

# A TRANSPORT SPECIFIC LIFE-CYCLE ASSESSMENT

## THE EUROPEAN SUPPORT ACTION TRANSENSUS LCA

Final Event

### Experiences from the road testing

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on behalf of the TranSensus LCA Consortium

June 24, 2025

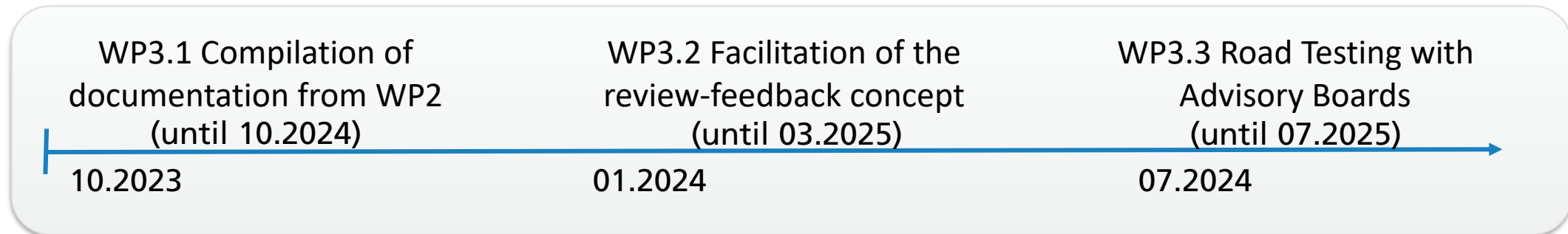


Funded by  
the European Union

GA # 101056715

# Overview of WP3

- WP3.1 and WP3.2 finished;
- D3.1 and D3.2 finalised;
- WP3.3 last steps: D3.3 handed in last week





# Road testing – presentation of road testing approach



- **Defining the test cases:**
  - Full vehicle: BEV LDV, BEV HDV Truck, BEV LDV S-LCA
  - FCEV: only FCEV specific requirements
- **Developing an average BOM for BEV LDV and HDV test cases via EUCAR**
  - LDV: BMW, Renault, VW
  - HDV: Scania, Volvo Trucks, MAN, Ricardo and ACEA literature data
- **Testing mandatory requirements & additional scenarios based on D2.3**
  - Using a mix of semi-quantitative (data availability/time effort) and qualitative (understandability) criteria
  - Rating by non-industry and industry working group members

# Methodological and editorial feedback

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- **Methodological feedback:** 8 topics

- Topics that proved difficult/impossible to be implemented without further amendment

- **Editorial feedback:** 14 topics

- Changes in unclear wording
- Additional explanation

# Methodological feedback

## Example 1: Default lifetime km per segment (LDV/LCV)



### Challenge:

- No definition of what a segment is (curb weight, power etc.) is given, OEMs use their own segmentation, no harmonisation on segments on UNECE level yet

### Solution:

- Keep the current table and state that no harmonisation of segments yet exists – until then use the 200,000 km for all segments but update the methodology once segments and default lifetime kilometres are being harmonised (e.g. based on UNECE)

# Methodological feedback

## Example 2: Charging losses in VECTO (HDV)

### Challenge:

- VECTO does not include charging losses like WLTC values (only internal battery charging losses)

### Solution:

- Statement that this gap will be filled once a harmonised approach is available (likely under the HDV CO<sub>2</sub> regulation or UNECE A-LCA IWG. Until then the following default values shall be used OR verifiable OEM specific ones
  - 10% charging losses for plug-in charging (unspecified)
  - 15% charging losses for dynamic charging/ERS (i.e. catenary or in-road charging system)
- Advisory Board feedback resulted in an additional clearer definition of “charging losses”

# Methodological feedback

## Example 3: Safeguards on EAC use

### Challenge:

- A list of characteristics (e.g. additionality, geographical consistency) shall be documented for every EAC used in the production phase. This is too time-intensive for the OEM background system

### Solution:

- OEMs shall document the adherence to these safeguards by making the EACs used in the foreground system available to a third party verifier. For the OEM's background system the safeguards shall be part of the contract between OEM and tier-1 supplier.

# Editorial feedback

## Example 4: Biogenic CO<sub>2</sub>

### Challenge:

- No statement on how to deal with biogenic CO<sub>2</sub> can be found in the current guideline

### Solution:

- We propose to add the information that biogenic CO<sub>2</sub> is currently excluded from the overall GWP results because of the referenced EF database. In case the EF database will include biogenic CO<sub>2</sub> in the future, it will also be included in the TSLCA GWP results.



# Additional scenarios (examples)

## Circular economy scenarios

- TSLCA is broadly applicable but certain adjustments necessary e.g. regarding refining assumptions around vehicle lifetime and electricity mix for stationary battery applications

## Future battery cell chemistries

- Classification of battery components as either "waste" or "good" at end-of-life is influenced by chemistry-specific recycling economics which introduces uncertainty as technologies evolve

## Vehicle-to-grid

- Adjustments are needed to account for energy fed back into the grid, and any additional technical equipment required for discharging must be included in the bill of materials

# Key Take Aways

- **Different stakeholders** should be involved in the testing to allow for a broad applicability perspective
- **Feedback loops** are needed to incorporate identified gaps and room for interpretation in the final methodology
- **Timing:** the road testing should accompany the methodology development phase and be planned with sufficient time
- **Secondary data** will remain a key ingredient for the comparability of vehicle LCAs (also for level 3-4)
  - Harmonised secondary datasets are needed for a higher degree of comparability
  - Secondary processes with up-to-date market-based energy mixes must be made available
- **Dependency** on other initiatives
  - Fulfilment of more demanding level 3 primary data requirements possible when third-party verified tools to exchange info between suppliers and OEMs are available (e.g. Catena-x)

# Results LDV BEV test case

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# Results LDV BEV: Parameters

