

# Disassembly process: The TREASURE vision

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# Motivation

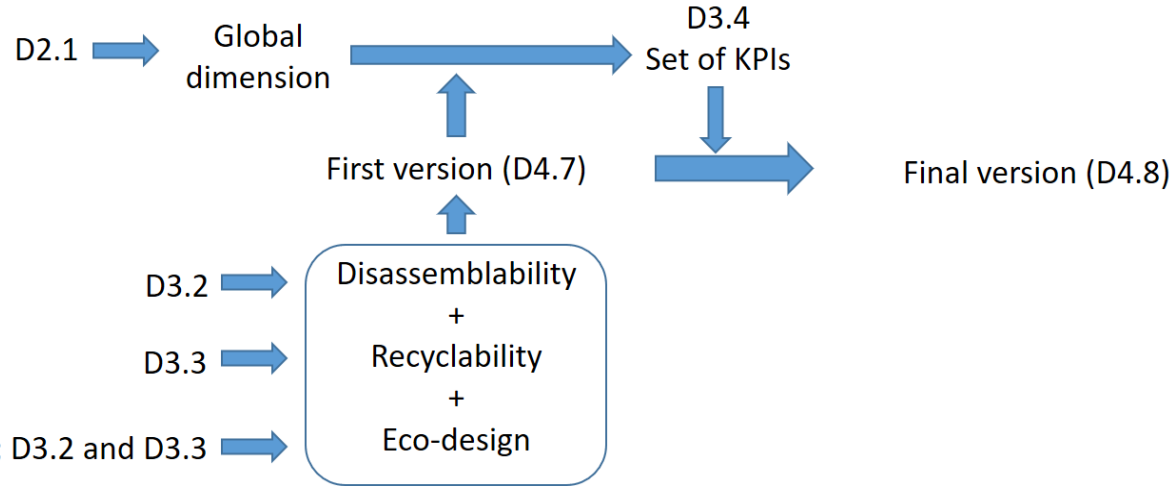


- The manufacturing of one car needs more than 50 metals being the highest part of them critical.
- Current recycling methods applied to ELV are ineffective for minor metals recycling.
- Every 4 recycled ELV the capital mineral of one is lost for downcycling.
- To improve the recycling needs the application of alternative processes mainly based on metallurgical operations.
- The effectivity of these processes needs high concentrations of critical and valuable metals.
- Disassemblability operations of these car parts or even subparts with high valuable metal concentrations are required.

## Previous consideration:

Considering a sample of ELVs from 2018 to 2021, from an overall amount of 4.483 ELVs, 170 came from accidents (3,79 %). In the cases of vehicle accidents, disassembly operations are complicated or even impossible. However, this is a small percentage of cases over the total. Accordingly, the recommendations are focused on obsolete ELV, and should be considered the norm.

# Disassemblability inside TREASURE



Disassembly time

Level 1 3min ⓘ

Level 2 2min ⓘ

Cobot

Manual only

Materials value

Ferrous metal	12,34€
Non ferrous metal (excluding Al)	18.43€
Non ferrous metal (Al)	10.43€
Plastics	2.43€

Disassemblability metrics

Insert your hourly cost  €/h

Disassembly time [s]	220 s
Disassembly cost [€]	15,99 €
Market value [€]	50,00 €
Difficulty level (level 1) [H/M/L]	L

# Methodology



Metal composition for each car part  
(Internal IT system of SEAT)



