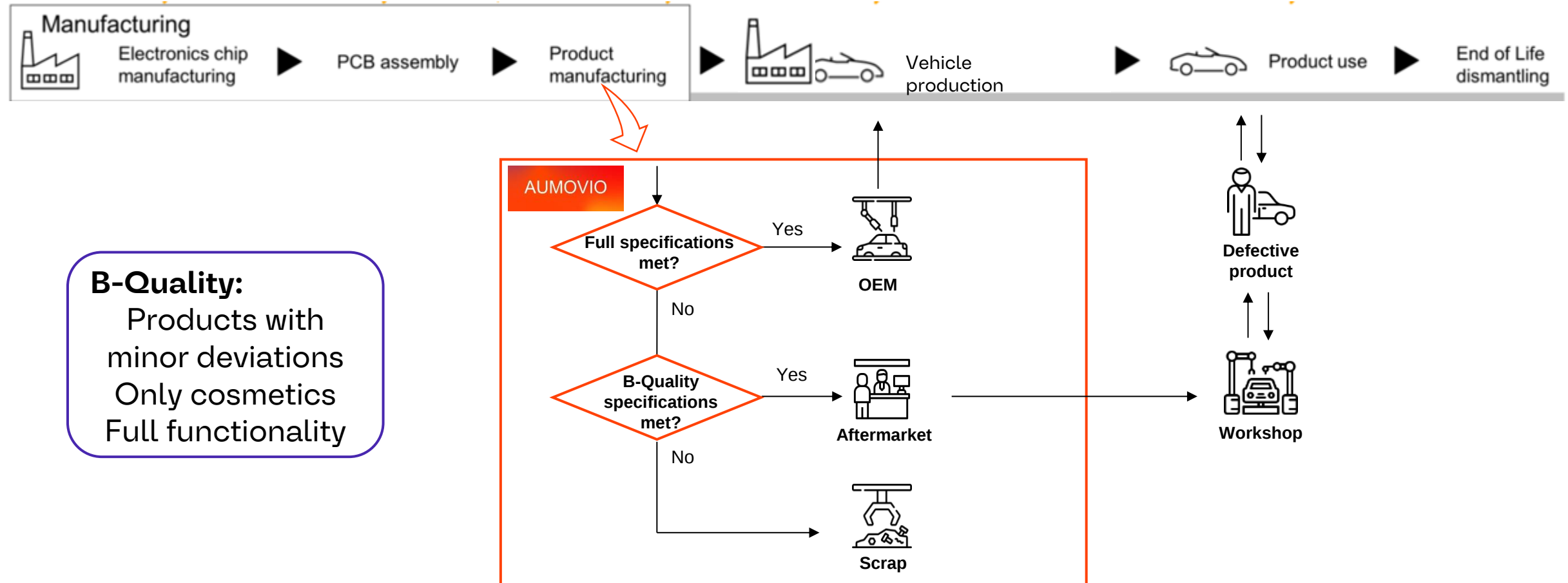
Functional testing

18.000 DCDC converters
500t CO2 eq saving



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Multiple "R" solutions – B Quality



Agenda

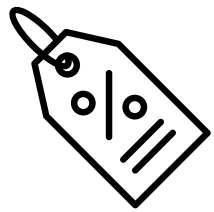
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Remanufacturing market in automotive

A big potential

Key facts:

Expectation from market:



30% discount



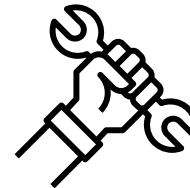
Vs

BOM cost 30% to 50% saved



High demand to **distributors** to propose more **remanufactured** components

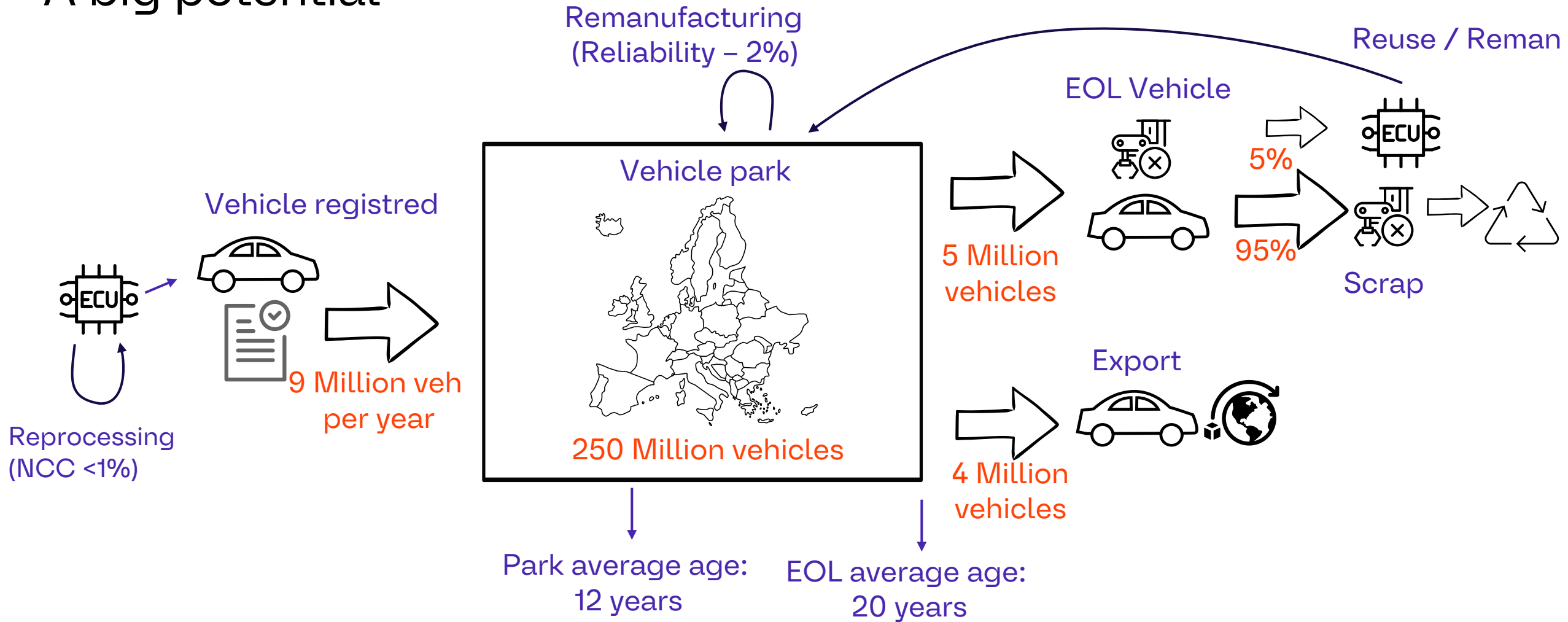
75% of car reparation are operated by **IAM**



250 Millions Vehicle in Europe with around 50 ECUs per vehicle => **12,5 B ECU** in the streets

Remanufacturing market in automotive

A big potential



Sources:

[ACEA-Pocket-Guide-2025-2026.pdf](#)

[End-of-life vehicle statistics - Statistics Explained - Eurostat](#)

[Véhicules : données 2022](#)

[Circularity requirements for vehicle design and management of end-of-life vehicle](#)

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Sourcing challenges	30
Virginization challenges	31
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Remanufacturing challenges and solutions

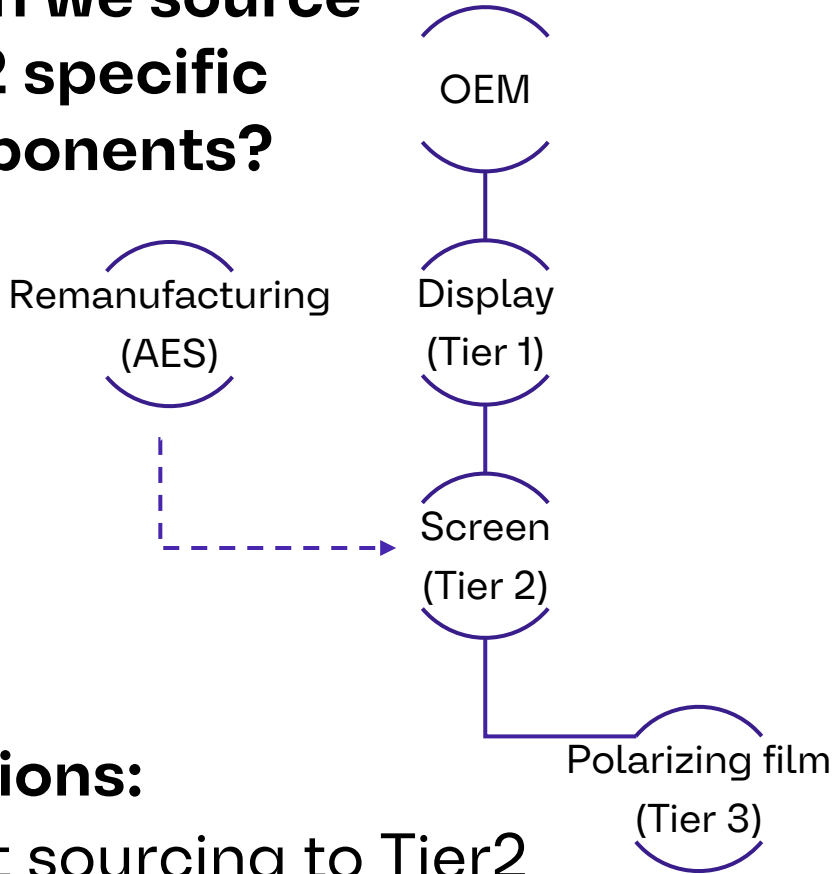
Sourcing challenge

Components Product Termination Notification (PTN)

Solutions:

- Last Buy Order and Storage of electronic components in electrical cabinet + replacement of electrostatic bags every 3 years
- Brokers
- Unsoldering of components from EOL boards + Test (Research programs)

How can we source Tier2 specific components?

