INVENOX
ADVANCED BATTERIES

Smart Battery Refurbing

Mechanical Component Cycling vs. Complex Material Separation

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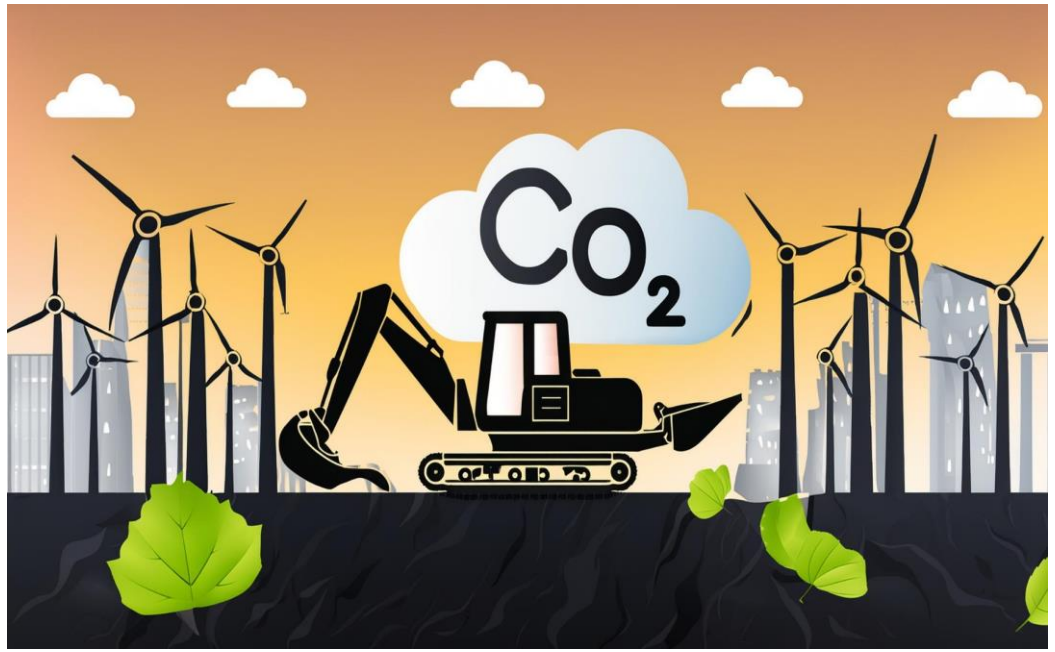
Herausforderungen und Potenziale des Recyclings von Fahrzeugbatterien - II, 25-Apr-2024

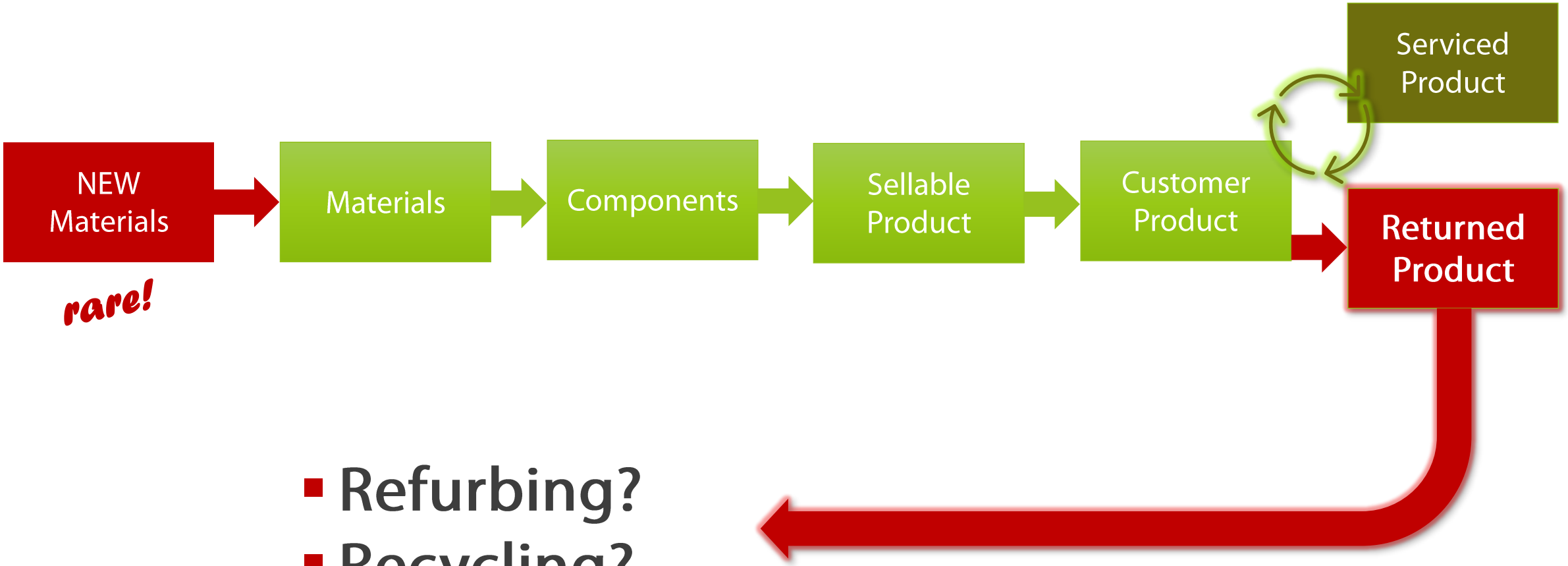
Motivation for Recycling of Batteries

- Our ENVIRONMENT cannot cope with any more pollution
- LEGAL requirements
- Lack of exclusive MATERIALS
- Dependence on critical SUPPLY chains
- To high supplier PRODUCTION cost and oem VEHICLE price
- Weak CO2 footprint due long distance logistics
- TAX load will increase in production and use.



In typical HYDAC/INVENOX applications, the battery system can account for up to **25-60% of the total vehicle costs**!