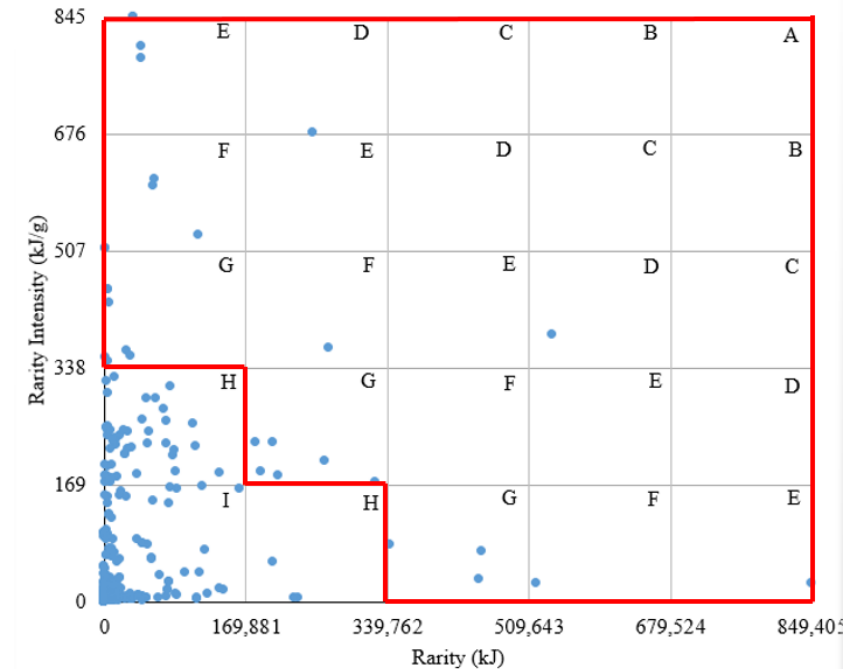
Thermodynamic Rarity by car part



More critical car parts selection  
(Thermodynamic Rarity and  
Rarity intensity)

- Assessment of Thermodynamic rarity [kJ] and Rarity intensity [kJ/g] for each vehicle component.
- The second allows to identify those components that despite having little weight, have a high concentration of valuable metals with respect to their total weight.

*\*Ortego. A, Valero. A, Valero. AI, Iglesias-Émbil, M. Towards material efficiency vehicles. Eco-design recommendations based on metal sustainability assessments. SAE International Journal of Materials and Manufacturing. September 2018.*



# Disassemblability process



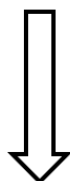
Critical parts identification – Deliverable 3.1

## Difficulty level

Difficulty level	Number and type of tools needed		Number of parts to be disassembled before		Are 2 or more persons required?
High	>5 OR unconventional	OR	>3	OR	YES
Medium	(1-5)	AND	[1-3]	AND	NO
Low	1	AND	0	AND	NO



**Disassemblability analysis**  
**Deliverable 3.2**



Ecodesign  
recommendations and  
conclusions

Level 1: Disassembling for the car






Level 2: From the main part to smaller subparts (if possible)



Level 3: From smaller subparts to recycling fractions (if possible)

- Ferrous metal
- Non ferrous metal (excluding Al)
- Non ferrous metal (Al)
- Plastics

# Case study

SEAT Leon model II	
	
Plate number	VIN number
0610FMW	VSSZZZ1PZ7RD78528
SEAT Leon model III	
	
Plate number	VIN number
7047JCW	VSSZZZ5FZFR111108
SEAT Ibiza model IV	
	
Plate number	VIN number
7071HDK	VSSZZZ6JZBR104727

## SEAT Leon Gen II:

This model was manufactured from 2005 to 2012

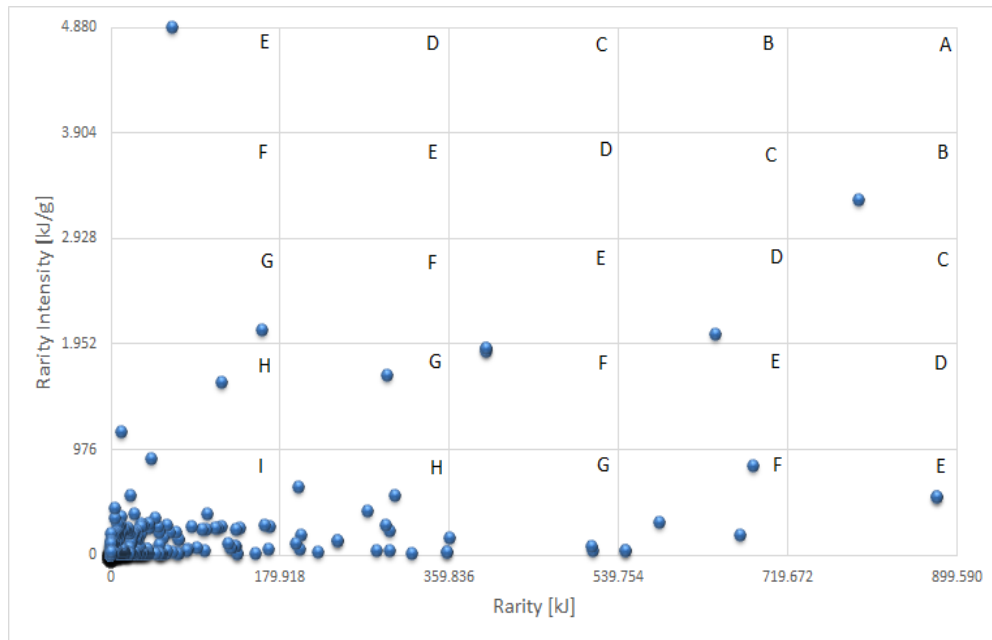
## SEAT Leon Gen III:

This model was manufactured from 2012 to 2020

## SEAT Ibiza Gen IV:

This model was manufactured from 2008 to 2017

# Case study



- 996 kg of metal weight
- 836 car parts with metals



SEAT León Gen II



SEAT León Gen III










SEAT Ibiza Gen IV

- 904 kg of metal weight
- 754 car parts with metals

- 867 kg of metal weight
- 671 car parts with metals

# Main results

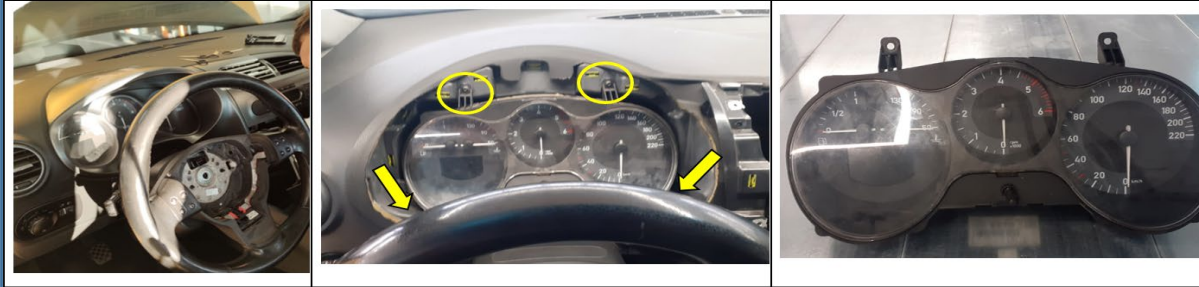
Car part		Leon II	Leon III	Ibiza IV
		More critical metals from Rarity point of view and share over the car part Rarity (%)	More critical metals from Rarity point of view and share over the car part Rarity (%)	More critical metals from Rarity point of view and share over the car part Rarity (%)
	Infotainment	Ta (57%); Pd (26%); Au (7%)	Ta (64%); Au (18%); Pd (5%)	Ta (64%); Au (18%); Pd (5%)
	Combi instrument	Au (53%); Ta (36%); Pt (6%)	Ta (76%); Au (8%); Pd (6%)	Au (45%); Ta (31%); Pt (16%)
	Exterior mirrors	Zn (60%); Cu (34%); Ni (2%)	Cu (44%); Ta (21%); Zn (15%)	Cu (77%); Mg (5%); Zn (5%)
	Additional brake lighting	Au (53%); Ta (37%); Pt (6%)	Ta (73%); Au (8%); Pd (6%)	Cu (79%); Cr (18%); Mn (1%)
	Speed sensor	Au (91%); Cu (4%); Pd (4%)	Au (91%); Cu (4%); Pd (4%)	Au (91%); Cu (4%); Pd (4%)
	Rain sensor	Au (53%); Ta (37%); Pt (6%)	Ta (73%); Cu (7%); Au (7%)	Non available in this model
	Air quality sensor	Non available in this model	Ta (76%); Au (7%); Pd (6%)	Non available in this model

