Life Cycle Assessment of the Eurostar Neo Battery Pack

DEFENCE AND SPACE

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ESA Clean Space Industrial Days

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Agenda

- The Eurostar Neo Battery
- LCA study cope definition
- Pack decomposition and Assembly Processes
- Data Quality Rating in line with ESA LCA guidelines
- LCA results: Relative impact contribution of each defined component
- Normalisation
- Alternative Scenarios
- Critical Raw Materials (CRM) Assessment

The Eurostar Neo Battery

- Integrated in Eurostar Neo satellites
- Manufactured by ADS up to two times per year
- Up to 27 kW
- Lithium-ion cells
- Cells assembled into modules
- Modules assembled into 2 packs (>250 kg)

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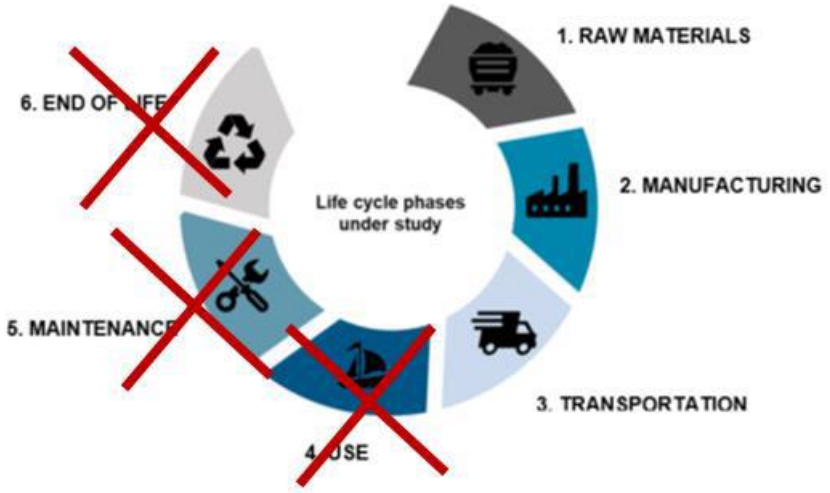
LCA of the Eurostar Neo Battery: Scope definition

System boundaries (Cradle to gate)

- Raw material extraction or production
- Production of the different parts
- Transportation from supplier to ADS (only for cell and for collectors suppliers)



Functional Unit

- “the production of one Eurostar Neo Battery“ by Airbus Defence and Space in Toulouse.

= 1 PX pack and 1 MX pack

Data sources

Battery centre from ADS, in Toulouse

- 1st step: Components and weight breakdown + description of production steps.
- 2nd step: Set of interviews for further details on each process and material composition.

LCI databases and scientific publications

- 3rd step: Literature review, in particular for the cells.