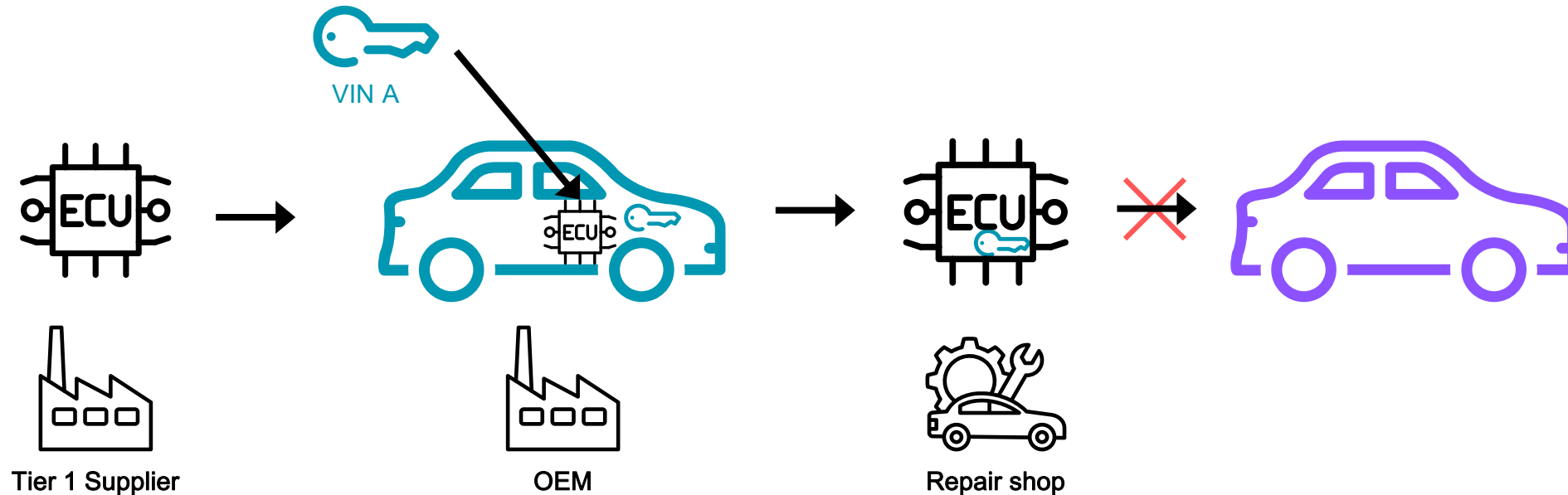
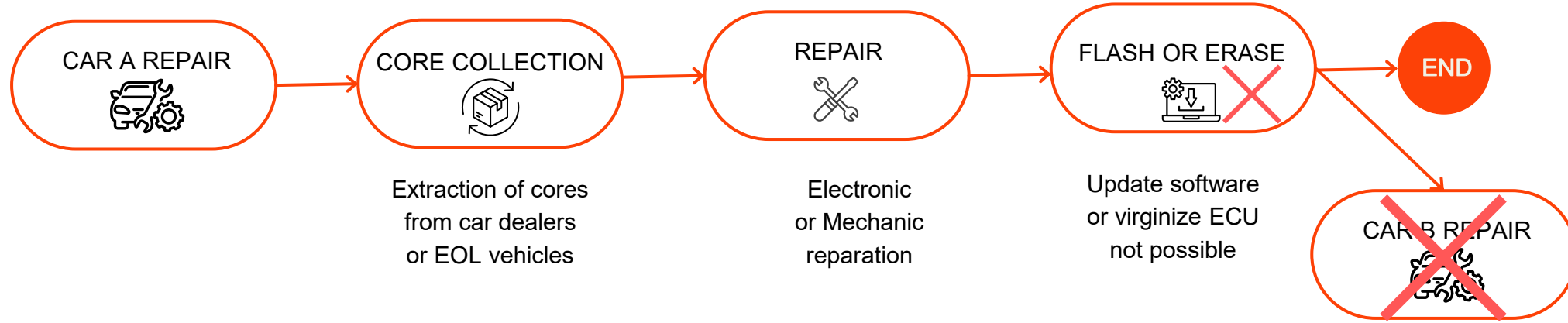