Motivation for Recycling of Batteries

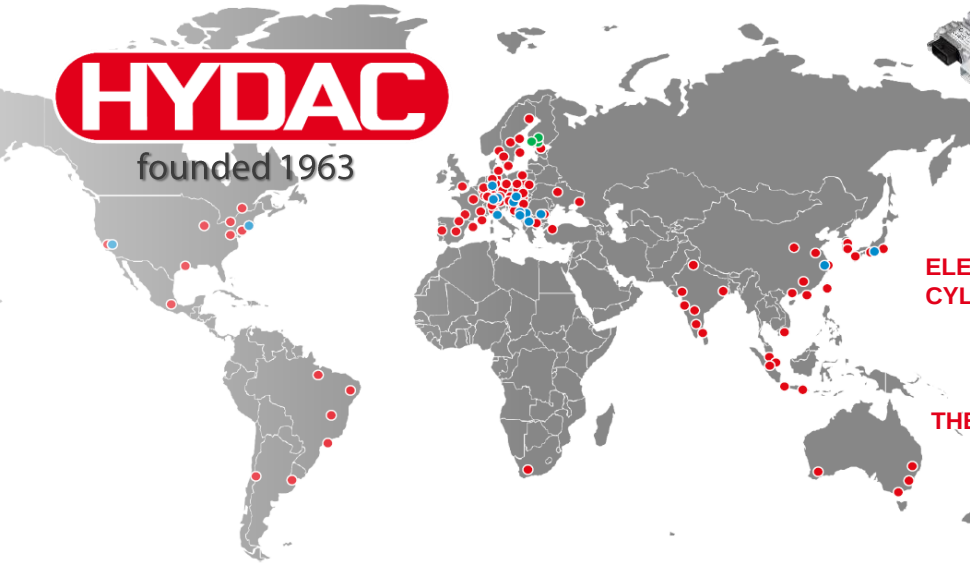


- Refurbing?
- Recycling?

The global HYDAC Focus in Mobile Electrification

INVENOX ADVANCED BATTERIES

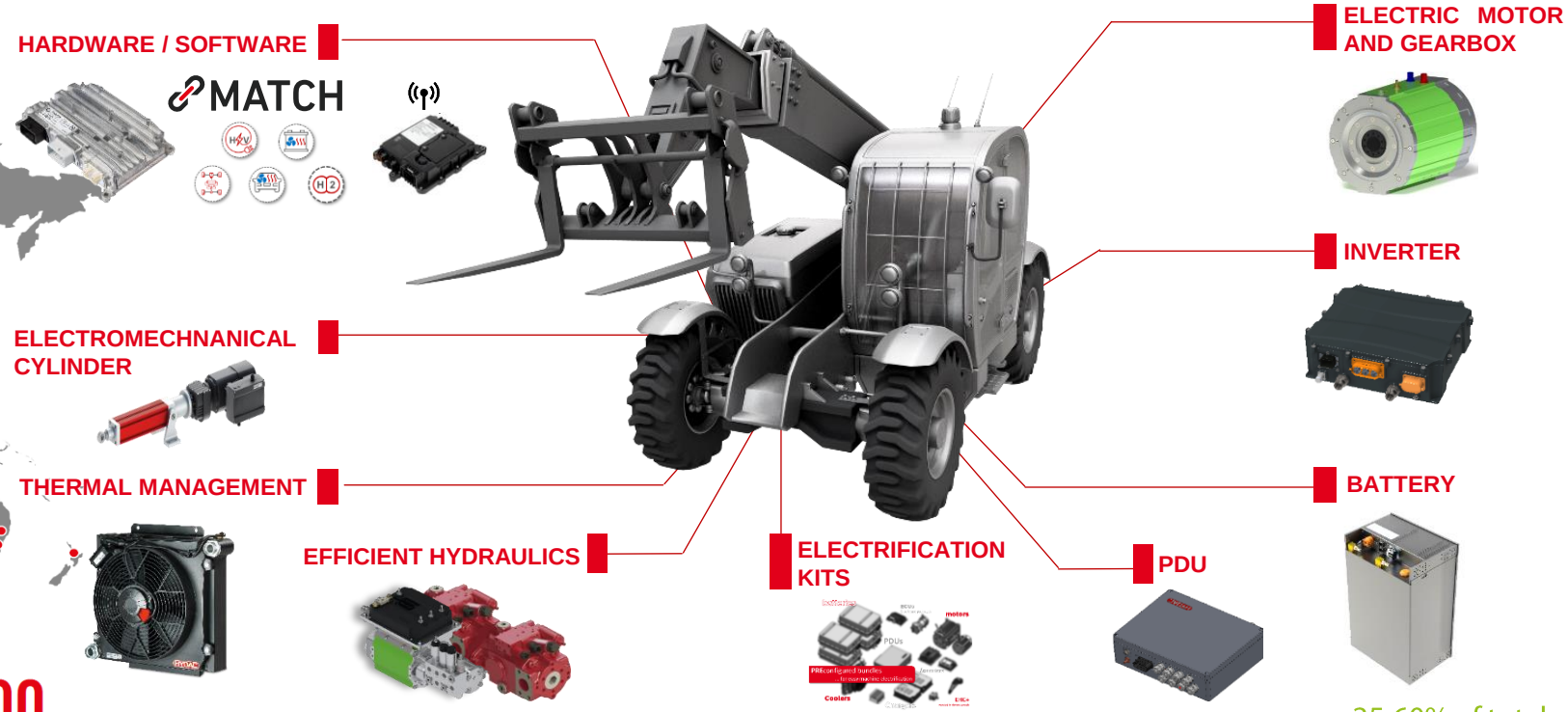
… a holistic markets, product portfolio and knowledge approach