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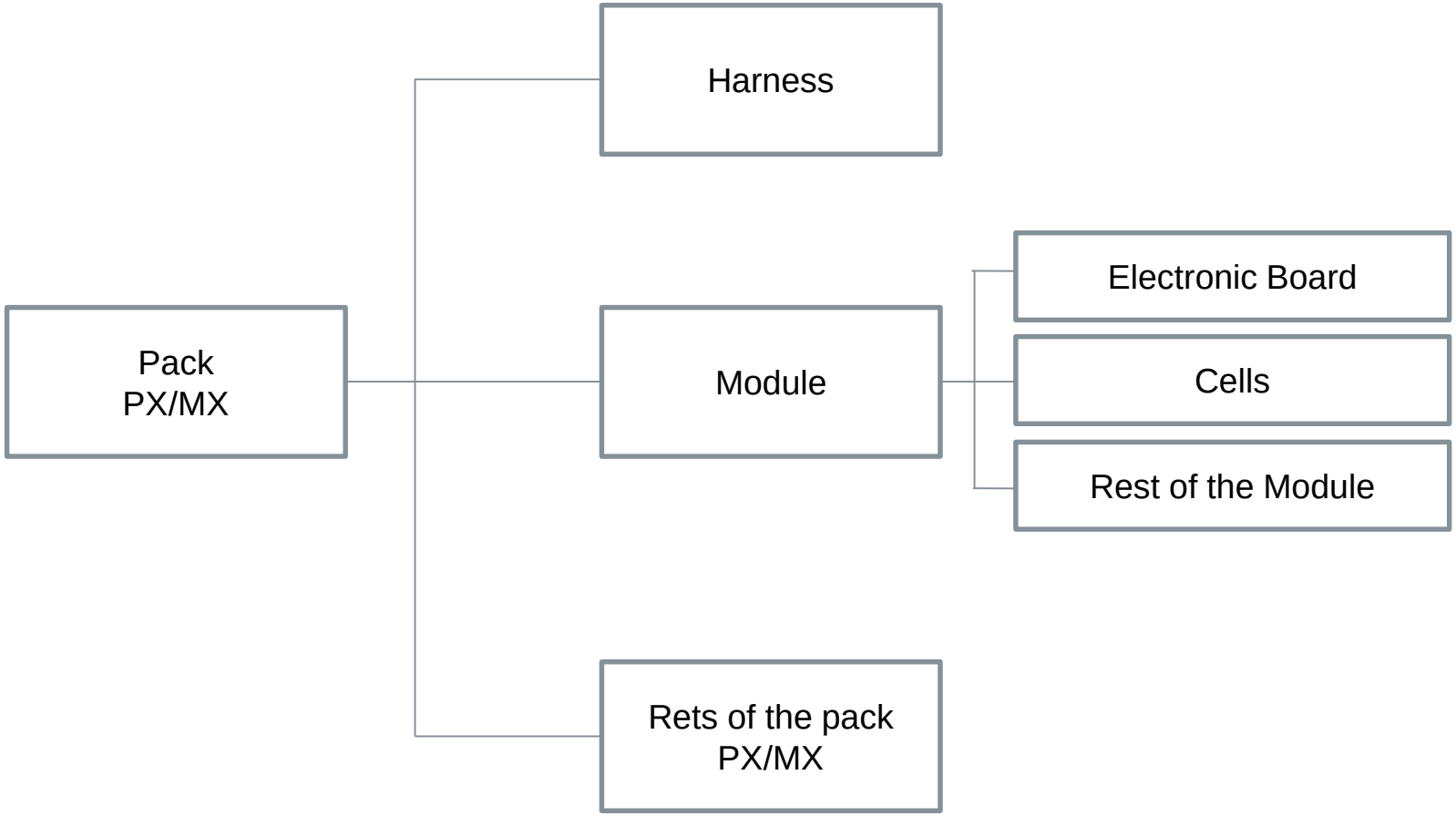
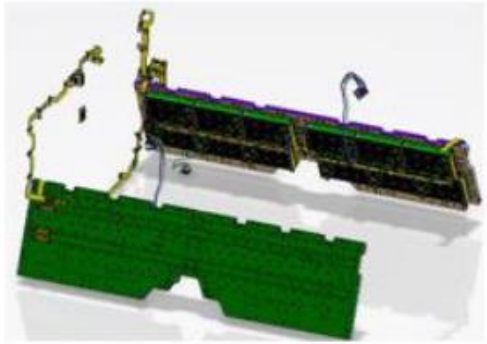
Pack decomposition





Pack PX/MX

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The module

- Composed by :
  - 180 lithium-ion cells
  - Base plate / 0,5 kg
  - Metallic collectors
  - Electronic board / 0,142 kg
  - Other : fixing, support
- Total mass : 10,9 kg
- All 23 modules integrated in the packs have the same structure.

The lithium-ion cells

- Standard lithium-ion cell
- Manufactured in Asia
- Type NMC 811 Cathodes (nickel/manganese/cobalt)
- Graphite-Silicon Anodes
- Dimensions : 18*65 mm
- Total mass : 47g

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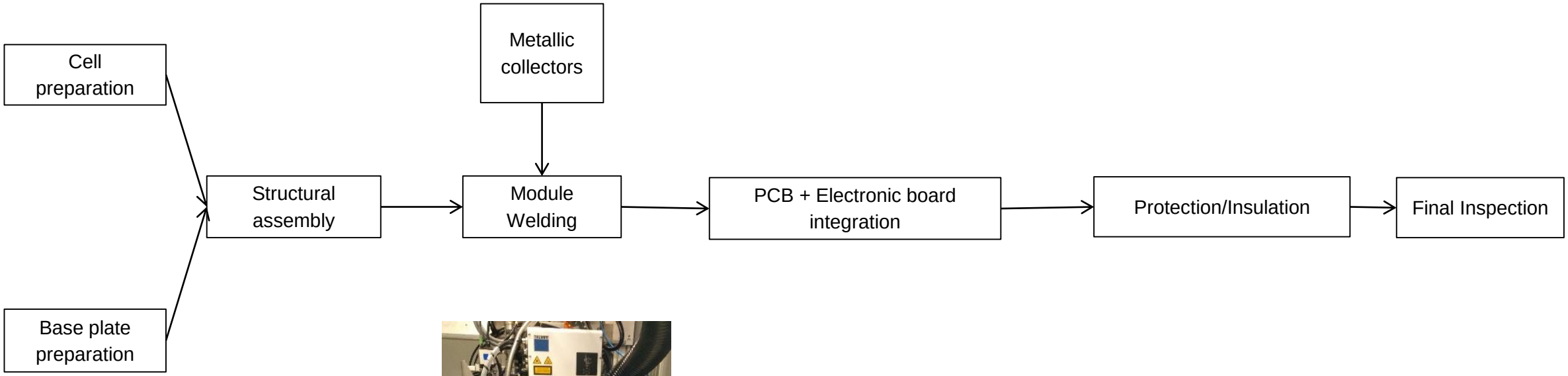
The module assembly process