Solutions:

Direct sourcing to Tier2
Make 1 out of 2

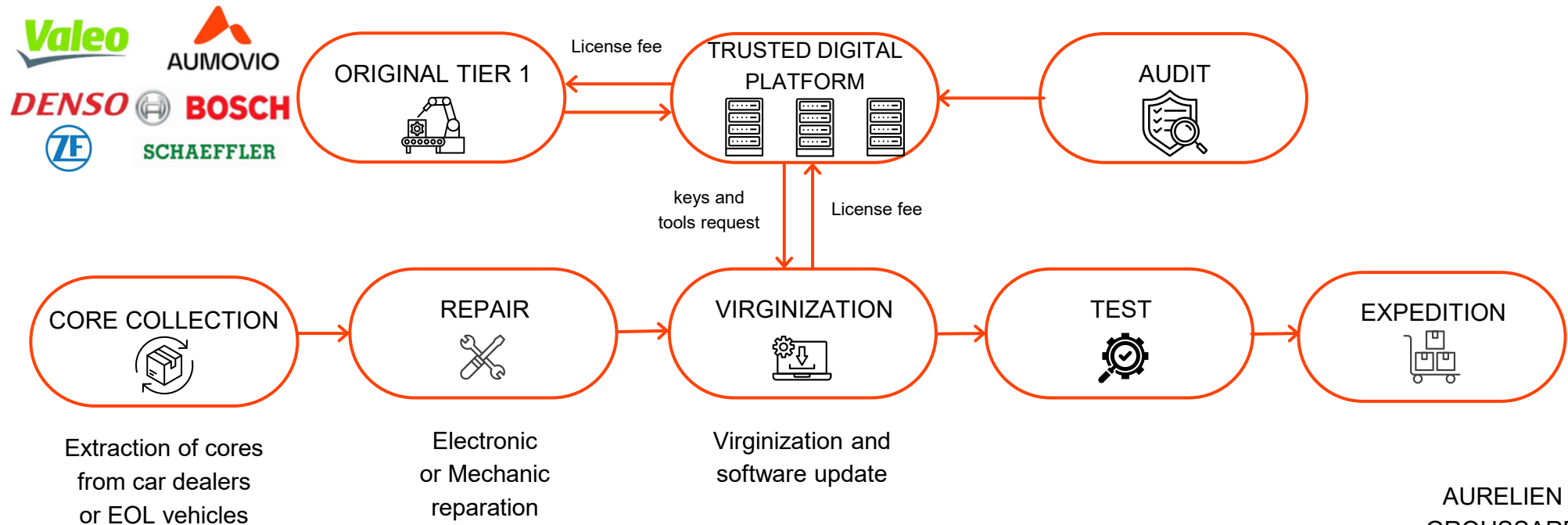
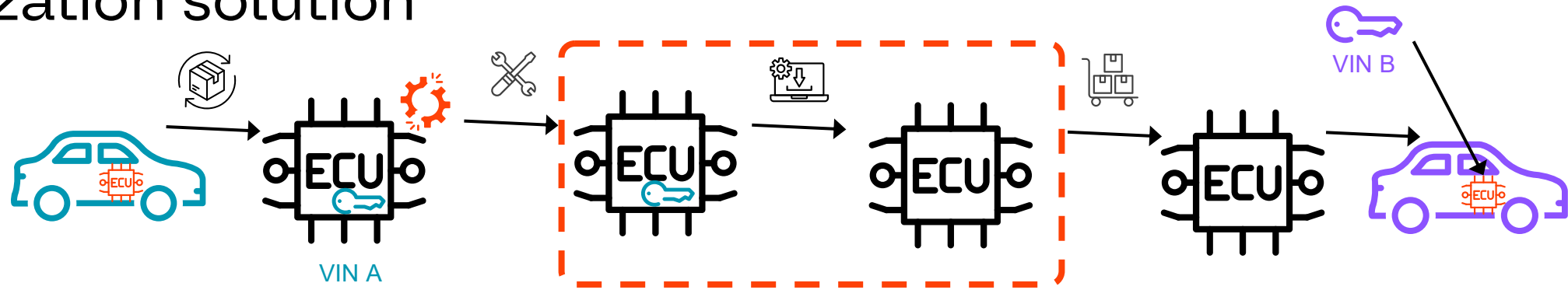
Remanufacturing challenges and solutions

Virginization problematic



Remanufacturing challenges and solutions

Virginization solution



Remanufacturing challenges and solutions

Virginization challenges



Who can manage the trusted digital platform?
OEM, Core Provider, Public entity?