2,1 Bn€
Hydac Group revenue

>50
Different countries with Hydac branches

~10.000
Employees globally



25-60% of total machine cost

The global HYDAC Focus in Mobile Electrification

INVENOX ADVANCED BATTERIES

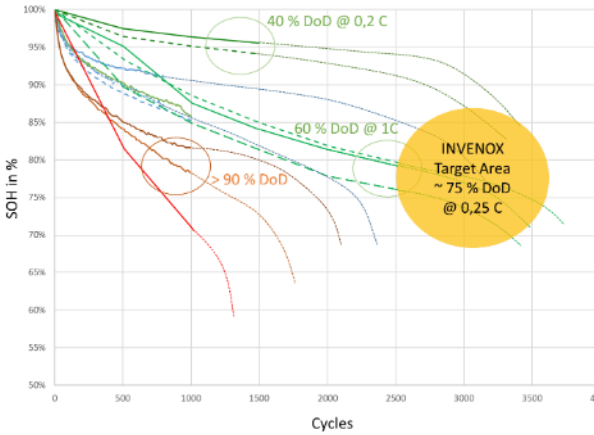
… within a powerful network

Company Profile

Foundation	**16.05.2014**	Spin-off from
Location	**Garching near Munich** • 1,200 m^2 Office Space • 4,300 m^2 Production Area	
People	**95 Employees** • Thereof 35 Engineers Mech / EE / Software • Thereof 20 Students & Interns	
Quality Management	Certified QM System since 2016	

What‘s the value we offer?

Research and Pre-Development	
Lithium-Ion Batteries	Analysis of Safety, Cycle Lifetime and Performance of Various Cell Types
Module Design	Patented Technology and Further Development
Battery Management System	Development of Hard- and Software in House
Product Design, Production and Customer Service	
Concept Phase	Supporting the Customer in Dimensioning for the Application and Requirement Definition
Design and Simulation	Mechanical and Electrical Design of the Battery System to Customer Needs
Production and Supply Chain	From the First Prototype to Series Delivery
Service and Aftersales	Comprehensive Customer Assistance during Installation and Troubleshooting



What are our fields of application?

… a wide range of different technical and commercial requirements



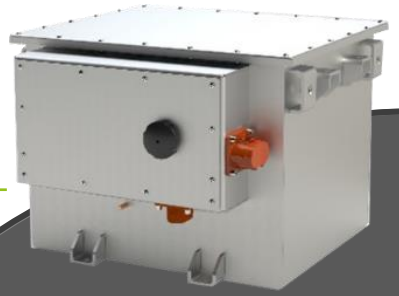





Product Portfolio

Customized /
Upcoming Standard

48 V
17 kWh | 22 kWh
Passive Cooling



400 V
20 kWh | 25 kWh
Liquid Cooling

cBMS

96 V
Up to | 52 kWh
Passive Cooling
Modular | IP67
UN 38.3

800 V
66 kWh | 88 kWh
Liquid Cooling

48 V
4 kWh | 6 kWh
Passive Cooling
Modular | IP67
ECE R 10 | UN 38.3

24 V
3 kWh | 4 kWh
Passive Cooling
Modular | IP67
ECE R 10

Standard

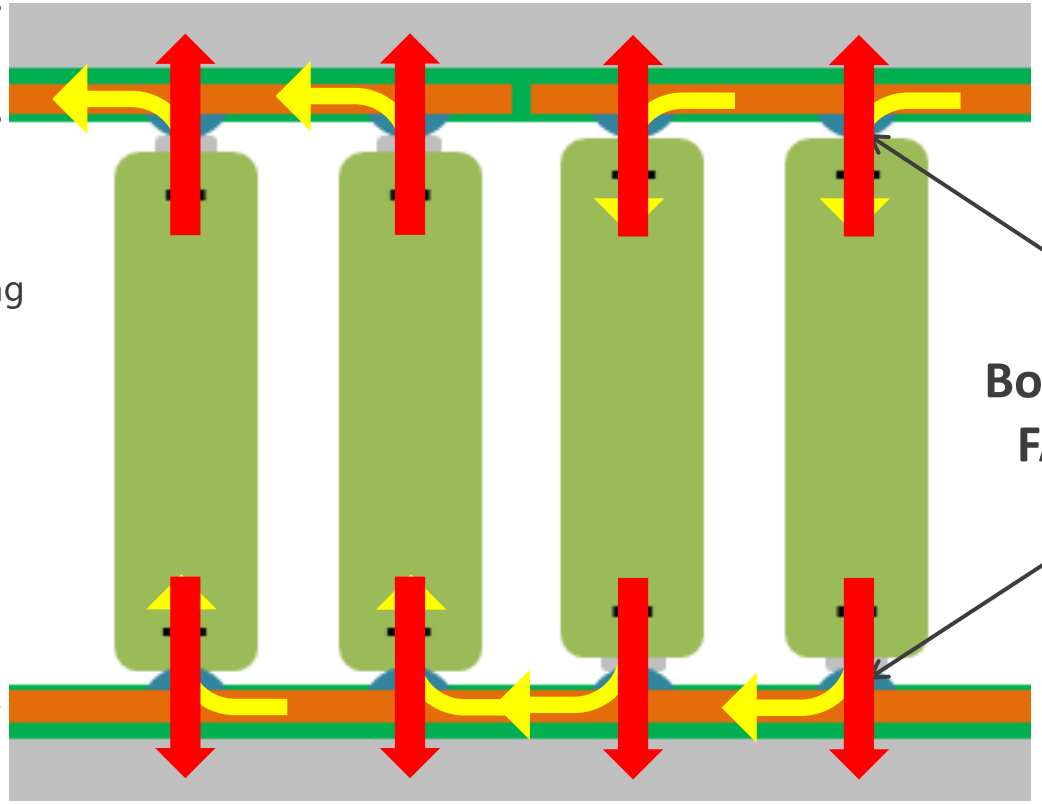
INVENOX‘ Innovative Cell Connection System

No Welding!
Reversible
Connection

Aluminum PCB

- ✓ Electrical **Power** Wiring
- ✓ Direct **Heating**
- ✓ **U / T** Measurement
- ✓ Single Cell **Fuse**
- ✓ Mechanical **Stability**

Thermal Flux



Copper Layer

Insulation up to 6,000 Volt

Aluminum

Bonding Material FANTASTIUM®

Battery System - Component Complexity

Battery Cells

Various **Mechanical Parts** (Metal, Plastic)

Conductive Polymer Components

PCB & **PCBA**

Electronic Components (Relais, Fuses…)