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**Functional unit:** 1 p-km

**Weight of the vehicle:** 1984 kg

**Total Electricity use:** 40680 kWh

**Battery info:** 70 kWh

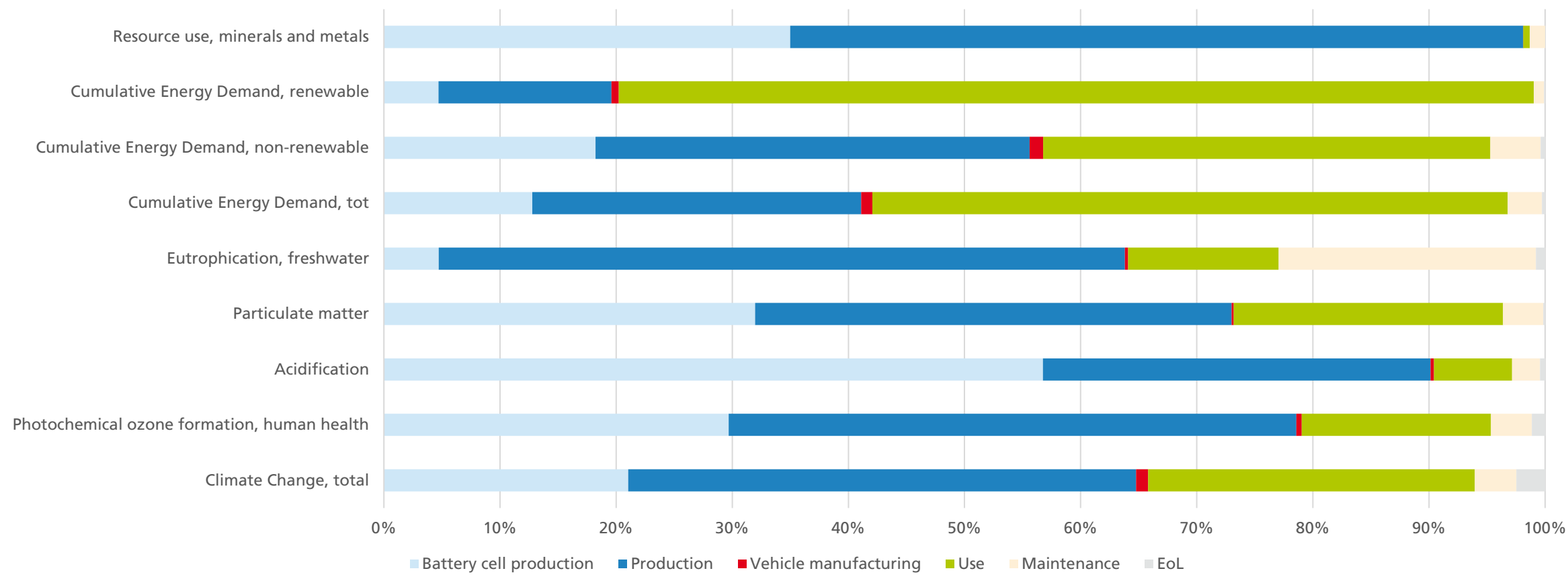
**Yearly driven kilometers:** 13 333 km

**Lifetime kilometers:** 200 000 km

**Electricity in use phase:** EU dynamic uniform grid mix

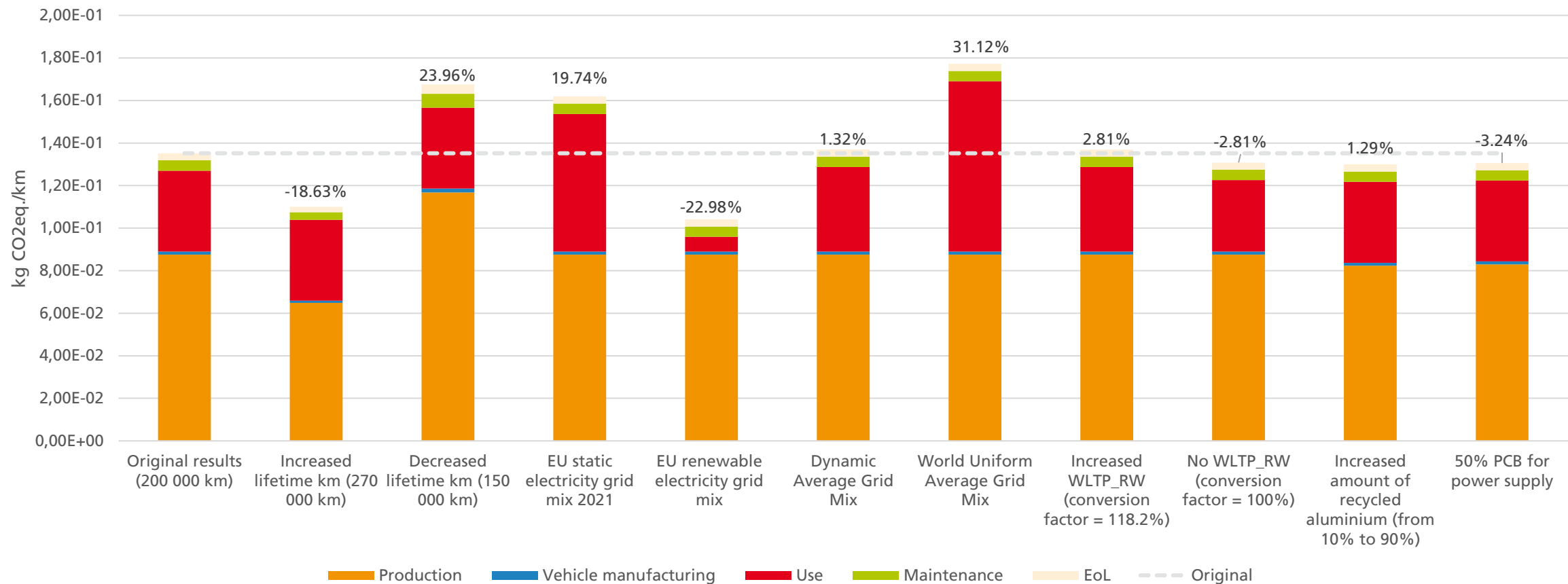
Results are divided into material production, vehicle manufacturing, use, maintenance and EoL.

# Results LDV BEV: Contribution





# Results LDV BEV: Sensitivity/Scenario Analysis – per km



# Results HDV BEV test case

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# Results HDV BEV: Parameters

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**Functional unit:** 1 Tonne-km

**Weight of the vehicle:** 10 811 kg

**Energy consumption:** 1.19 kWh/km (without charging losses)

**Charging losses:** 10 %

**Battery info:** 610 kWh, 2422 kg

**Payload (weighted average):** 13.84 Tonnes

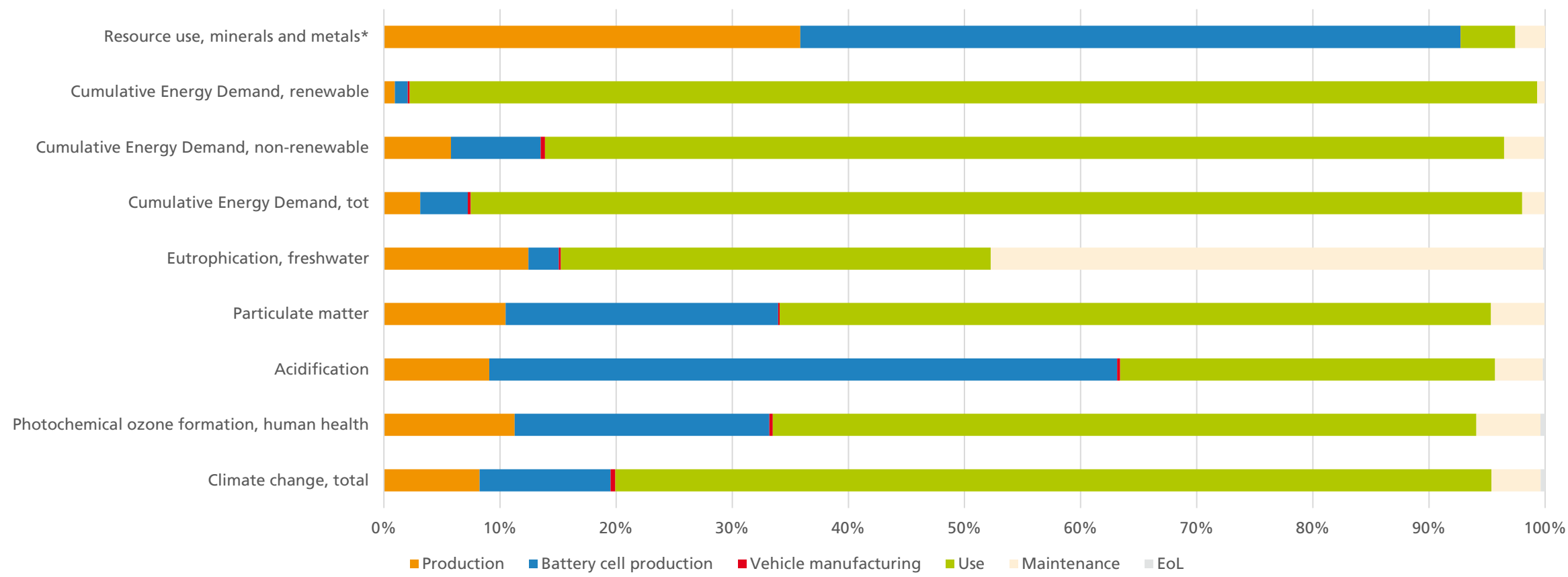
**Yearly driven kilometers:** 116 000 km

**Lifetime kilometers:** 1 392 000 km

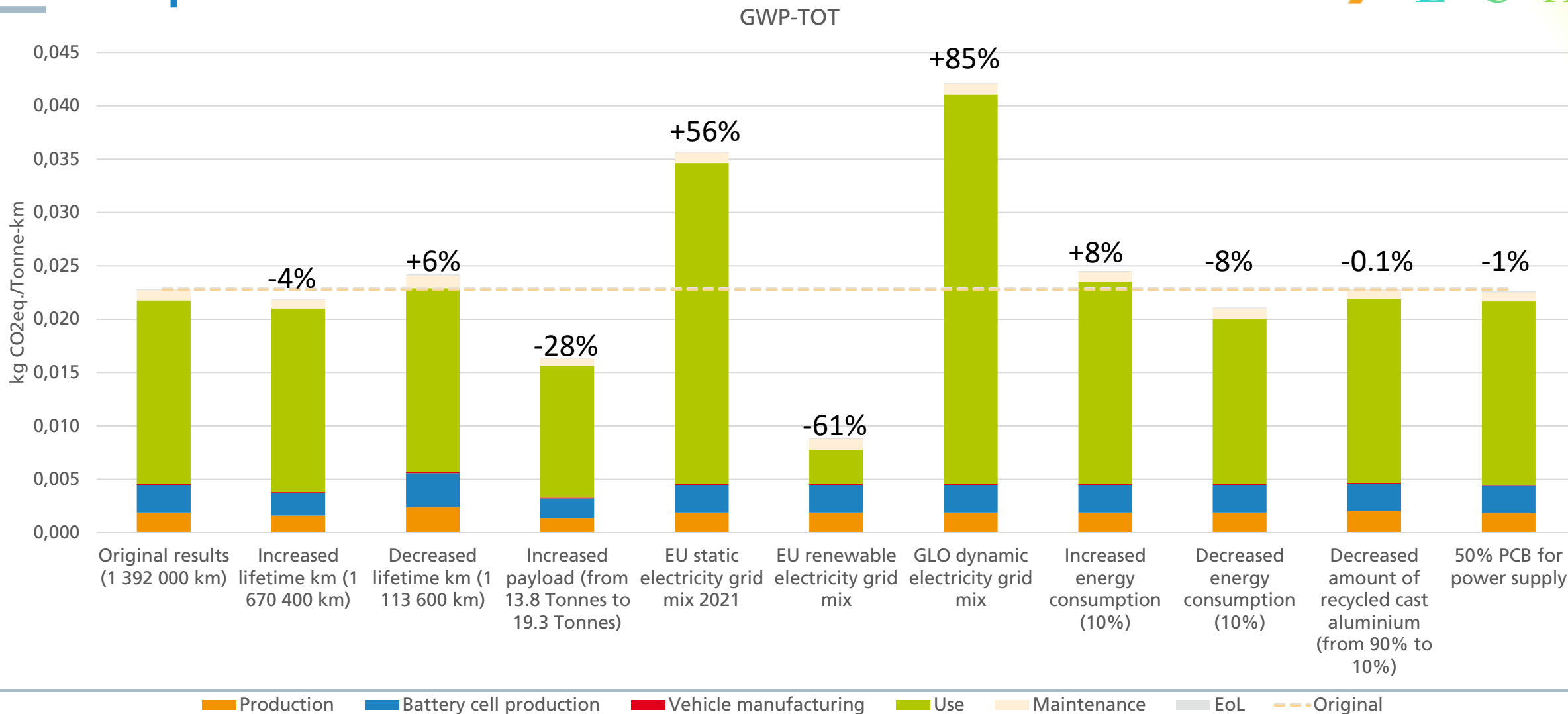
**Electricity in use phase:** EU dynamic uniform grid mix

Results are divided into production, battery cell production vehicle manufacturing, use, maintenance and EoL.