ELV update (European parliament ELV amendment from 07/2025) :
“technical instructions on access, removal and replacement, including **the ability to deregister or decouple a part from the VIN of an end-of-life vehicle** »
[FINALConsolidatedCAs1-28_EN.pdf](#)

How to handle the sequence?
Shall it be **Tier 1 / OEM tool** placeholder or **CAN and data sequences?**

Remanufacturing challenges and solutions

Virginization challenges

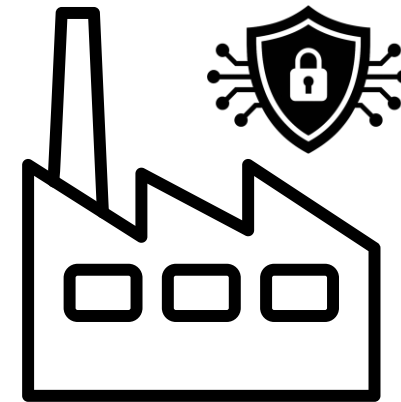


After virginization and software update, the Product Number can not be anymore aligned with the original PN.

Recommendation : Flash the last available software compatible with the hardware
Management of **UN-R156** could be impacted

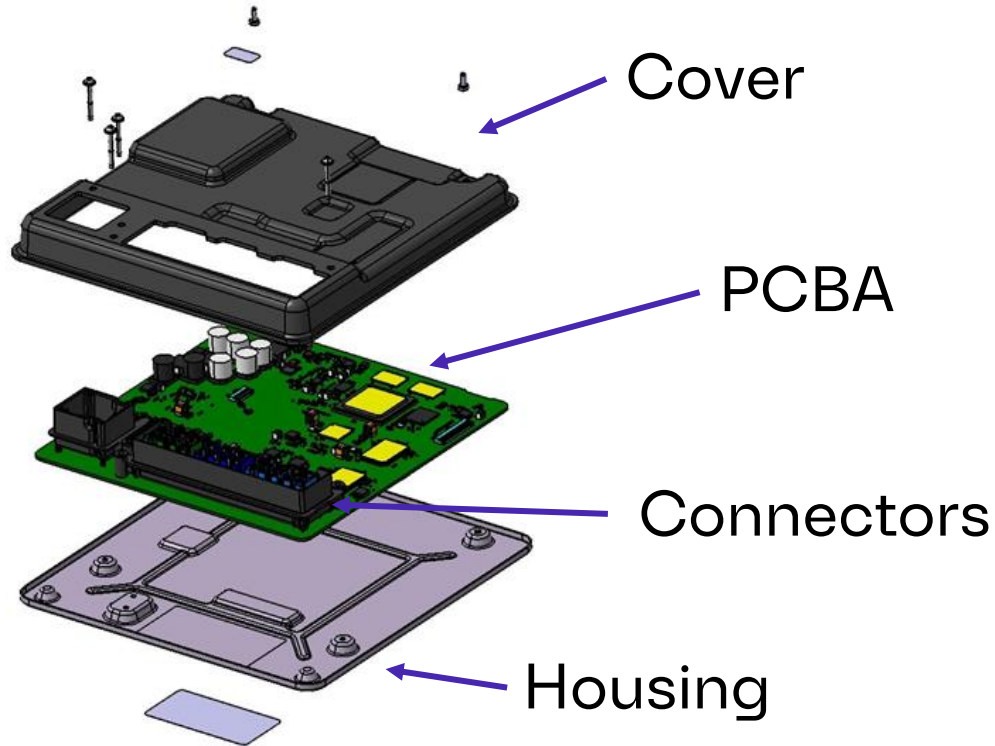
UN-R155 aim is to manage cybersecurity risks in vehicles.
However, Cybersecurity has been applied with only a **Linear** view.

- ⇒ Circular economy shall be considered in the **design** phase.
- ⇒ Virginization must only be possible in a **secured environment**



Remanufacturing challenges and solutions

Disassembly challenge



Difficult disassembly or reassembly:

- Clips that breaks
- Rescrewing not possible
- Thermal Paste
- Varnish

Disassembly or Reassembly not possible:

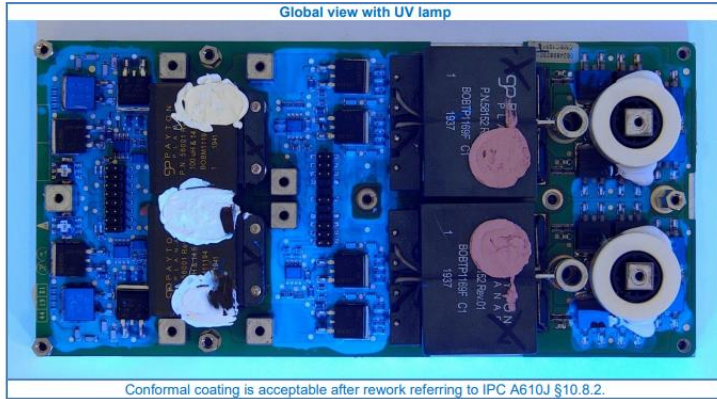
- Laser welding
- Stacking
- Riveting
- Fold over tabs
- Glueing
- Riveting