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Data Quality Rating *in line with ESA LCA guidelines*

Technological Representativeness

Geographical representativeness

Time-related representativeness

Completeness

Precision/ uncertainly

Methodological appropriateness and consistency

Project: LCI dataset:
Date: Reviewer:

Indicator	Sub-quality parameters	Rating 1 (Excellent)	2 (Very Good)	3 (Good)	4 (Fair)	5 (Poor)
TeR	Expert judgement based on the consideration of the production process and materials	Technology aspects have been modelled using data from enterprises, processes and materials under study	Technology aspects have been modelled using data from processes and materials under study but from different enterprises	Technology aspects have been modelled using data from processes and materials under study but from different technology	Technology aspects have been modelled using data related to process or materials but the same technology	Technology aspects ha been modelled on relat processes or materials b different technology o unknown
GR	Expert judgement based on geographical coverage of data	Involve data from the specifc area under study	Involved average data from a larger area in which the area under study is included	Involved data from an area with similar production conditions	Involved data from an area with slightly similar production conditions	Involved data from unknown area or area w very different productio conditions or unknow
TiR	Expert judgement based on defined time on data inventory	All the data sources refer to the defined time and are ≤3 years of difference to year of study	Most of the data sources refer to the defined time and are 3 to 6 years difference	At least half of the data sources refer to the defined time and are 5 to 10 years difference	Less than half of the data sources refer to the defined time and are 10 to15 years difference	None of the data source refer to the defined time age of data is unknown is ≥15 years of differenc
C	Consideration of impact categories and share of elementary flows (to adjust the final rating)	>80% of Process completeness determined flows have been evaluated and given a value, and ≥15 considered impact categories	60-79% of determined flows have been evaluated and given a value, and 12-14 considered impact categories	40-59% of determined flows have been evaluated and given a value and, 8-11 considered impact categories	<40% of determined flows have been evaluated and given a value, and 5-7 considered impact categories	Process completeness not scored unknown, and ≤5 considered impact categories
P[1]	Expert judgement based on the precision/uncertainty of data sources	Very low uncertainty and/or very high precision	Low uncertainty and/or high precision	Fair uncertainty and/or fair precision	High uncertainty and/or low precision	Very high uncertainty and/or very low precision unknown
M	Definition of situation context and subsequent expert judgement of system boundaries, multi-functionality and EoL	Inclusion of all LCA stages (with the EoL stage). Consideration of allocation procedures. Completion in a very high degree	Inclusion of most relevant LCA stages. Consideration of allocation procedures. Completion in a high degree	Inclusion of a still sufficient LCA stages. Consideration of allocation procedures. Completion in a sufficient degree	Inclusion of sufficient LCA stages. Consideration of allocation procedures. Completion in a low degree	No inclusion of sufficient L stages. No consideration allocation procedures (multifunctionality has no been solved according to t situation context). Complet in a low degree or unkno