# Results HDV BEV: Contribution



# Results HDV BEV: Sensitivity/scenario analysis – GWP – per tkm



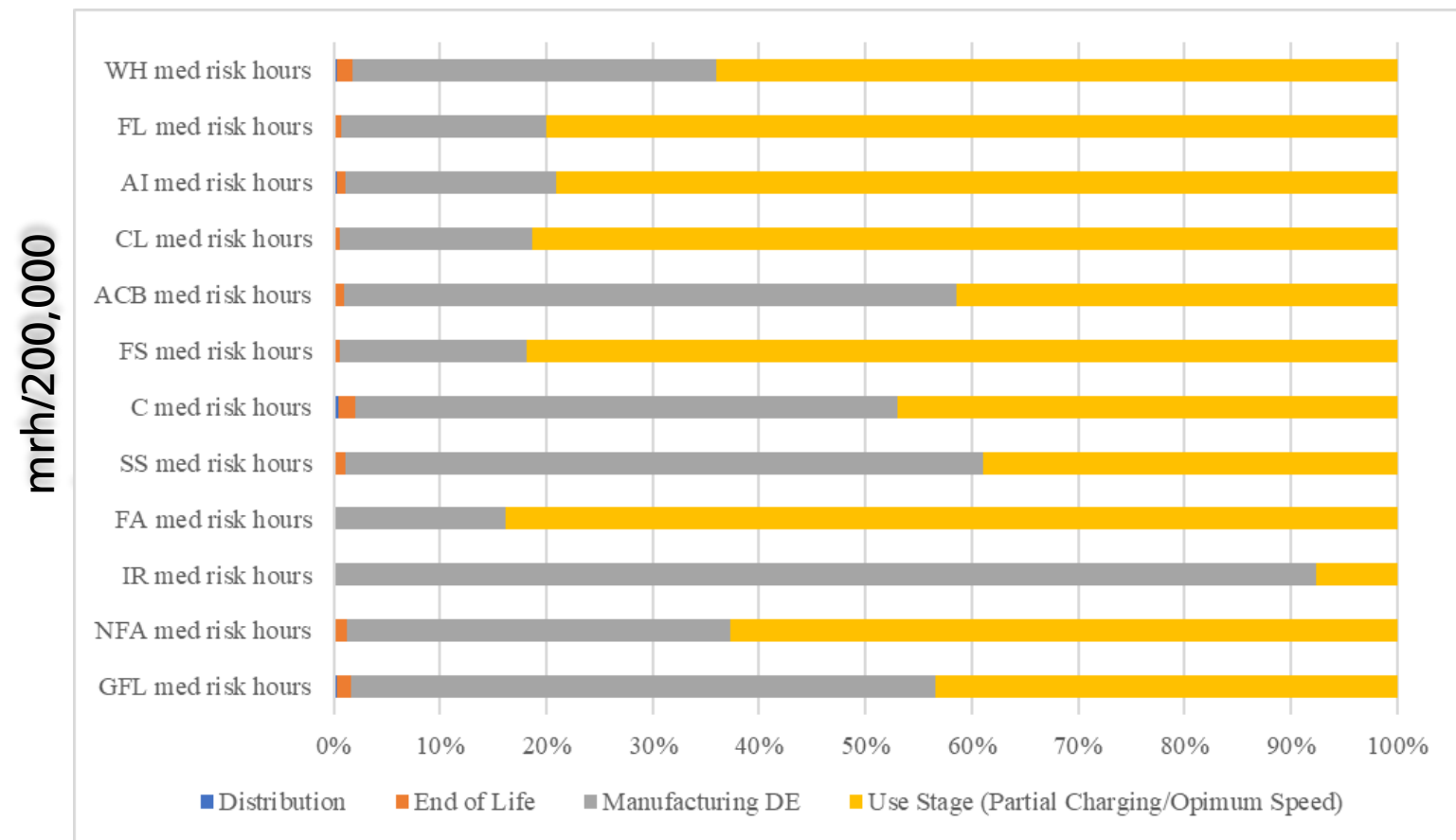


# Results S-LCA test case

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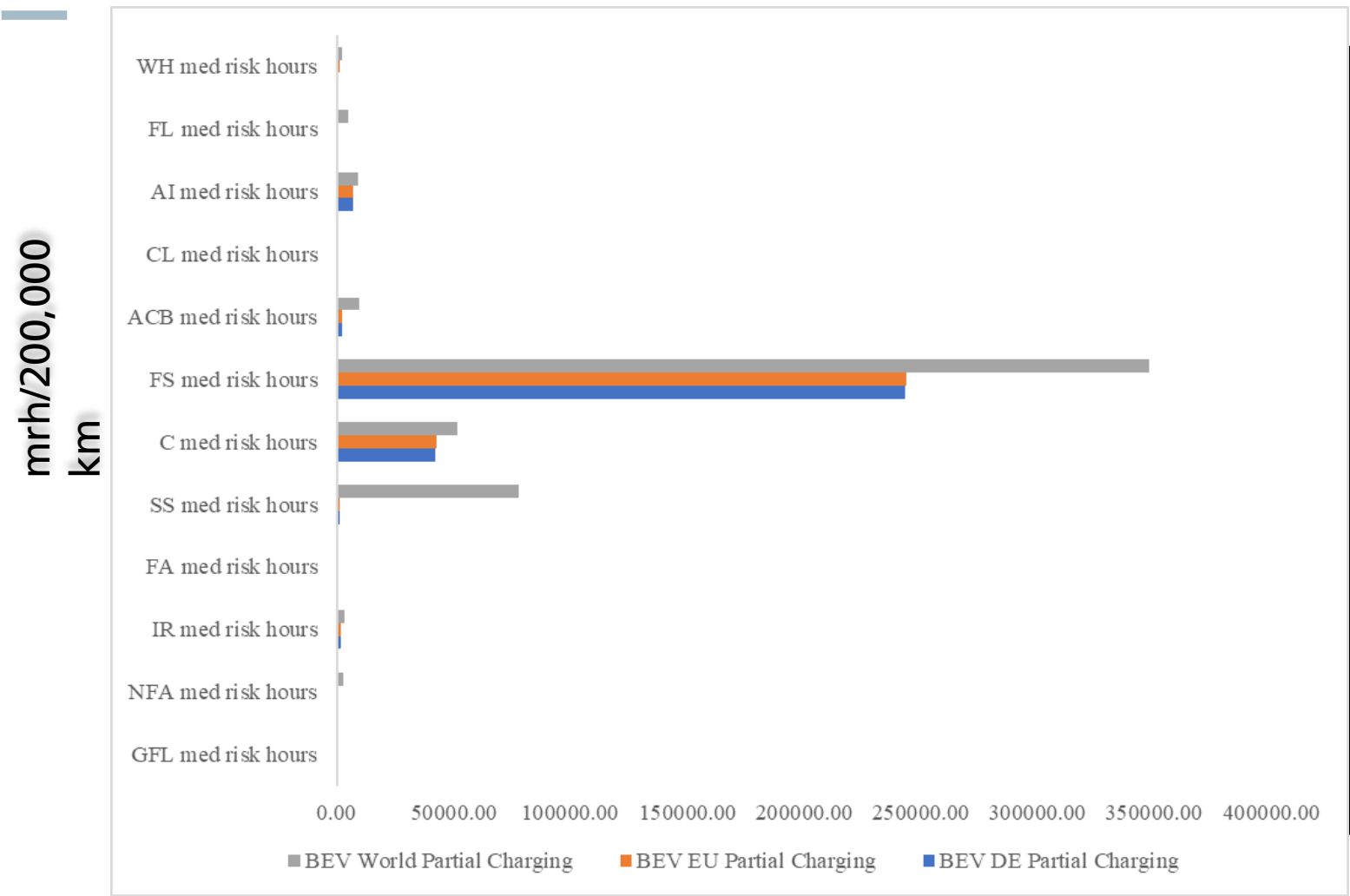


# Results S-LCA test case – Contribution Tree



| Impact subcategory  | Reference unit     |
|---|--------------------|
| Goods produced by forced labour                             | GFL med risk hours |
| Non-fatal accidents   | NFA med risk hours |
| Indigenous rights   | IR med risk hours  |
| Fatal accidents   | FA med risk hours  |
| Social security expenditures                                | SS med risk hours  |
| Public sector corruption                                    | C med risk hours   |
| Fair Salary   | FS med risk hours  |
| Association and bargaining rights                           | ACB med risk hours |
| Child Labour, total   | CL med risk hours  |
| Active involvement of enterprises in corruption and bribery | AI med risk hours  |
| Frequency of forced labour                                  | FL med risk hours  |
| Weekly hours of work per employee                           | WH med risk hours  |

# Results S-LCA test case – Interpretation based on Geography



| Impact subcategory  | Reference unit     |
|---|--------------------|
| Goods produced by forced labour                             | GFL med risk hours |
| Non-fatal accidents   | NFA med risk hours |
| Indigenous rights   | IR med risk hours  |
| Fatal accidents   | FA med risk hours  |
| Social security expenditures                                | SS med risk hours  |
| Public sector corruption                                    | C med risk hours   |
| Fair Salary   | FS med risk hours  |
| Association and bargaining rights                           | ACB med risk hours |
| Child Labour, total   | CL med risk hours  |
| Active involvement of enterprises in corruption and bribery | AI med risk hours  |
| Frequency of forced labour                                  | FL med risk hours  |
| Weekly hours of work per employee                           | WH med risk hours  |