- **ELV regulation** requests ([End-of-Life Vehicles - Environment - European Commission](#))
 - Battery removal
 - 25% of recycled materials
- Recycling **performance** is reached with single materials

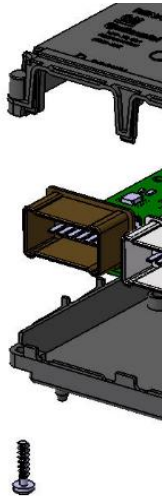
Remanufacturing challenges and solutions

Difficult disassembly or reassembly

Varnish



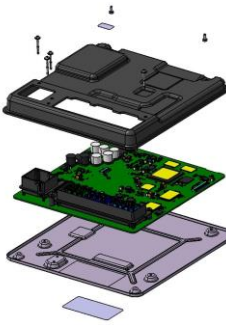
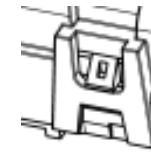
Rescrewing difficult (Tapping)



Thermal Paste reworking

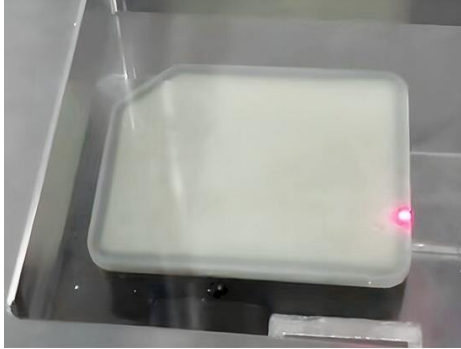


Clips that breaks

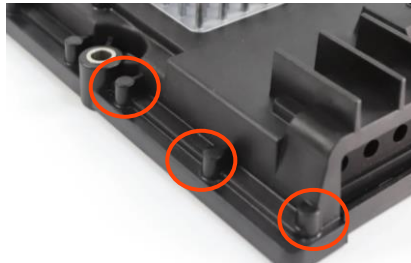


Remanufacturing challenges and solutions

Disassembly or reassembly not possible :