Connectors, **Cables,** Bus Bars, **Wire Harness…**

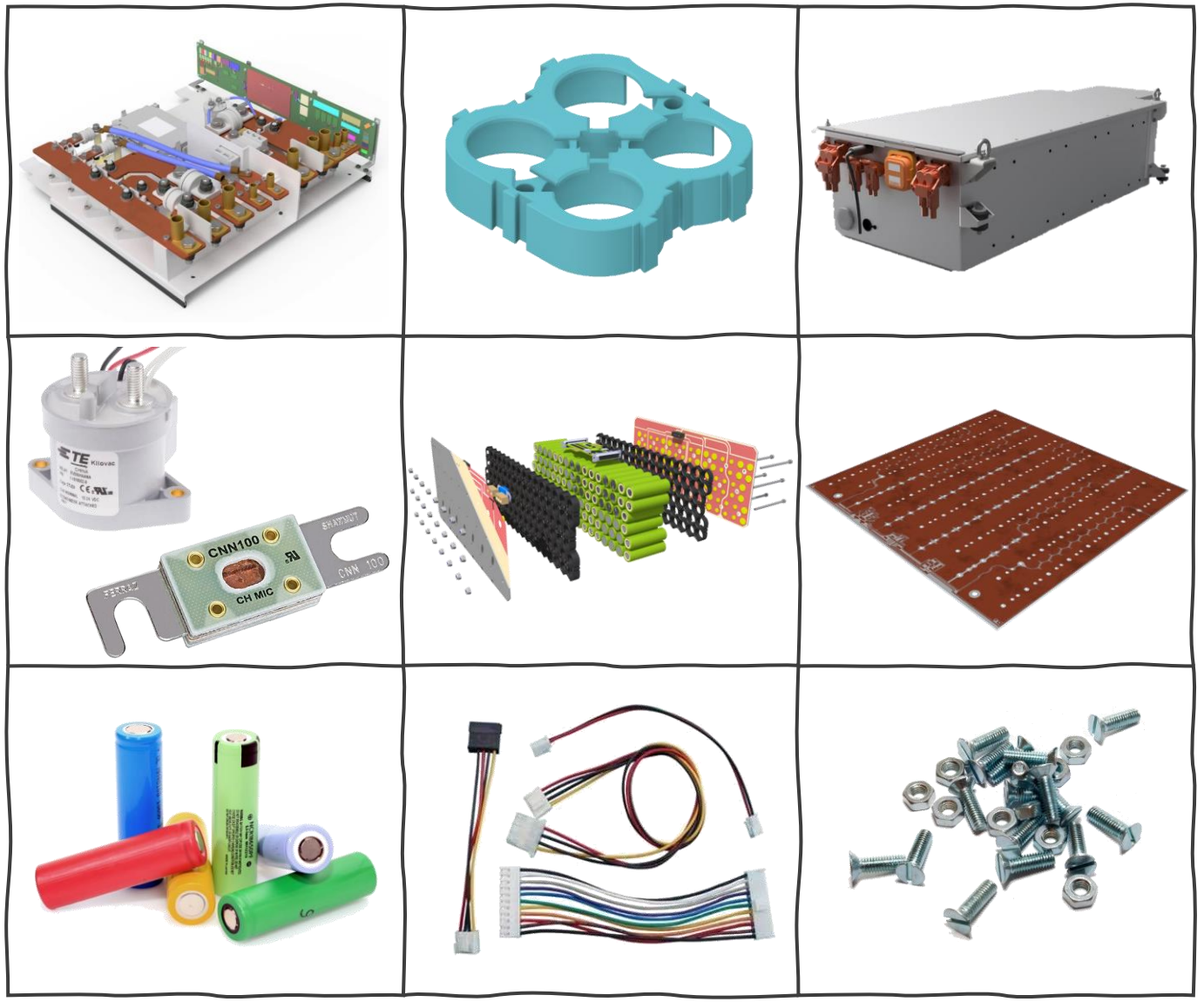
Gaskets & **Sealings**

Screws & Fasteners

Housings & Mountings

Cooling System Components

…



Battery System - Raw Materials Complexity

Battery Cells: Lithium, Nickel, Cobalt, Manganese, Graphite, Copper, Aluminum, Steel, …