## D3.3 - Outlook

### Planned methodological adjustments depending in other initiatives

- Vehicle segments and lifetime kilometers
- UNECE level 3 primary data requirements
- Charging losses HDV

### Future research

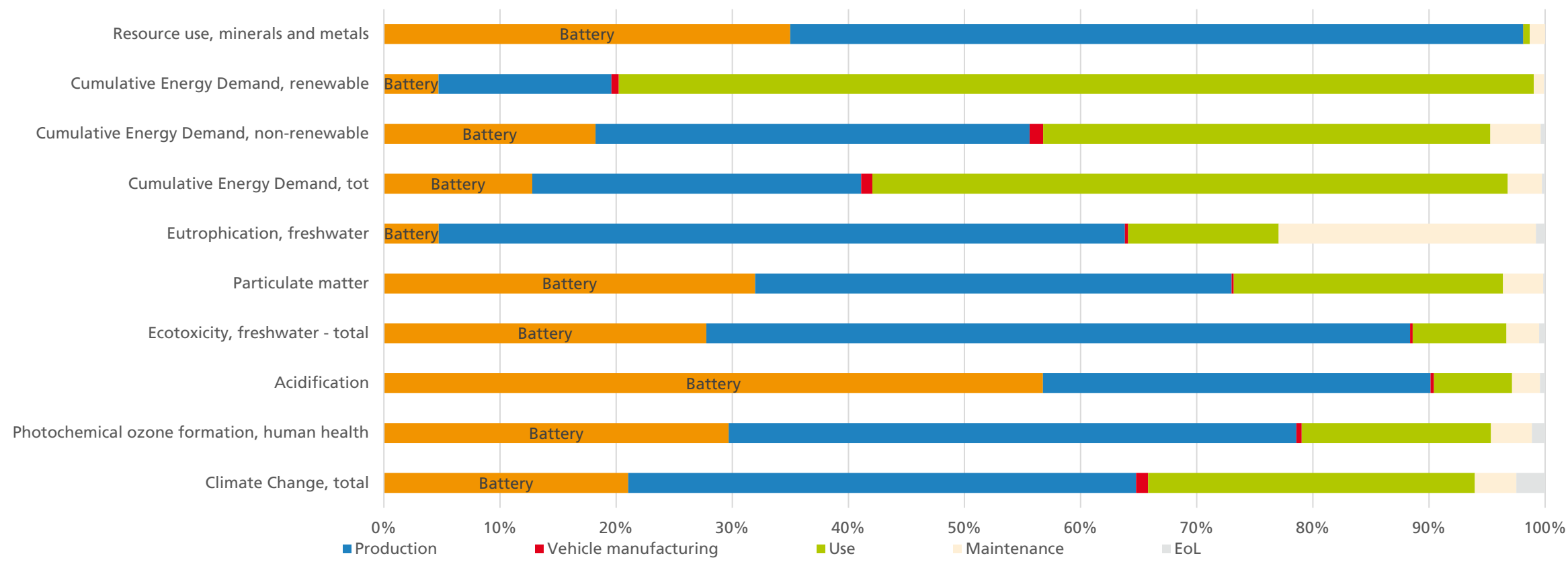
- *V2G*: allocation of environmental credits for energy fed back into the grid: determining who receives these credits—vehicle owners, grid operators, or manufacturers—remains unresolved and requires a standardized methodological approach
- *CE & LCA*: Current LCA methodologies allow for the assessment of individual impact categories, but there is no unified indicator that comprehensively captures the concept of “resource savings.” This gap hinders the ability to evaluate circular economy strategies holistically and avoid burden shifting between impact categories. Research is needed to develop integrative metrics that reflect the benefits of resource efficiency and material circularity