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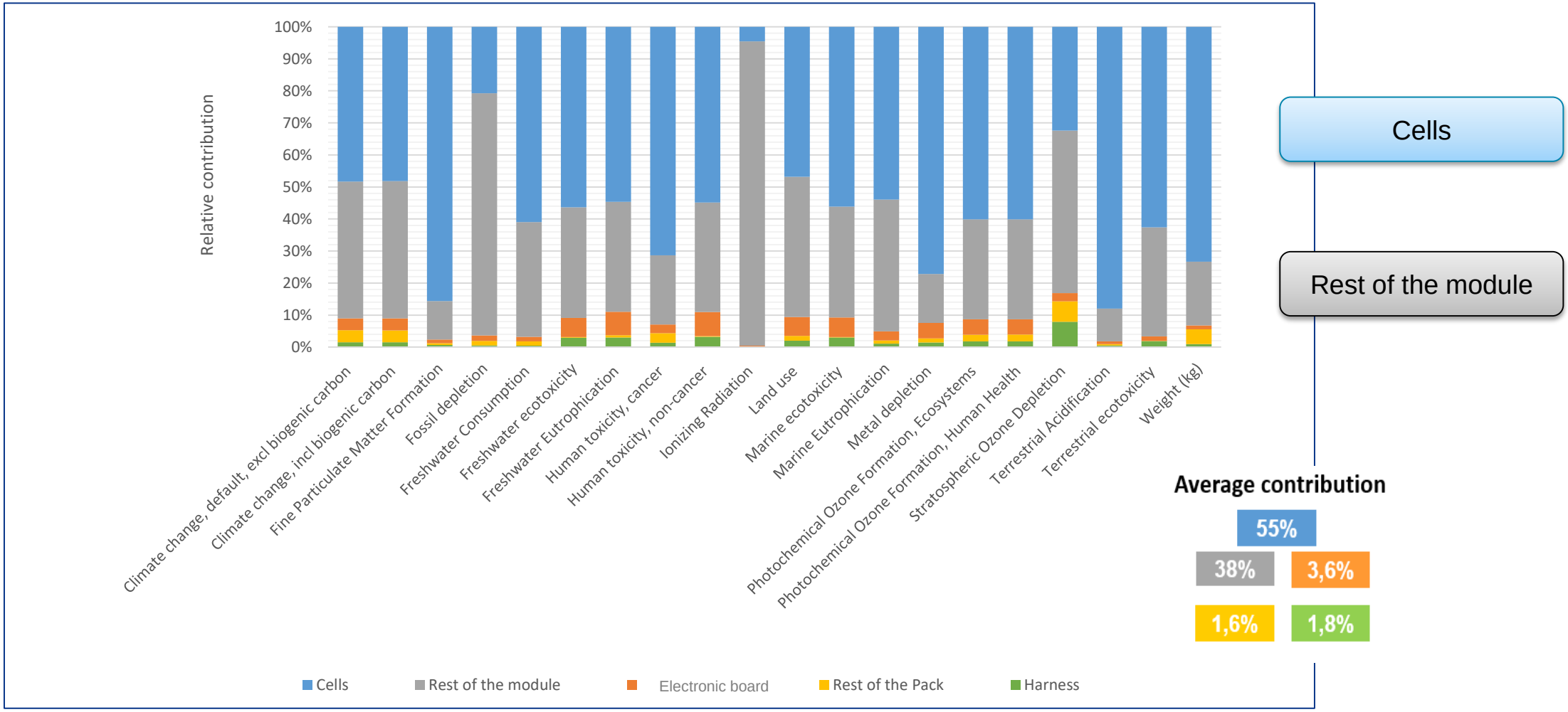
LCA results: Relative impact contribution of each defined component



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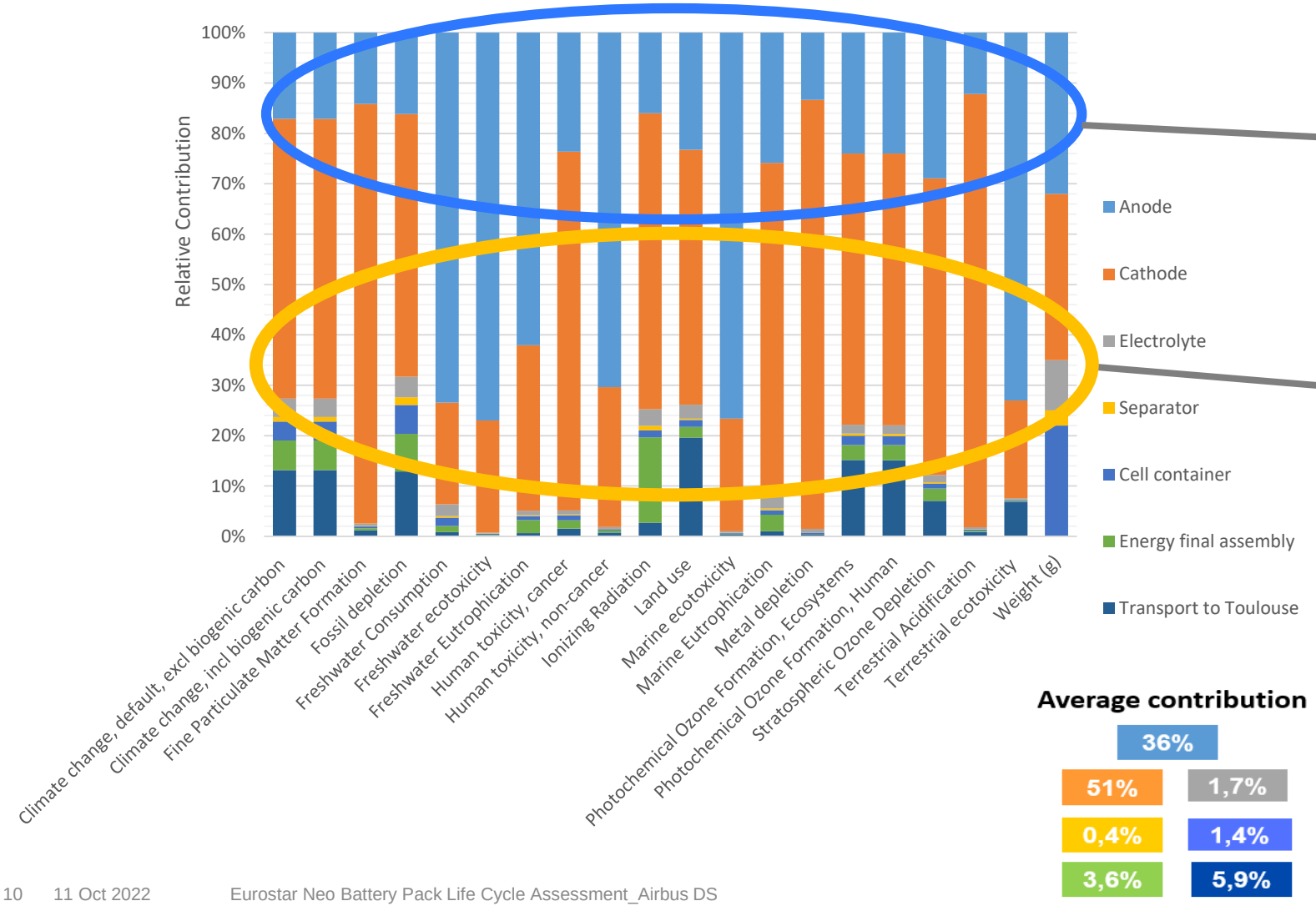
Cells