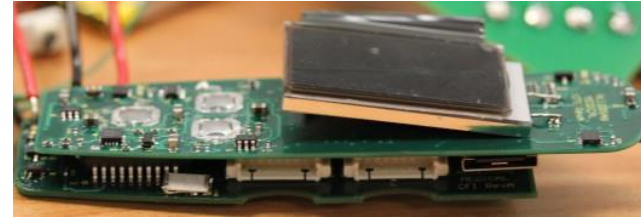
Laser welding



Riveting



Glueing



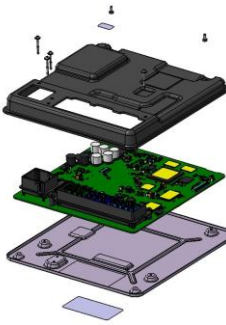
Stacking and Fold over tabs



Potting



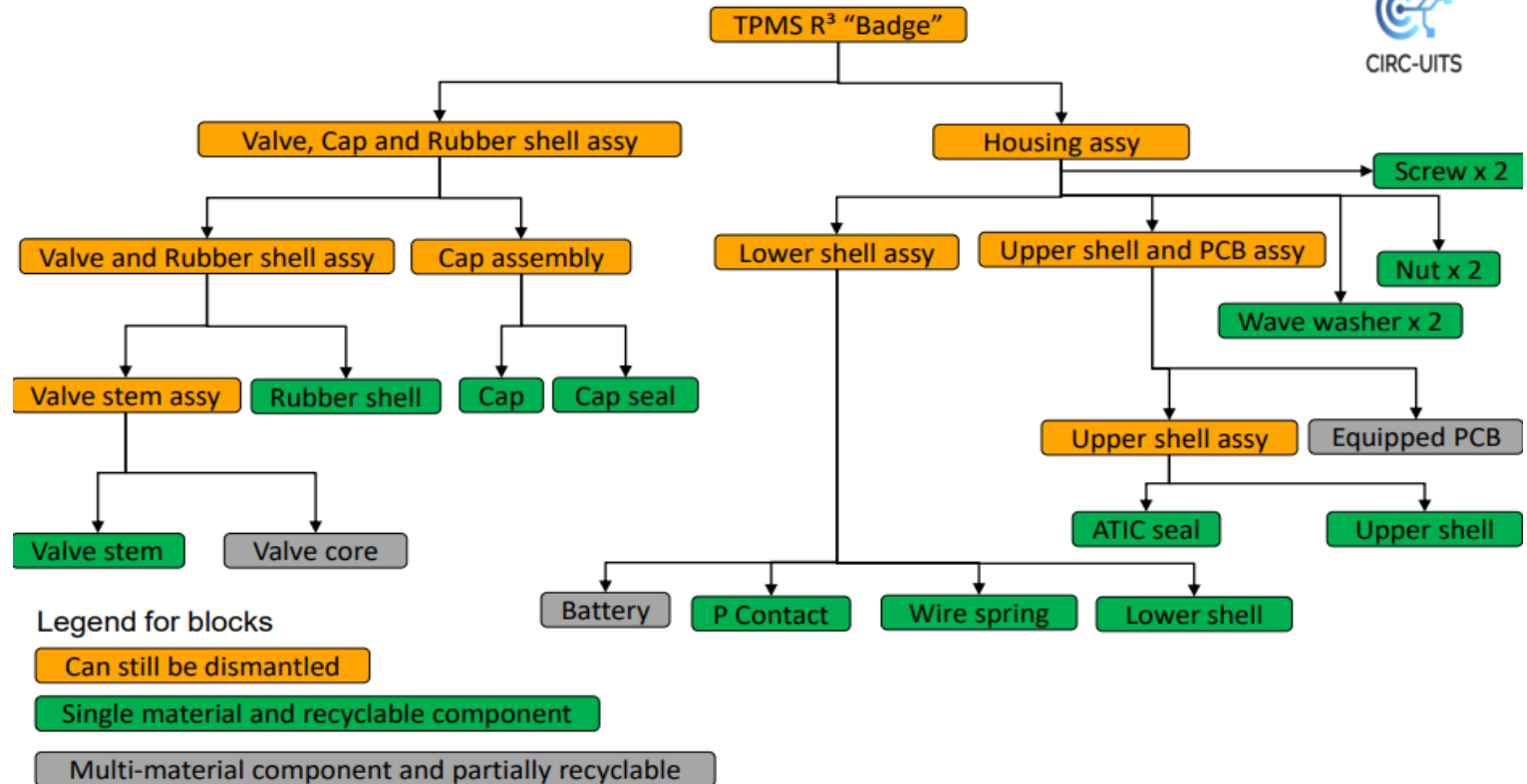
Source:
[Electronic Potting|PCBA|Potting process|Tortai](#)
[Electronic control unit \(ECU\)of cars – grefee mold company](#)
[Exploring Transparent Plastic Laser Welding – Han's Laser](#)



Remanufacturing challenges and solutions

Disassembly state of the art: TPMS R3 from circuits

Dismounting sequence



Remanufacturing challenges and solutions

Why disassembly is key to profitability?



	› Removal of Back Cover and Ornamental Frame Destruction of: Back Cover, Ornamental Frame		 Dismantling of structural parts		› Individual disassembly of Closing Assys No components get destroyed	
	› Unscrewing of PCB No components get destroyed		 Dismantling of PCB		› Unscrewing of PCB No components get destroyed	
	› Separation of Bonding Assy and Backlight Assy Destruction of: Display Panel, Backlight Assy		 Degluing		› Separation of Bonding Assy and Backlight Assy Destruction of: Display Panel, Backlight Assy	
	› Separation of Display Panel and Cover Glass Destruction of: Cover Glass		 Debonding		› Separation of Display Panel and Cover Glass No components get destroyed	

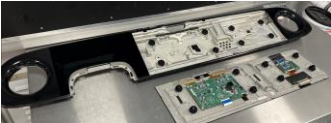
Product design makes non-destructive disassembly impossible.

Product design enables partial disassembly, but reuse of certain components is hindered by residual glue.

Remanufacturing challenges and solutions

Why disassembly is key to profitability?

- Detachable glue for display closing
- Screws and index plates allow displays to be removed one by one
- Modular components



	Scenario : Post-Warranty
Product 1	€
Product 2	€



	Scenario : Post-Warranty
Product 1	€
Product 2	€

Four defect categories affecting main components:

- › Display Panel, Cover Glass, Main PCB, and Backlight Assembly
- › Weighted average calculated

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A first step towards a sustainable industry?

Several initiatives to push towards European Union

Modular design approach enhance:

- Disassembly
- Remanufacturing
- Recycling if combined with single material
- Profitability
- Upgrade

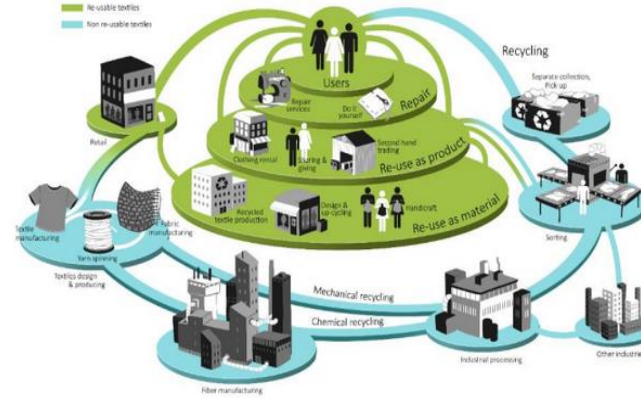


Design recommendations proposal to Europe by CEN CENELEC:

Draft CWA for comment: “Enabling Circular Economy Practices: Repair and Recycling of PCBAs” - CEN-CENELEC

A first step towards a sustainable industry?