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# BACKUP

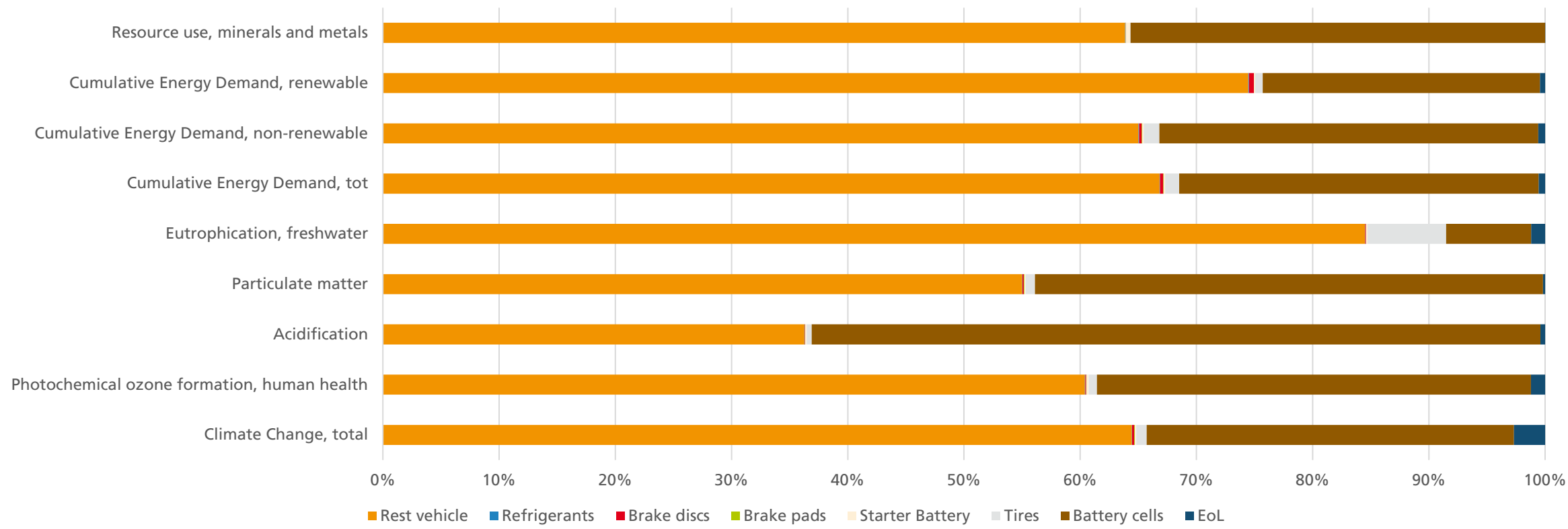


# Results LDV BEV: Contribution



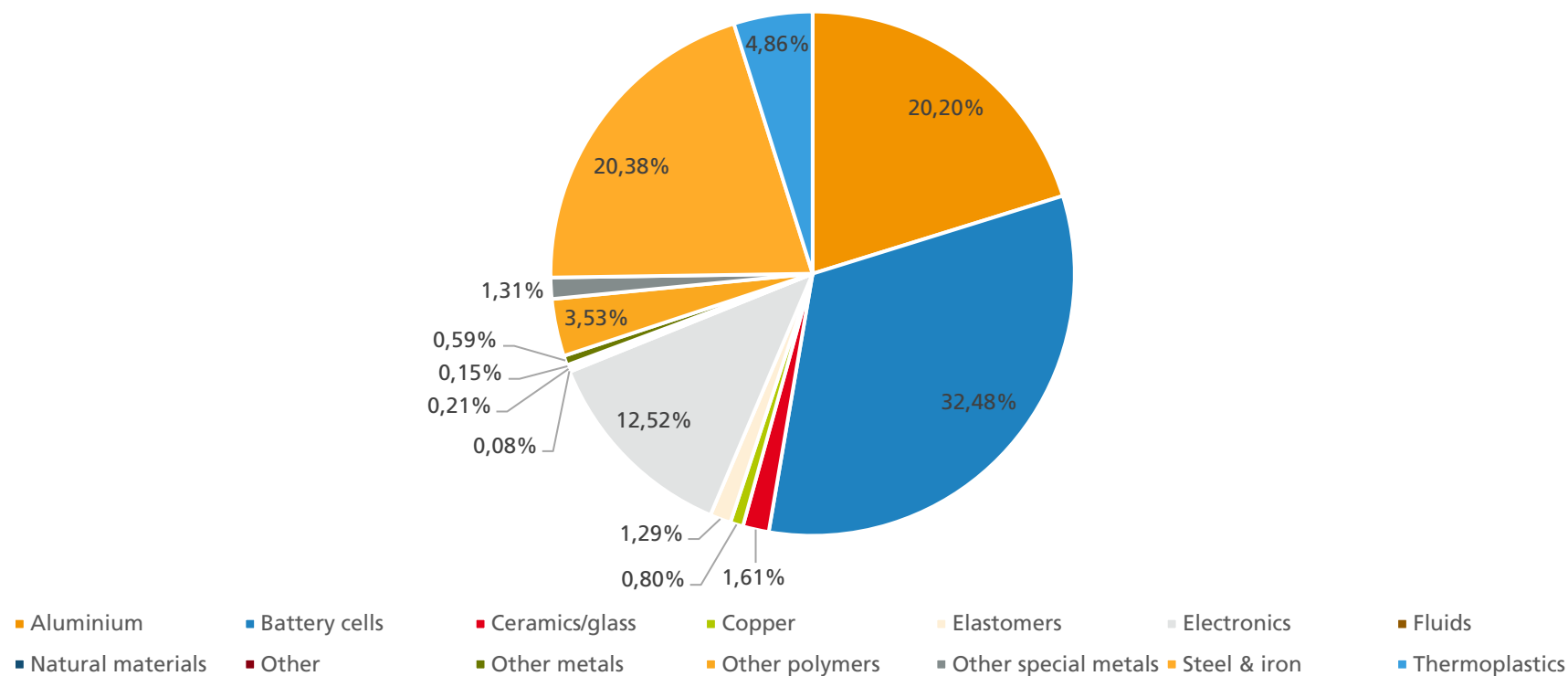
# Results LDV BEV: Component Production

Production contribution analysis

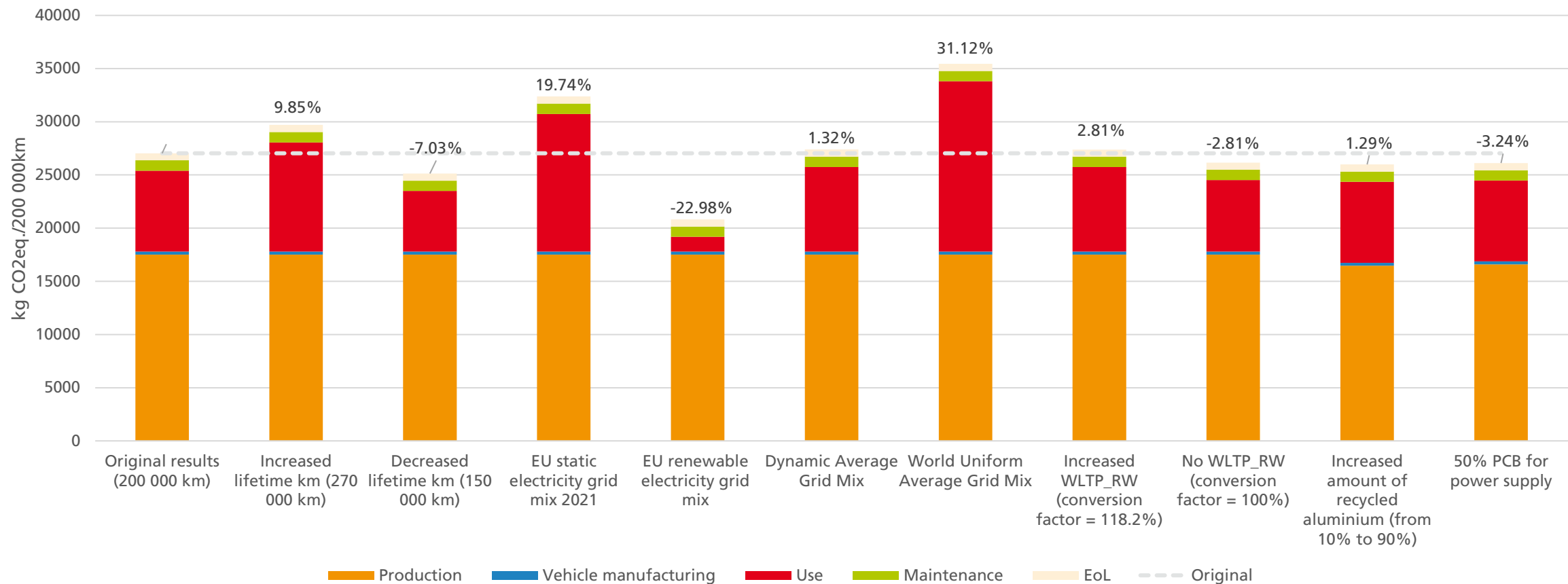


# Results LDV BEV: Material Production - GWP Total

Climate Change, total

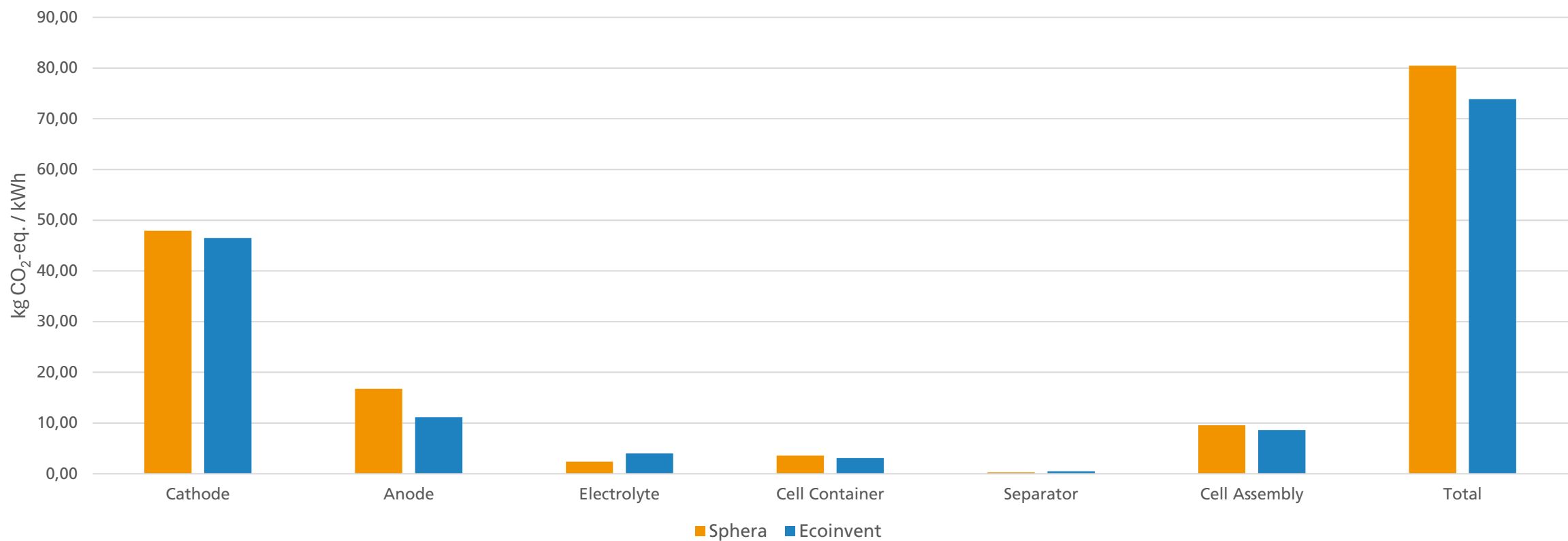


# Results LDV BEV: Sensitivity/Scenario Analysis – per lifetime km



# Results LDV BEV: Battery cell - Database Comparison

GWP NMC-811 cell (modeled after Crenna et al. 2021)

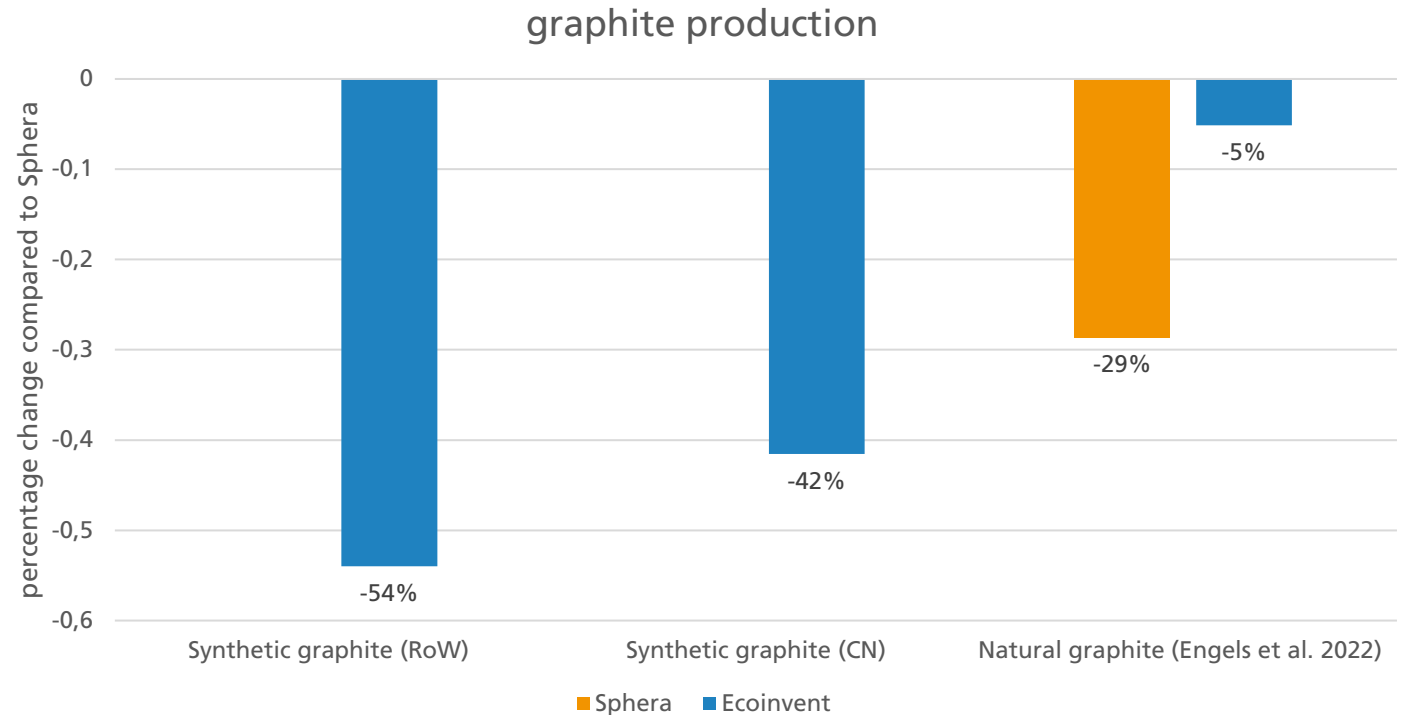




# Results LDV BEV: Battery cell - Database Comparison

- Largest difference within graphite production
- GWP for different production routes/datasets to be seen on the right side