## Overall 19 studied car parts



# Main results

Disassemblability Level 1



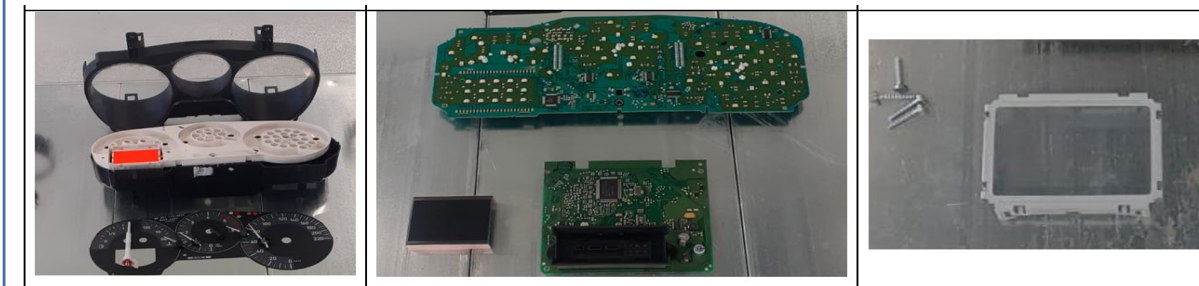
9 min  
Standard tools

Disassemblability Level 2

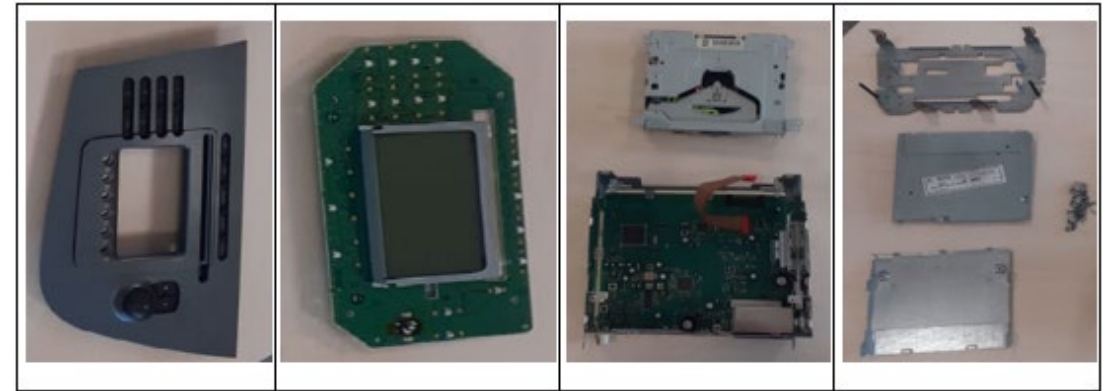


< 5 min  
Standard tools

Disassemblability Level 3

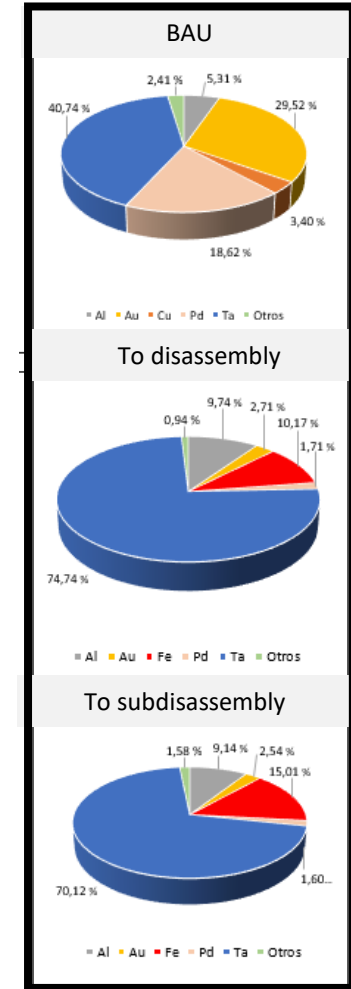
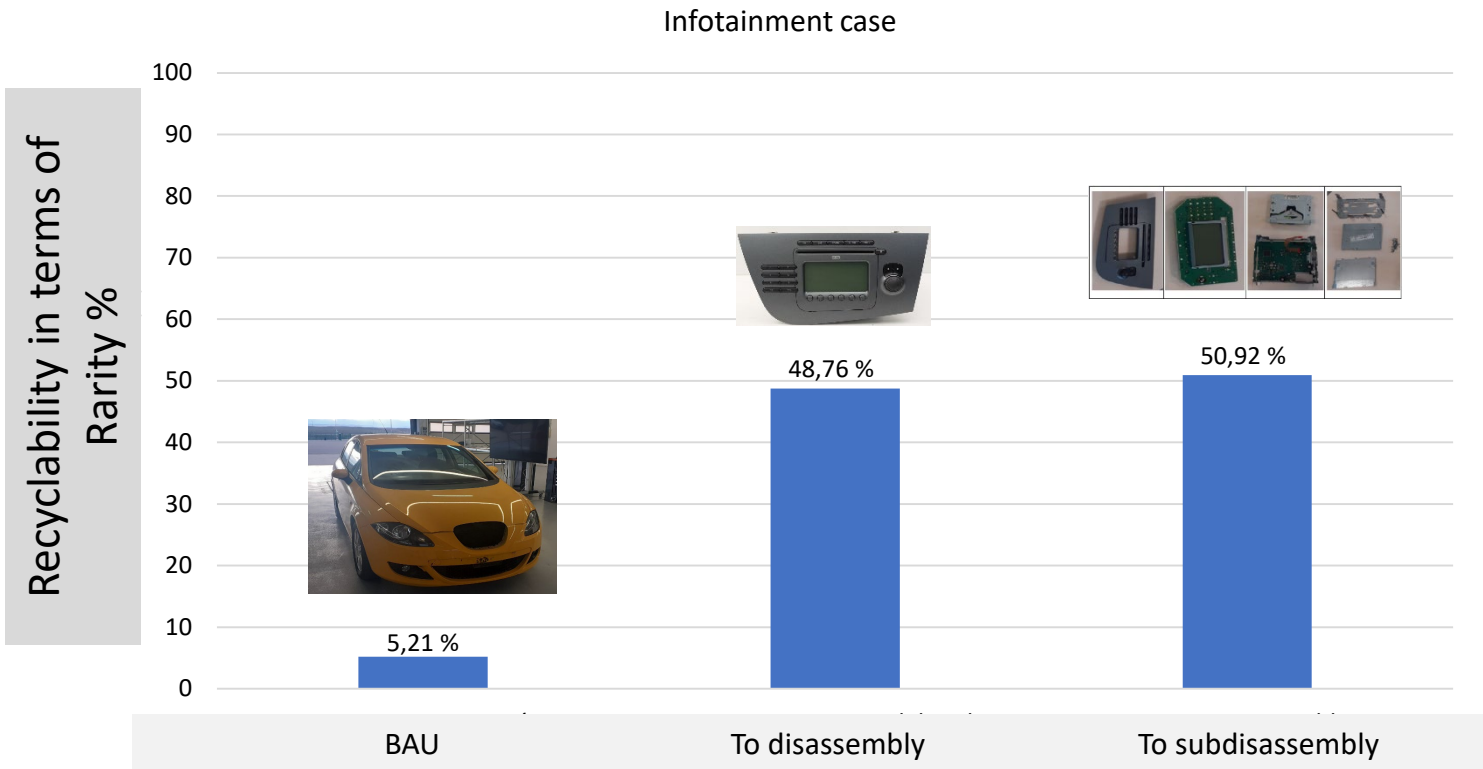