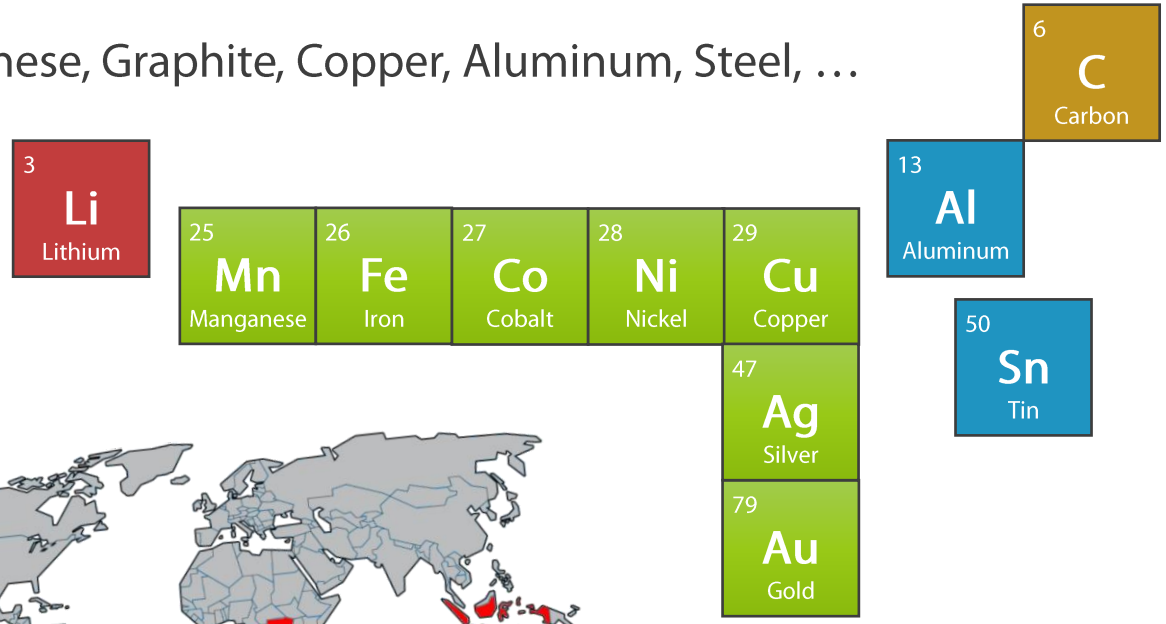
Module PCB: Aluminium, Copper, …

Conductive Elastomer: 😇

Electronics: Copper, Tin, Gold, Silver, …

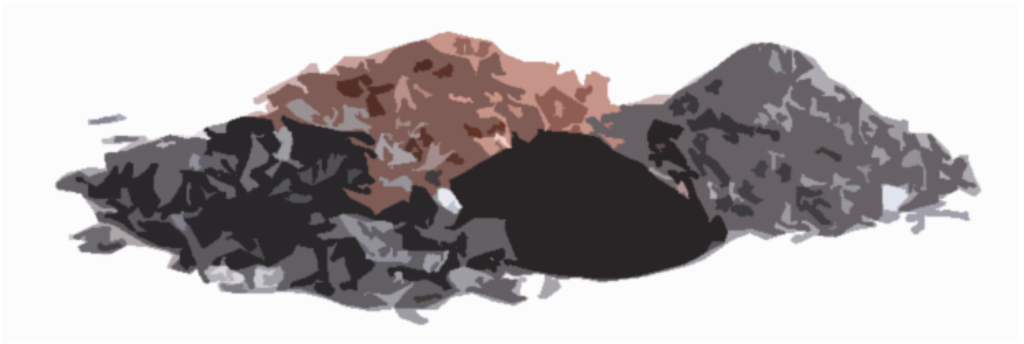
Housing: Aluminum, Steel, …

+ Various Polymer and Ceramic Materials…



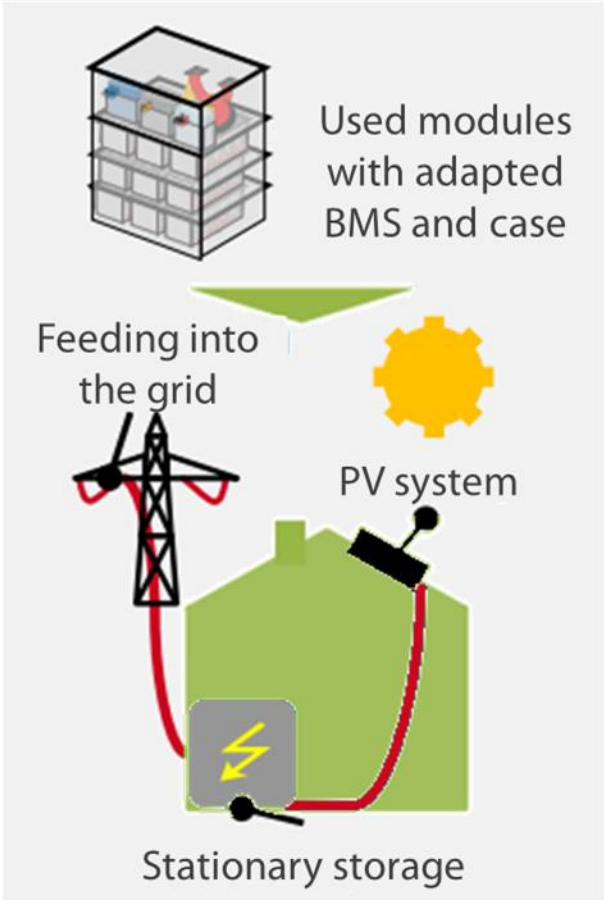
Effective Recycling is crucial!

- **High & volatile Prices** for scarce and precious materials
- Mining and Disposal cause **Environmental Damage**
- Dependency on specific Countries = **Supply Chain Risk**



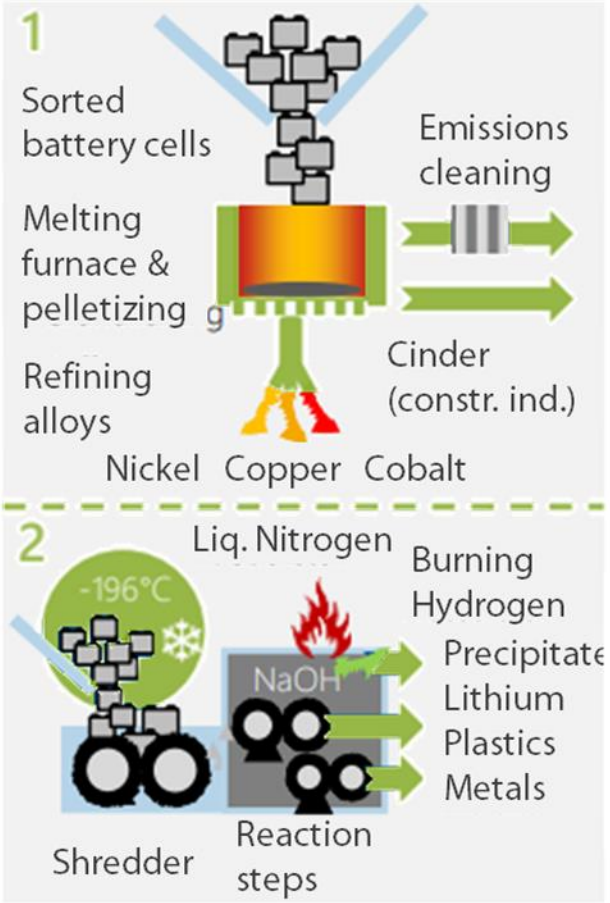
What comes after a Battery‘s service life?