Human challenge



Partnership and networking foster circular economy development

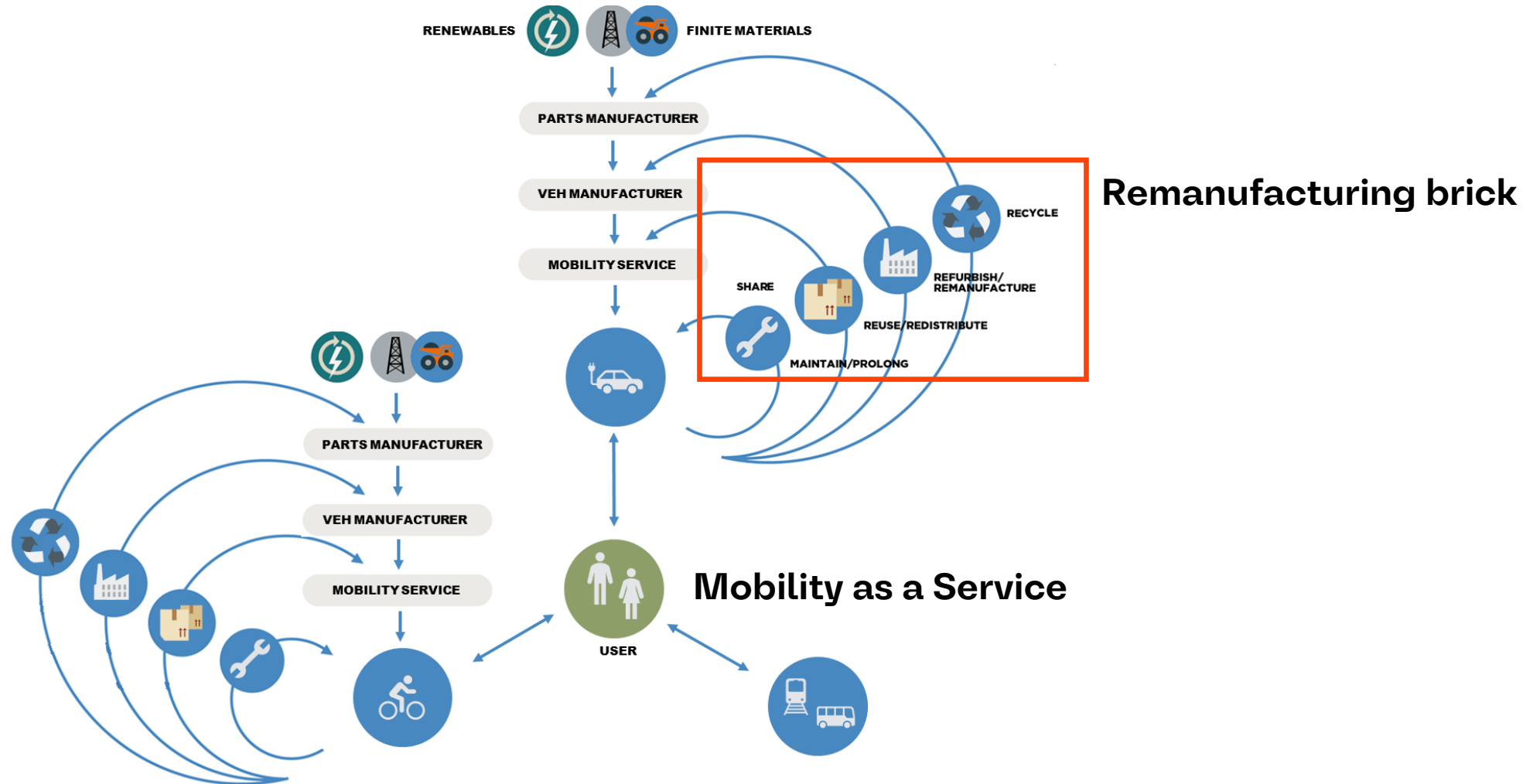
The remanufacturer champion:

- Provides solutions with what is **available**
- „**As good As New**“ is her/his moto
- **Creativity** and Experience
- **Validates** only what makes sense



A first step towards a sustainable industry?

First brick to mobility as a service



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Thank you
for your participation.

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