Anode:
Foil Cooper average contribution of 73%
Silicon average contribution of 22%
Energy (mix from Asia) has important impact on IR (>30%)

Cathode:
Nickel average contribution of 60%
Lithium average contribution of 14%
Energy (mix from Asia) average contribution of 12,5%, high impact on IR (>60%)

Average contribution

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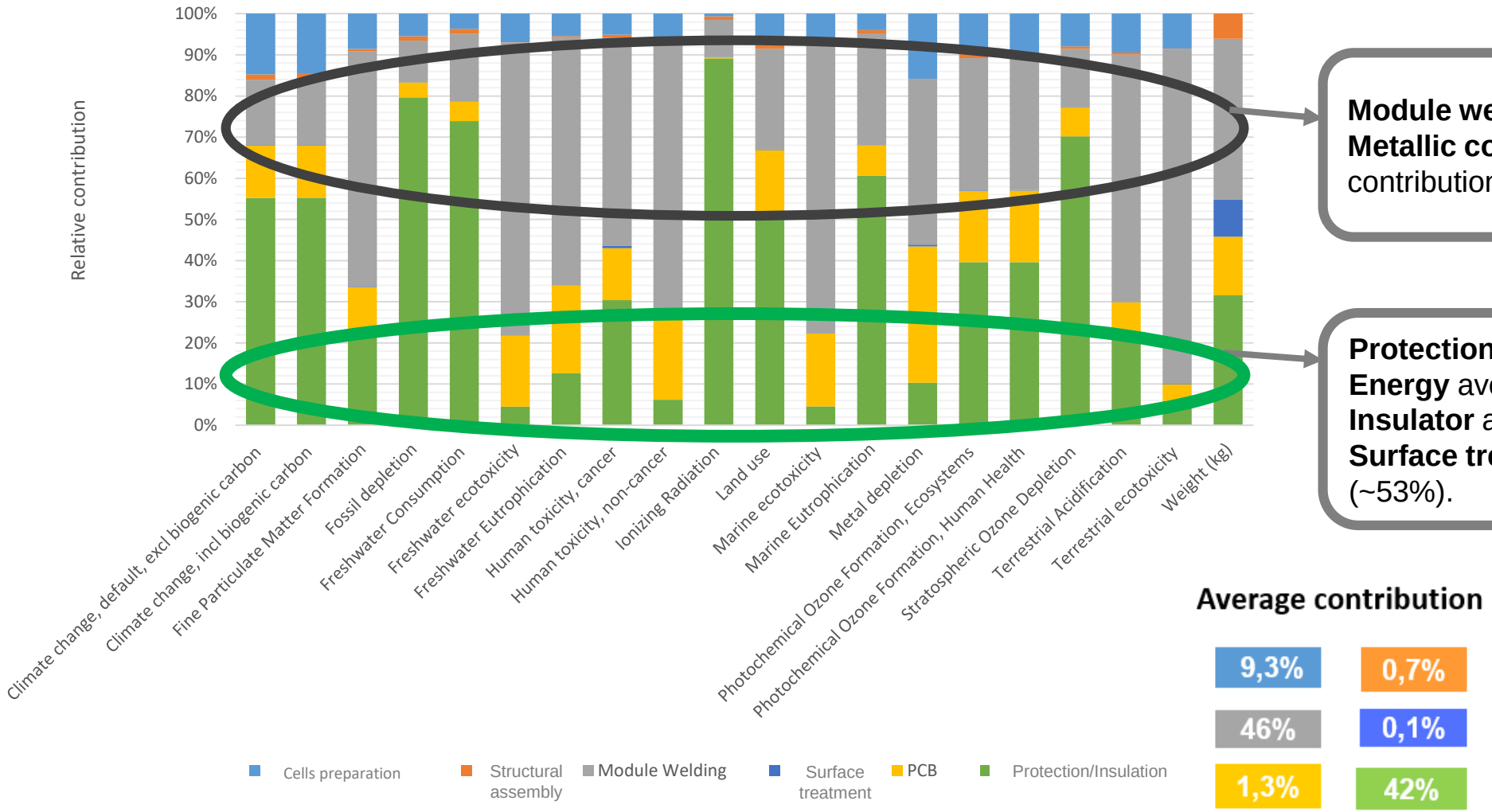
Rest of the module