Second Use



Refurbed Battery

Recycling

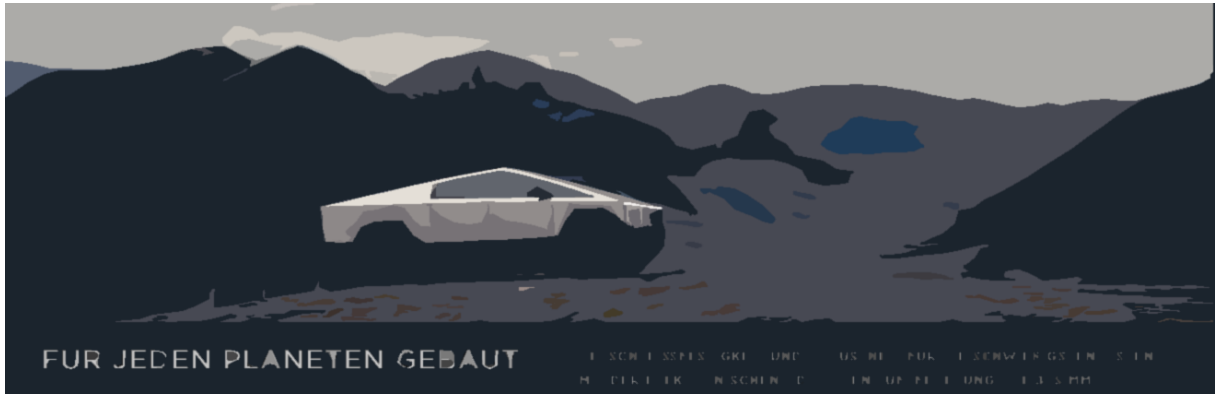


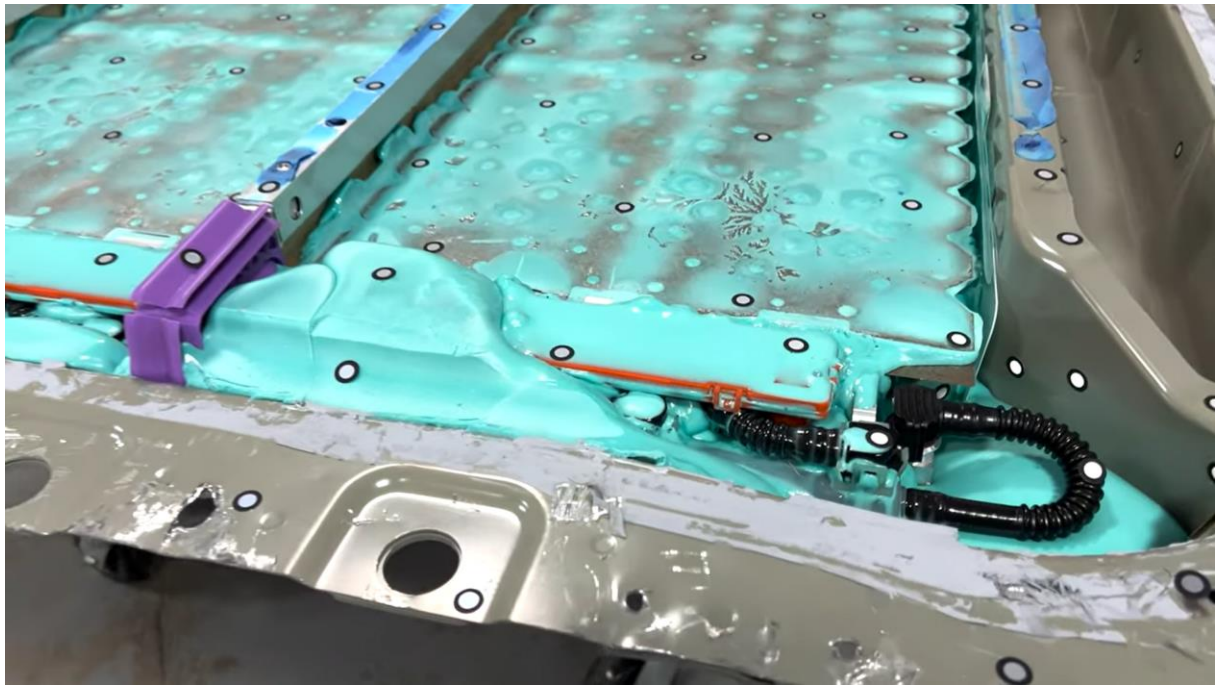
State of the Art – Tesla Cybertruck Battery

"Looks like we got plenty of foam. Looks like they've basically glued everything in here."