# Main results



# Main results

## Why is disassembly important?



# Relevant outcomes



- There is only one part (exterior mirror) that is usually exposed in case of an accident. The other parts are protected and should be available for subdisassembly.
- There were several car parts that needed to be removed in order to access the selected critical part.
- The average disassembly time is 11 min. There is only one part in SEAT Leon model II with a quite high disassembly time (exterior mirrors – 50 minutes).
- Only one part (infotainment used in SEAT Leon model II and SEAT Leon model III) requires non-standard tools for the disassembly process.
- Only one part (speed sensor) cannot be subdisassembled into the required recycling fractions. In the rest of the cases, different subparts can be subdisassembled. Nevertheless, the separation degree achieved for the different fractions varies according to the given car part.

# Disassemblability beyond TREASURE



65 kg



96 udes of permanent magnets – 2 kg



# Main conclusions



- In ELV, the residual value of the vehicle is very small, and disassembly processes need to be much faster and straightforward to facilitate a proper recycling of critical raw materials.
- Considering the analysed parts, they are not frequently repaired. Although there are still professionals who repair combi-instruments or generators, repairability is not cost-effective in most cases. This fact makes that such parts are not designed to be subdisassembled. As a result, it is not easy to obtain recycling fractions rich in high critical raw material concentrations so that specific metallurgical recycling processes can be applied.
- Most of the electronic car parts frequently use fast join methods such as glues or thermal rivets, because manufacturing costs are considerably reduced. However, this is very counterproductive from a repairability and recyclability point of view as subdisassemblability is often hindered.

# Main conclusions

- Vehicle design focuses on fast and cheap manufacturing processes.
- BUT, this often works against the disassemblability and recyclability of the product.
- The current transition to new types of vehicles (electric, connected) must seriously rethink design, given the supply chain problems and the scarcity of raw materials recently faced by the car manufacturing industry.
- This new design should be oriented towards reusability, repairability and recyclability to prevent the further loss of 25 % of the mineral capital used in vehicles.



To 65 kg of car part to 2 kg of permanent magnets

# Thank you for your attention