Module welding:
Metallic collectors together have an average contribution of 67%

Protection/Insulation:
Energy average contribution of 73%
Insulator average contribution of 22%
Surface treatment has important impact on OD (~53%).

Average contribution

9,3%	0,7%
46%	0,1%
1,3%	42%

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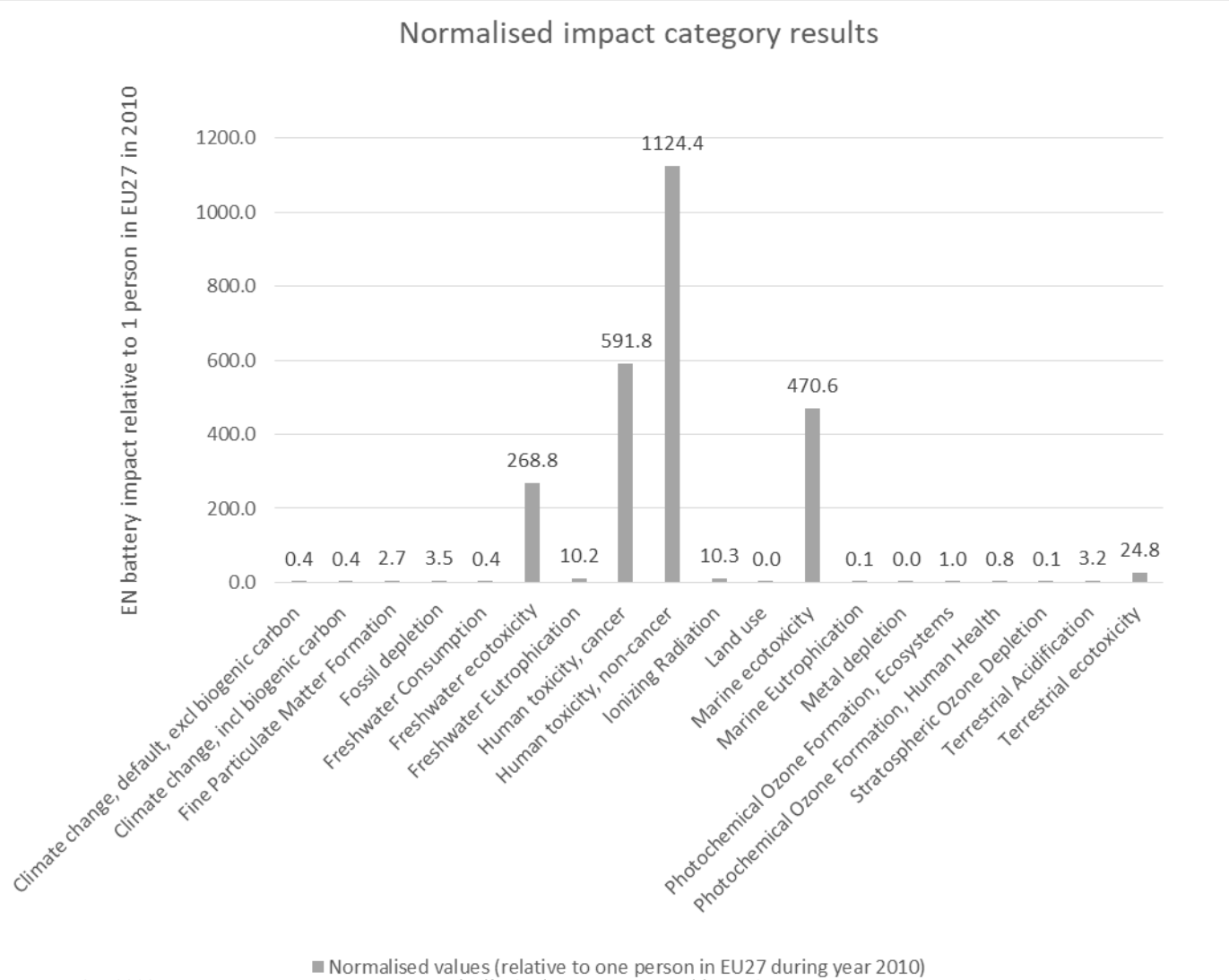
Normalisation