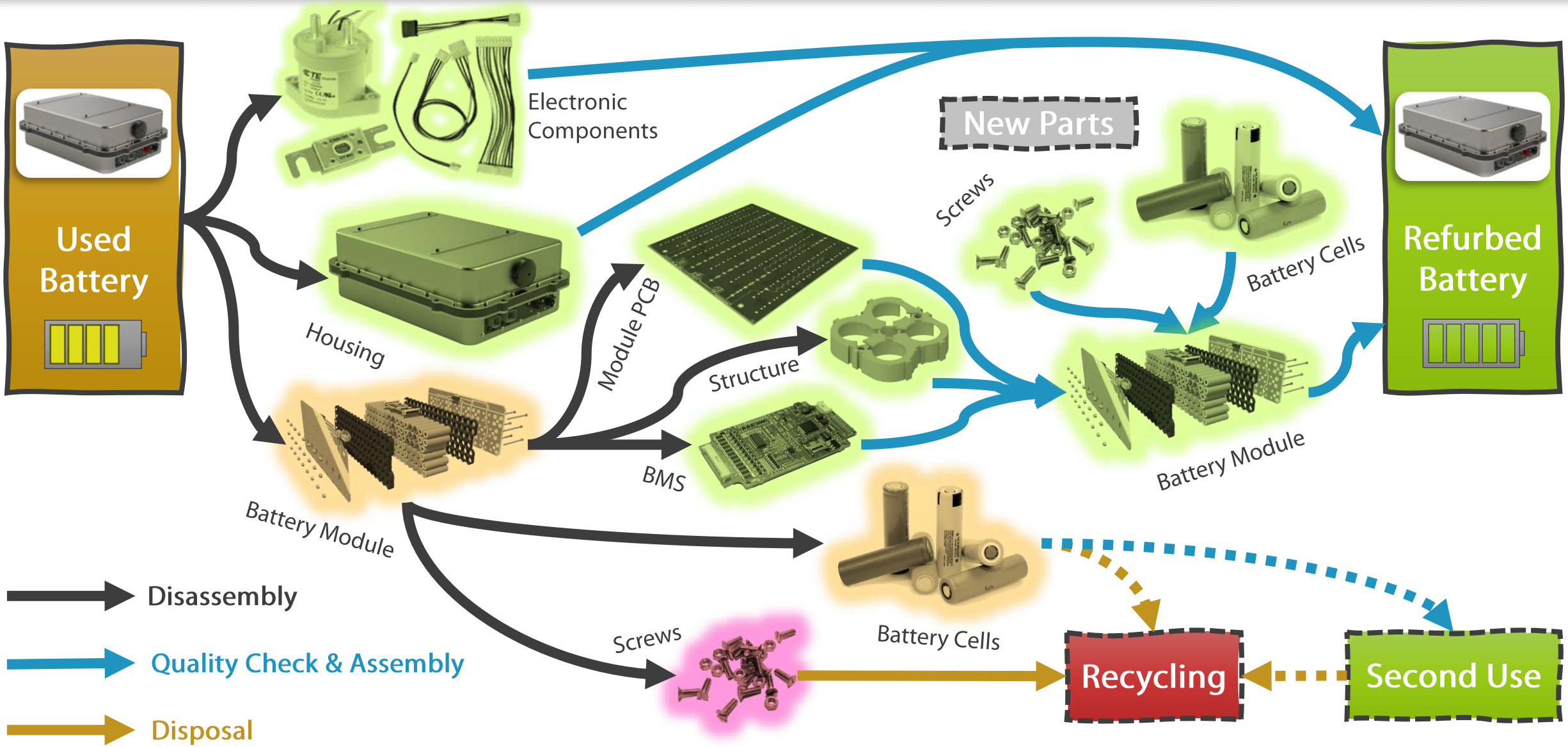
– Sandy Munro

https://www.youtube.com/watch?v=ipe5A4ZN3Gc

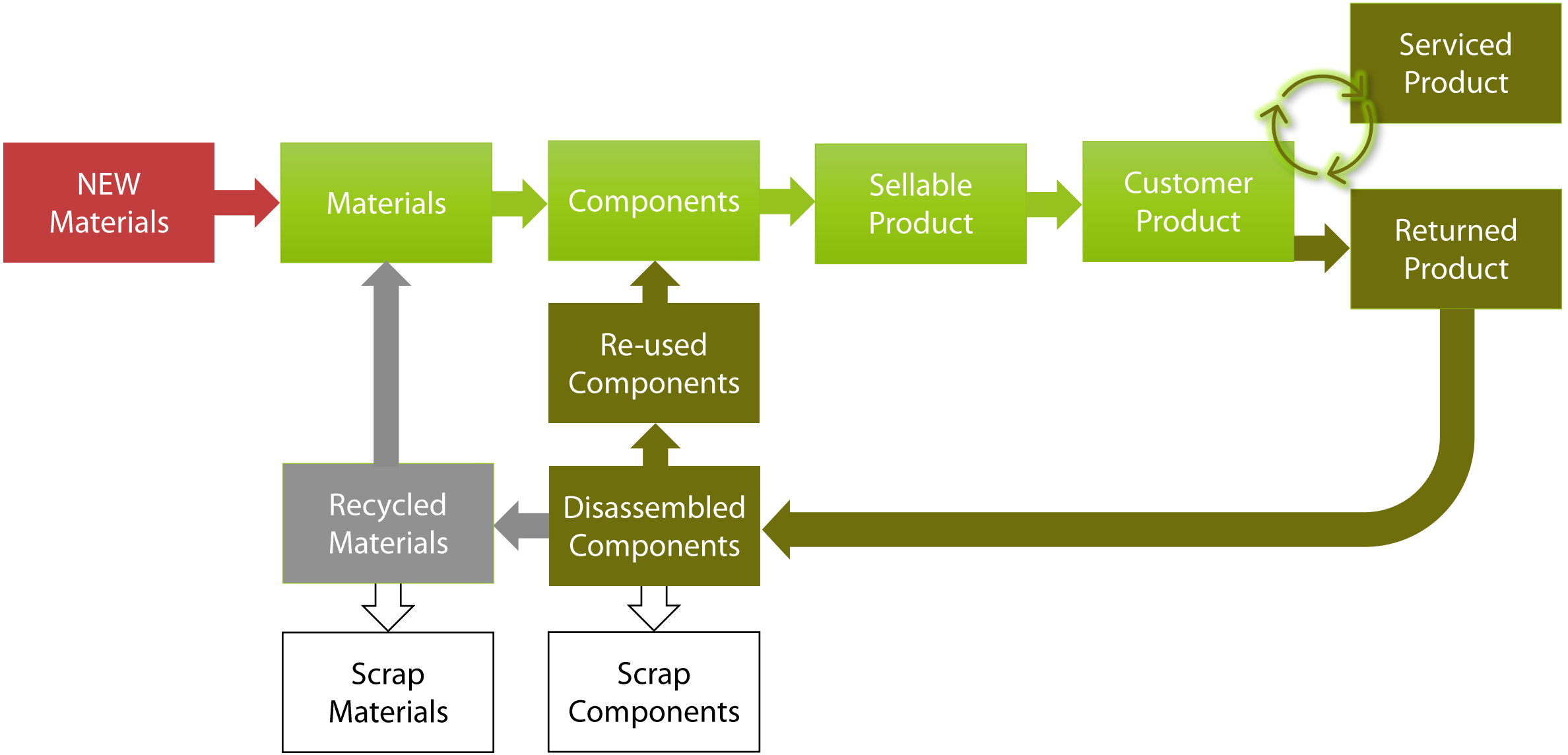




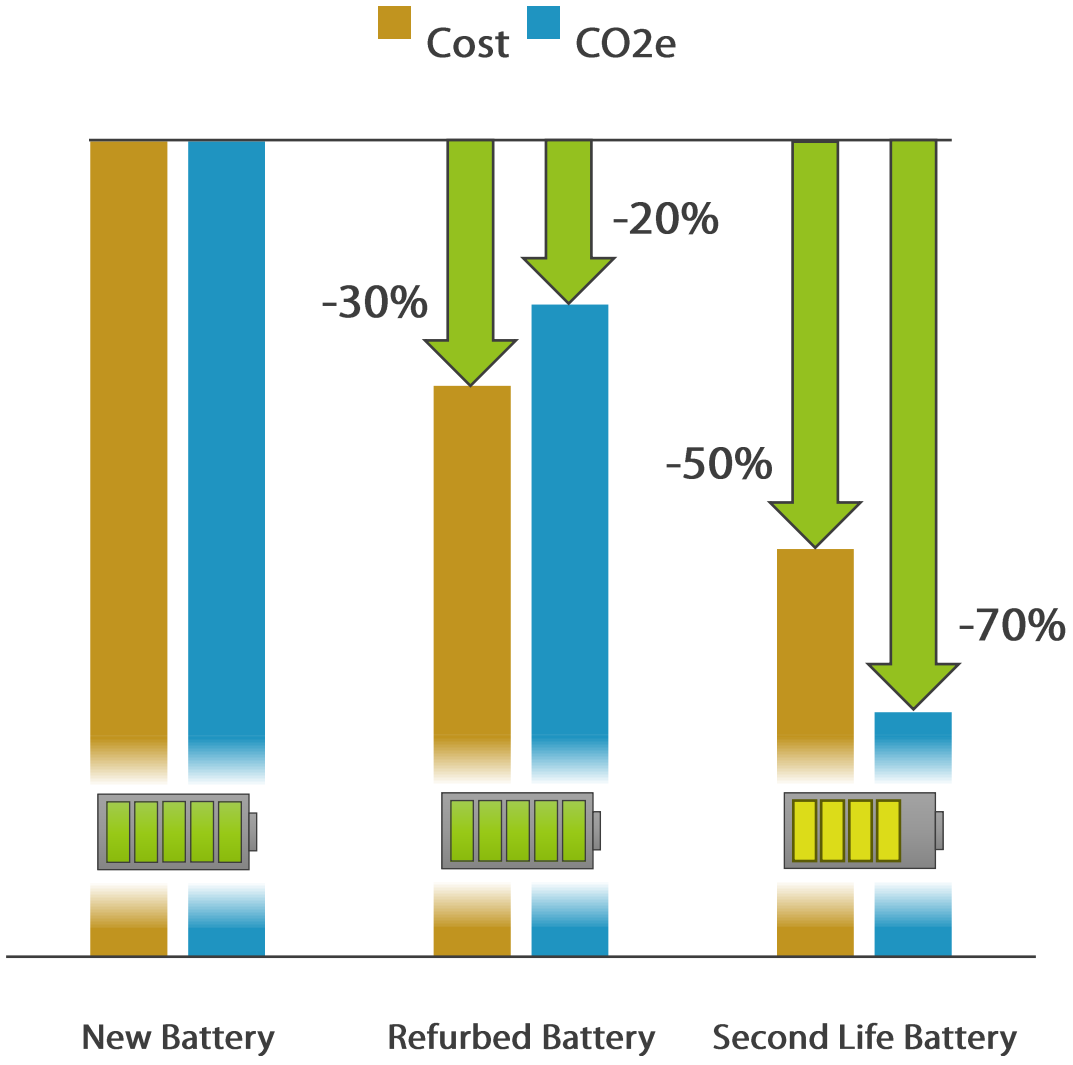
Efficient Refurbing Process



Future Production Process



Effect on Cost and CO_2-Footprint



Battery Cells dominantly determine both Cost and CO_2-Footprint of a Battery System!

Extended Usage of Material **greatly improves** the **Manufacturing Cost** and the **Environmental Impact.**