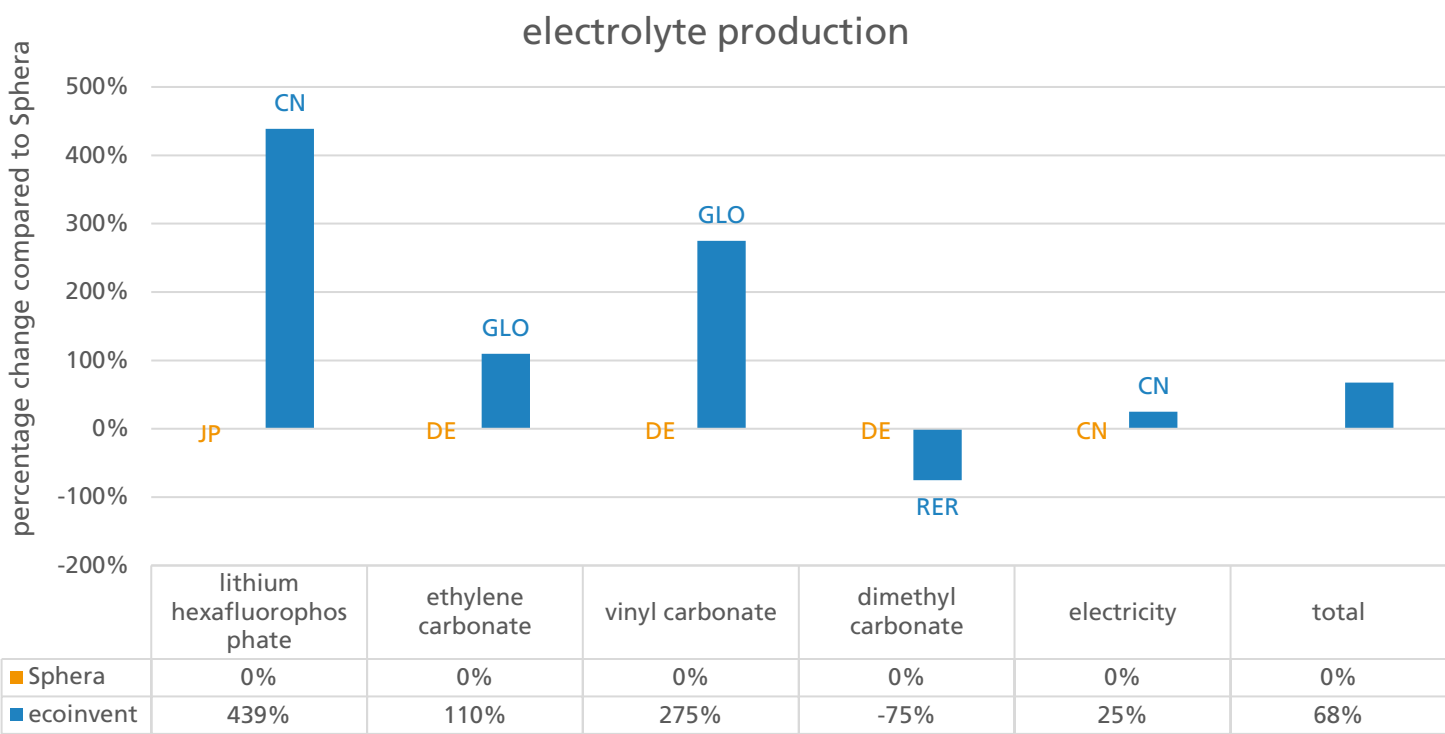
→ 0.95867 kg Graphite per kWh battery cells needed



# Results LDV BEV: Battery cell - Database Comparison

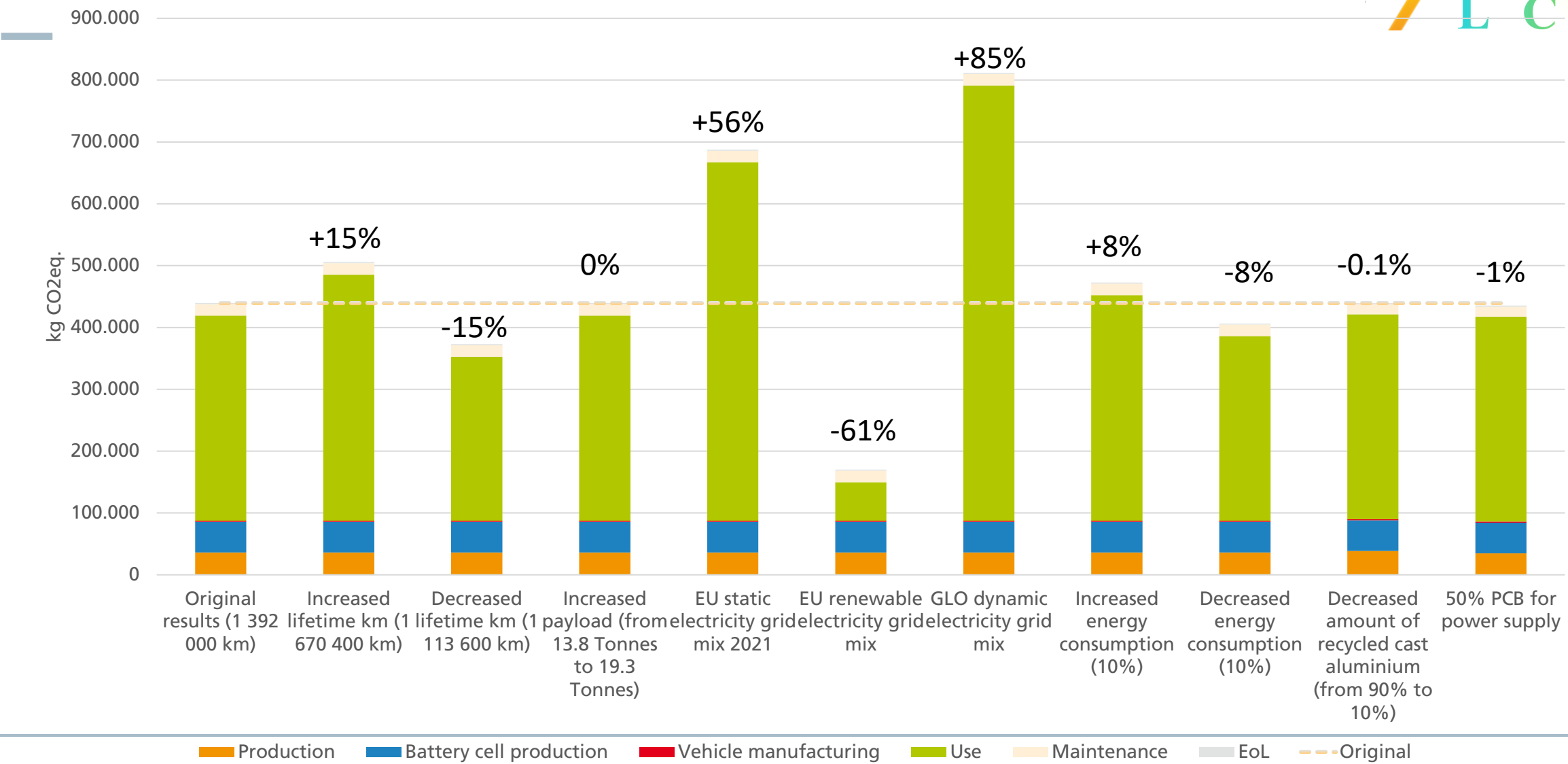
- Another difference within electrolyte production
- GWP for different production routes/datasets to be seen on the right side

→ 0.80399 kg Graphite per kWh battery cells



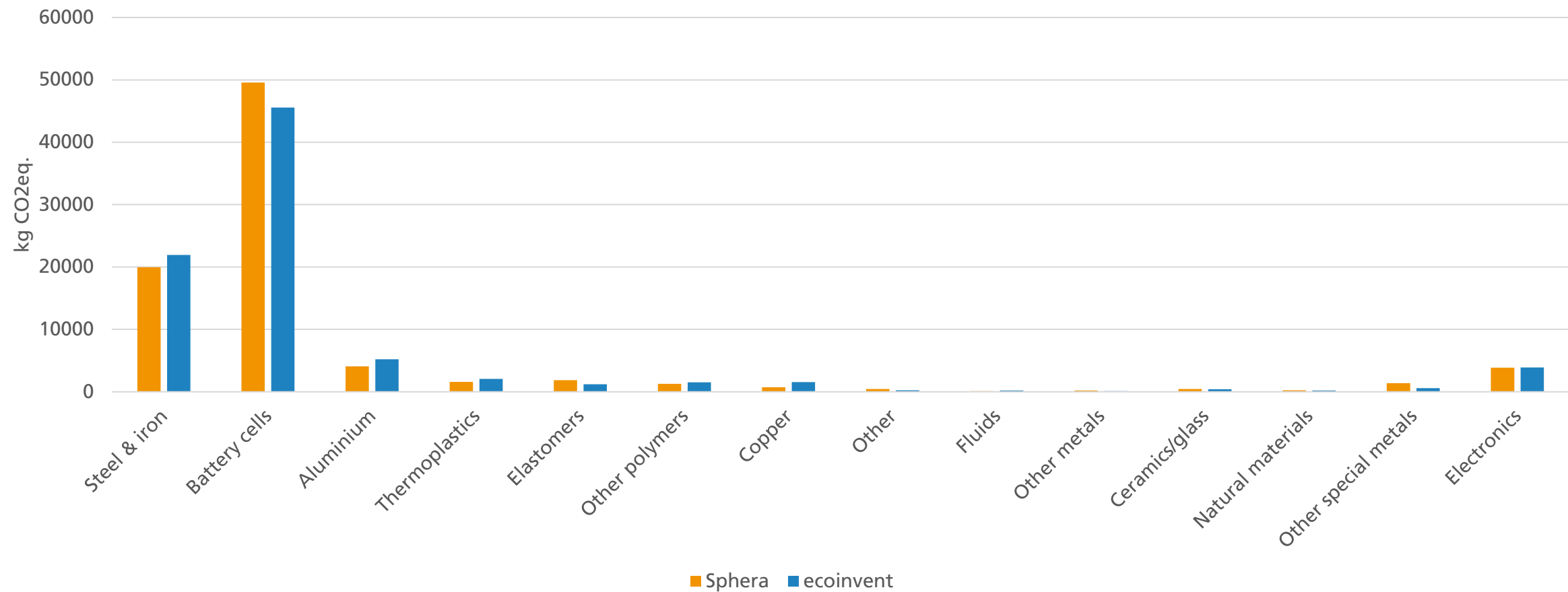
# LDV: Sensitivity/Scenario Analysis – per lifetime km