- **FE, HT/HTN and ME** exhibit significant values due to cell and module production:

- Nickel present in the cathode
- Cooper present in the anode
- Metallic collectors

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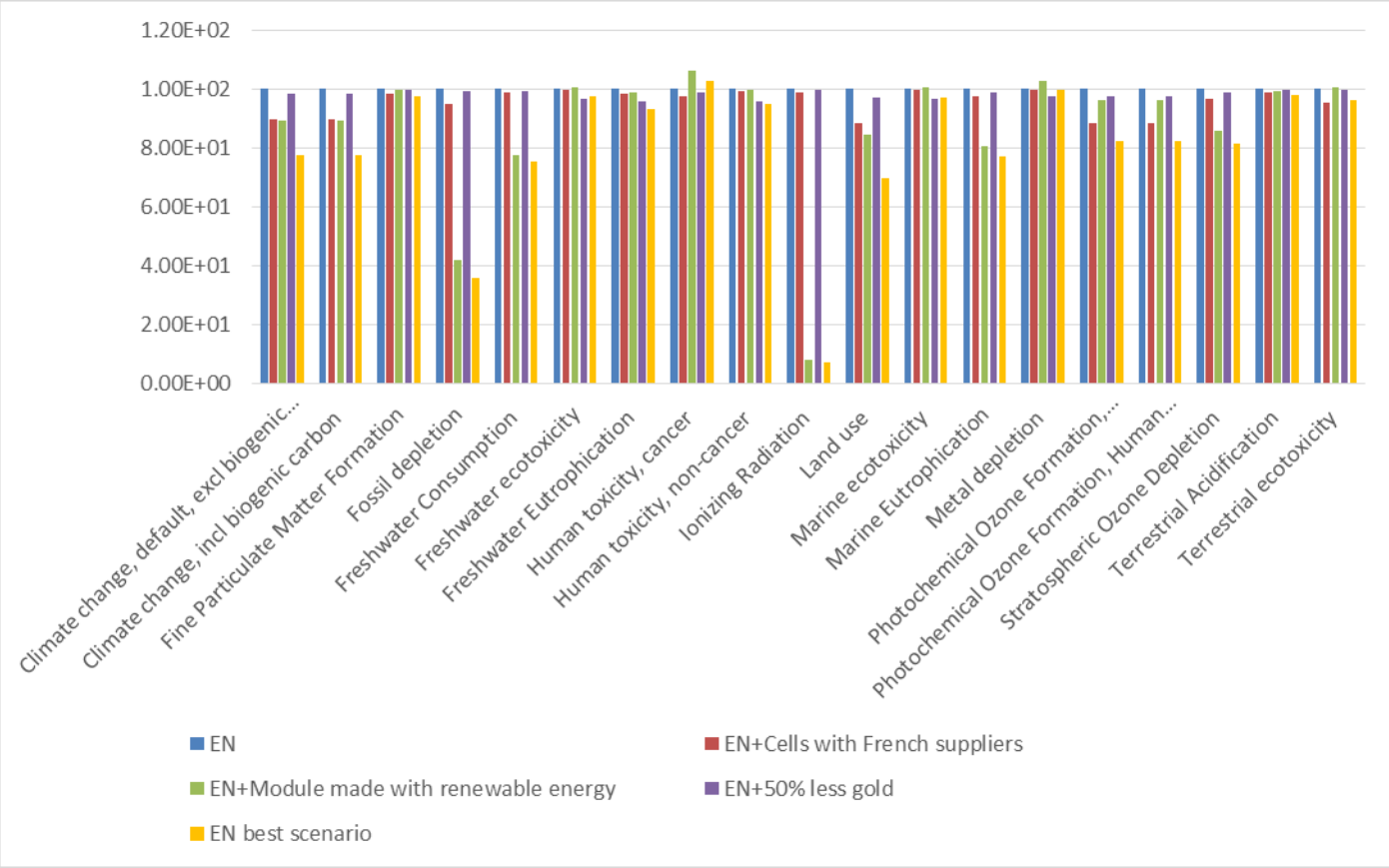
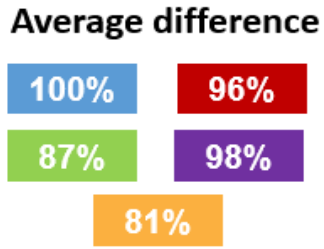
Alternative Scenarios