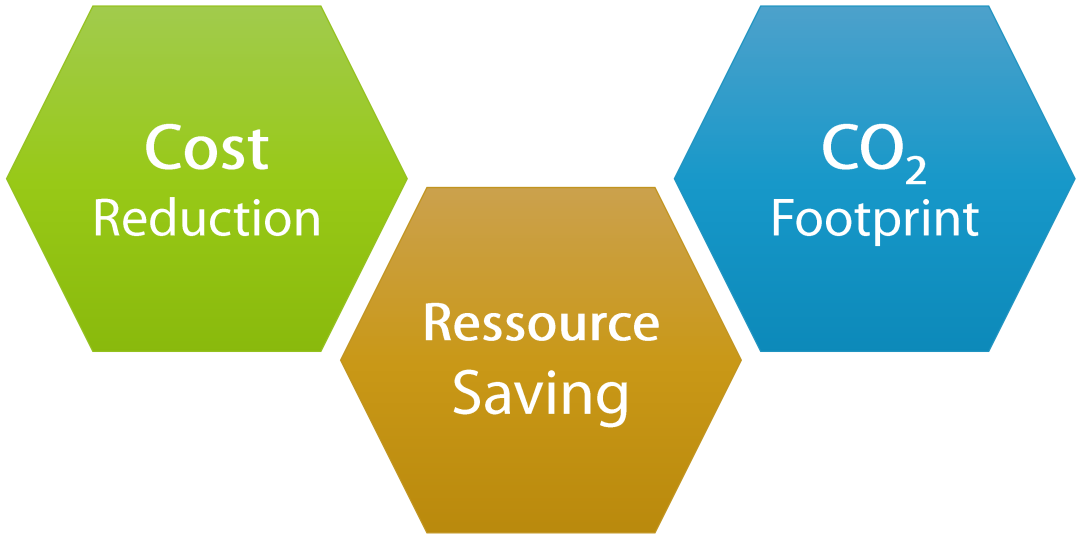
Additional Commercial Benefit:

Enabler to **meet Targets** required by **emerging Laws** and hence to **avoid Taxes, Fees & Penalties:**

- ✓ CO_2 / GHG Emissions
- ✓ Recycling Efficieny

Summary

Battery Recycling is **highly important!**



Smart Technology for **easy Disassembly** enables to **unleash** the **Potential**

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