GWP-TOT



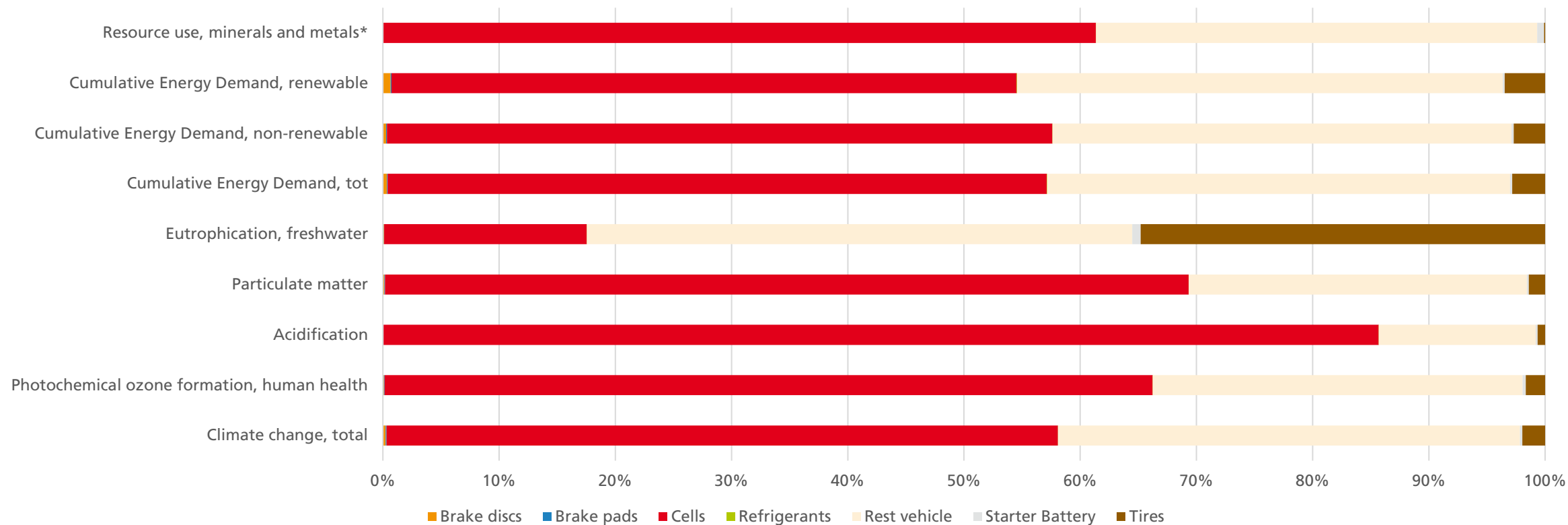
# HDV BOM - Database Comparison (limited to production)

GWP tot



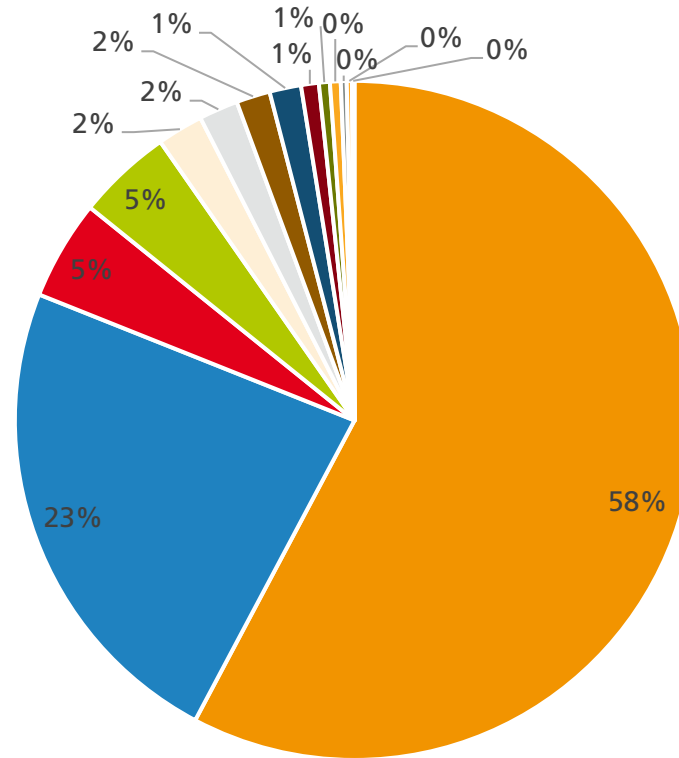
# HDV: Component Production

Production - components



# Results HDV BEV: Material Production – GWP Total

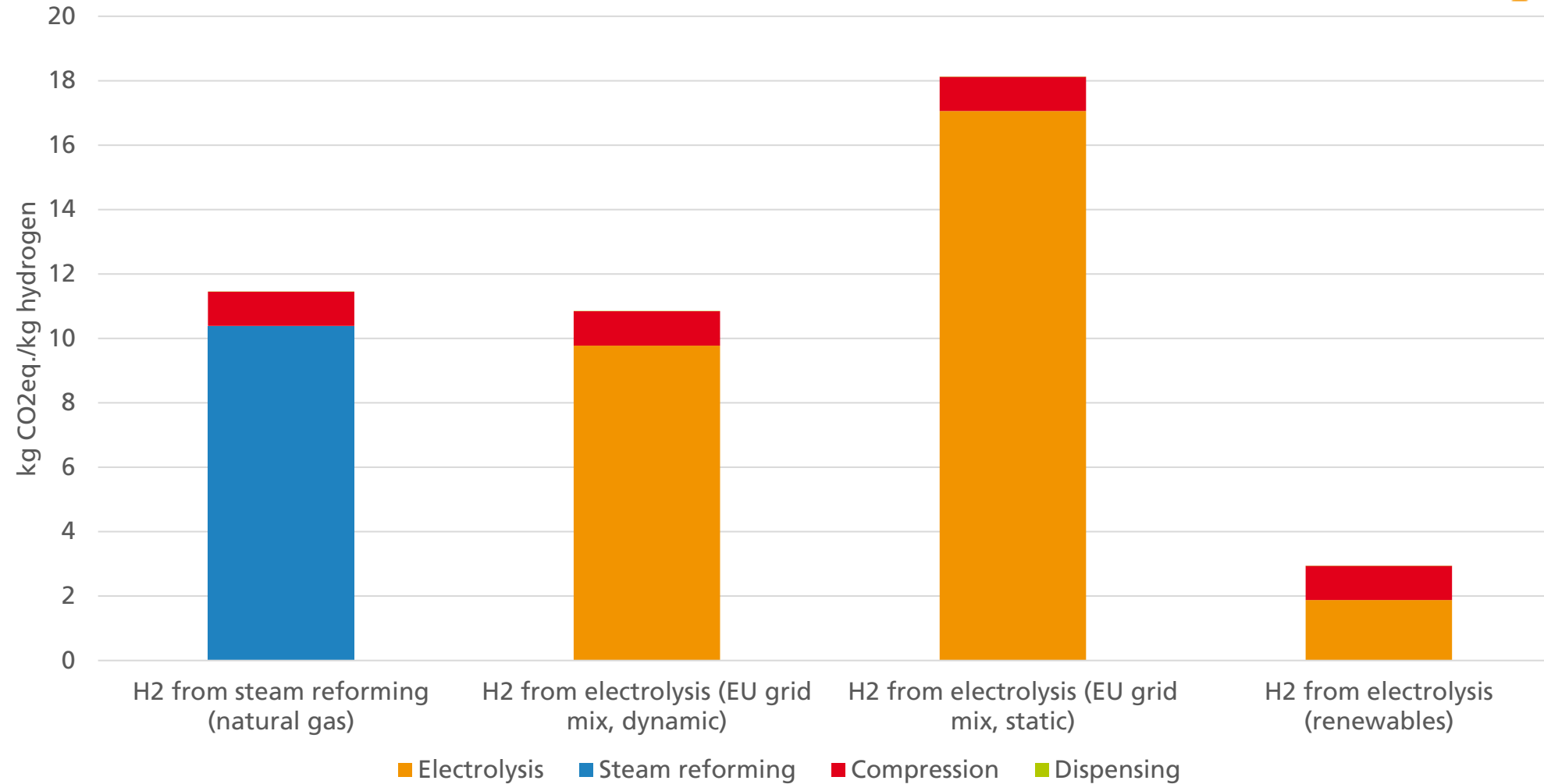
EF 3.1 Climate Change - total [kg CO2 eq.]