1. Cells supplied by a French supplier
2. Module manufactured using renewable energy source (such as a wind farm)
3. 50% less gold on electronic parts (harness, electronic board)
4. *The best scenario with all of the above points implemented.*



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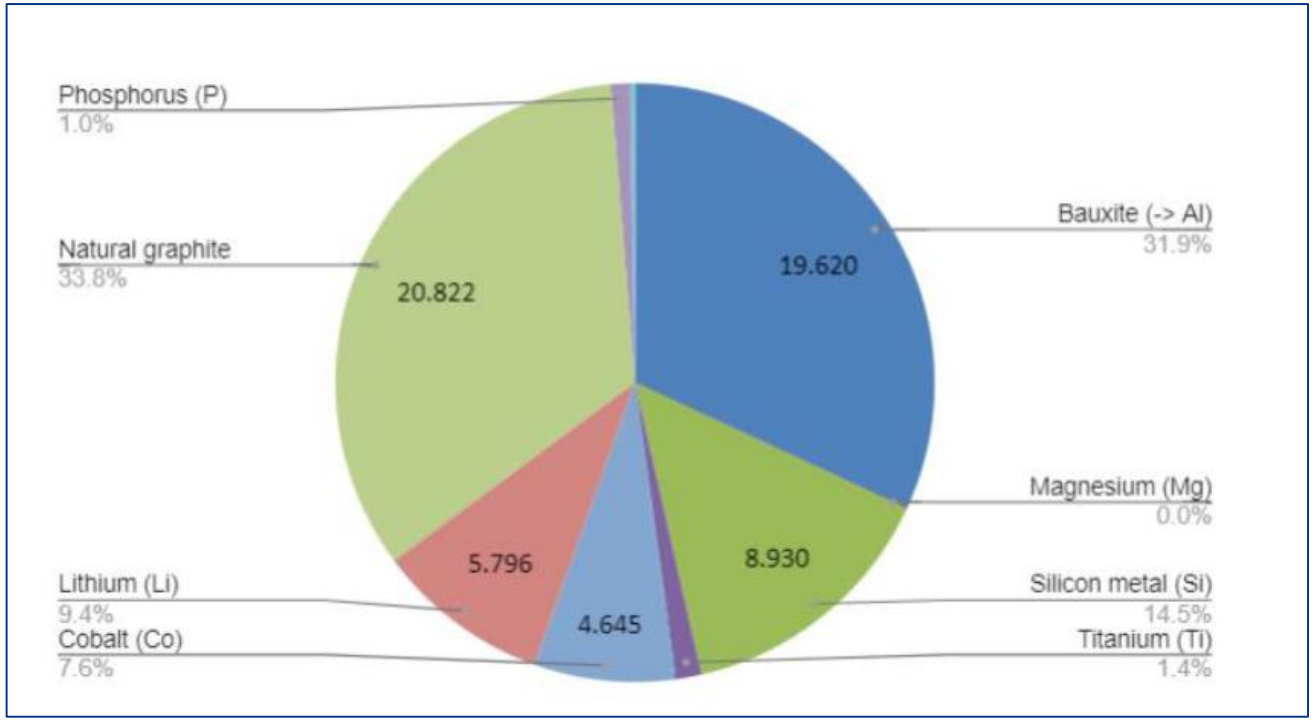
Critical Raw Materials (CRM) Assessment

- ***CRM:*** *Materials that have high economic importance for the EU and whose supply is associated with high risk. The list includes 27 raw materials that are now considered critical by the European Commission.*

  (Source: Methodology on CRMs 2017 by the European Union)

- CRM contribute approximately 15 wt.% of the battery pack
- **Lithium** and **cobalt** used in the cathode
- **Graphite** and **silicon** used in the anode
- **Bauxite, Magnesium**, **Phosphorus** and **Titanium** used in other components



Proportion by weight of CRM making up the 15 wt.% CRM in the Eurostar Neo battery pack, Adapted *from* ***Critical Raw Materials: Assessment of usage, Associated risks and recommended Mitigation actions****, ADS 2022*

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- Questions

For any questions, do not hesitate to contact us:

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Thank you