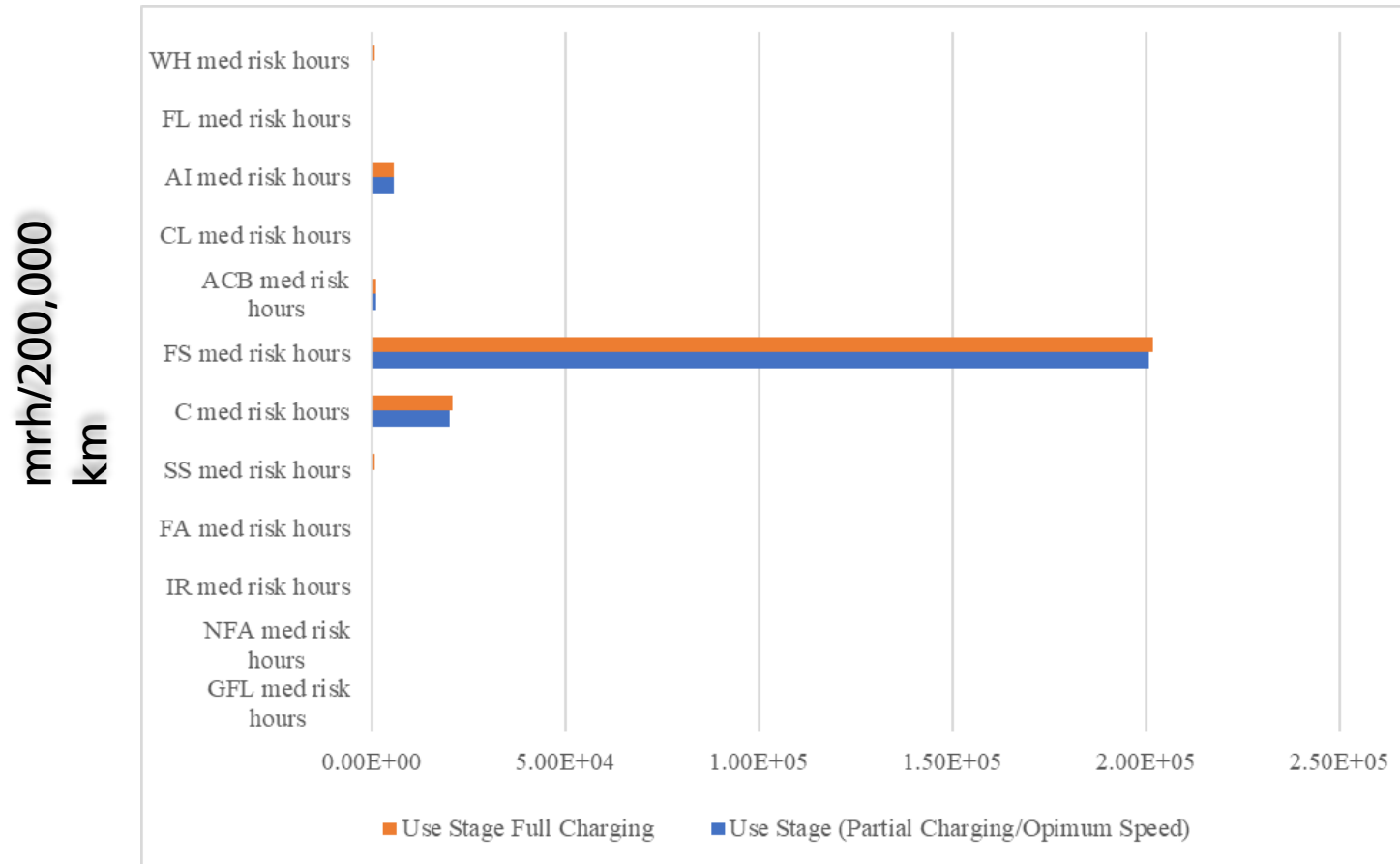
- Battery cells
- Steel & iron
- Aluminium
- Electronics
- Elastomers
- Thermoplastics
- Other special metals
- Other polymers
- Copper
- Other
- Ceramics/glass
- Natural materials
- Other metals
- Fluids

# Results FCEV test case (hydrogen production)

GWP Tot



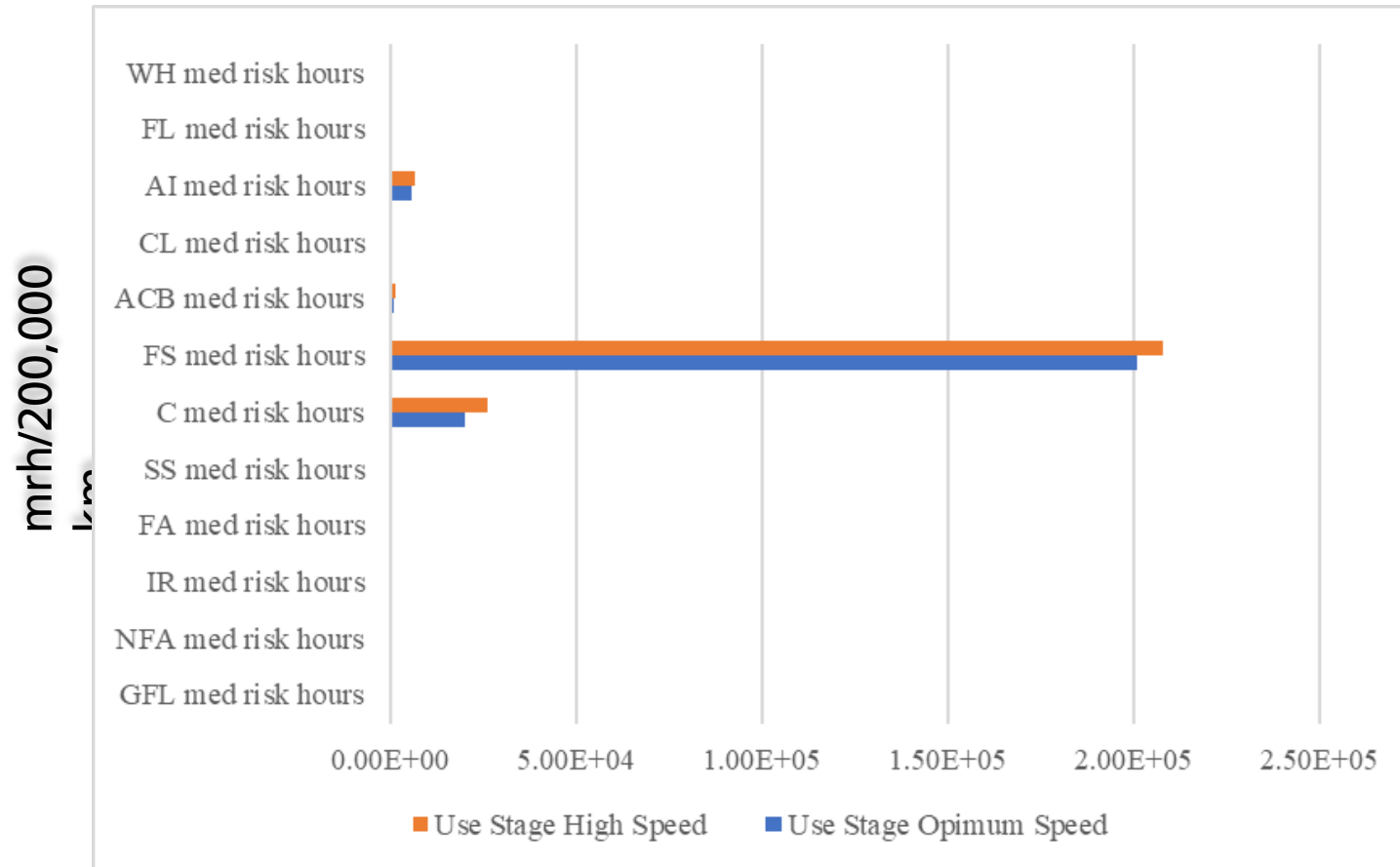
# Results S-LCA test case – Interpretation based on Full / Partial charging



| Impact subcategory  | Reference unit     |
|---|--------------------|
| Goods produced by forced labour                             | GFL med risk hours |
| Non-fatal accidents   | NFA med risk hours |
| Indigenous rights   | IR med risk hours  |
| Fatal accidents   | FA med risk hours  |
| Social security expenditures                                | SS med risk hours  |
| Public sector corruption                                    | C med risk hours   |
| Fair Salary   | FS med risk hours  |
| Association and bargaining rights                           | ACB med risk hours |
| Child Labour, total   | CL med risk hours  |
| Active involvement of enterprises in corruption and bribery | AI med risk hours  |
| Frequency of forced labour                                  | FL med risk hours  |
| Weekly hours of work per employee                           | WH med risk hours  |



# Results S-LCA test case – Interpretation based on Speed



| Impact subcategory  | Reference unit     |
|---|--------------------|
| Goods produced by forced labour                             | GFL med risk hours |
| Non-fatal accidents   | NFA med risk hours |
| Indigenous rights   | IR med risk hours  |
| Fatal accidents   | FA med risk hours  |
| Social security expenditures                                | SS med risk hours  |
| Public sector corruption                                    | C med risk hours   |
| Fair Salary   | FS med risk hours  |
| Association and bargaining rights                           | ACB med risk hours |
| Child Labour, total   | CL med risk hours  |
| Active involvement of enterprises in corruption and bribery | AI med risk hours  |
| Frequency of forced labour                                  | FL med risk hours  |
| Weekly hours of work per employee                           | WH med risk hours  |