A TRANSPORT SPECIFIC LIFE-CYCLE ASSESSMENT

THE EUROPEAN SUPPORT ACTION TRANSENSUS LCA

An Overview

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on behalf of the TranSensus LCA Consortium

Funded by
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Motivation

Challenges for a harmonised assessment of the ecological footprint

Ecological footprint assessment and communication is needed to support the transition toward low carbon and circular economy of the transport sector, but…

Standardised and comparable (real) data are missing.

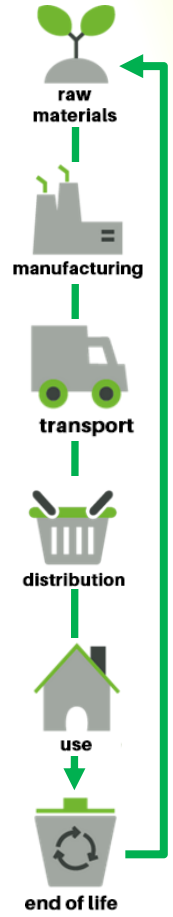
Harmonised methods and tools for affordable (in terms of cost and time) and easy-to-handle assessment of the ecological footprint are needed.

Strategies and definitions for consistent circular economy approaches (e.g. categories like share of recovered materials, energy efficiency of recycling process …) are missing.

Knowledge and skills for LCA and CE are lacking.

LCA- and circular economy-based solutions are not implemented on a wide scale.

Communication and acceptance of LCA- and circular economy-based solutions.



Source: 2ZERO SRIA, Cluster 4

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The Coordinated and Support Action (CSA) TranSensus LCA

€ EU Funding **~3,7M€**

30 Months
Started in **January 2023**

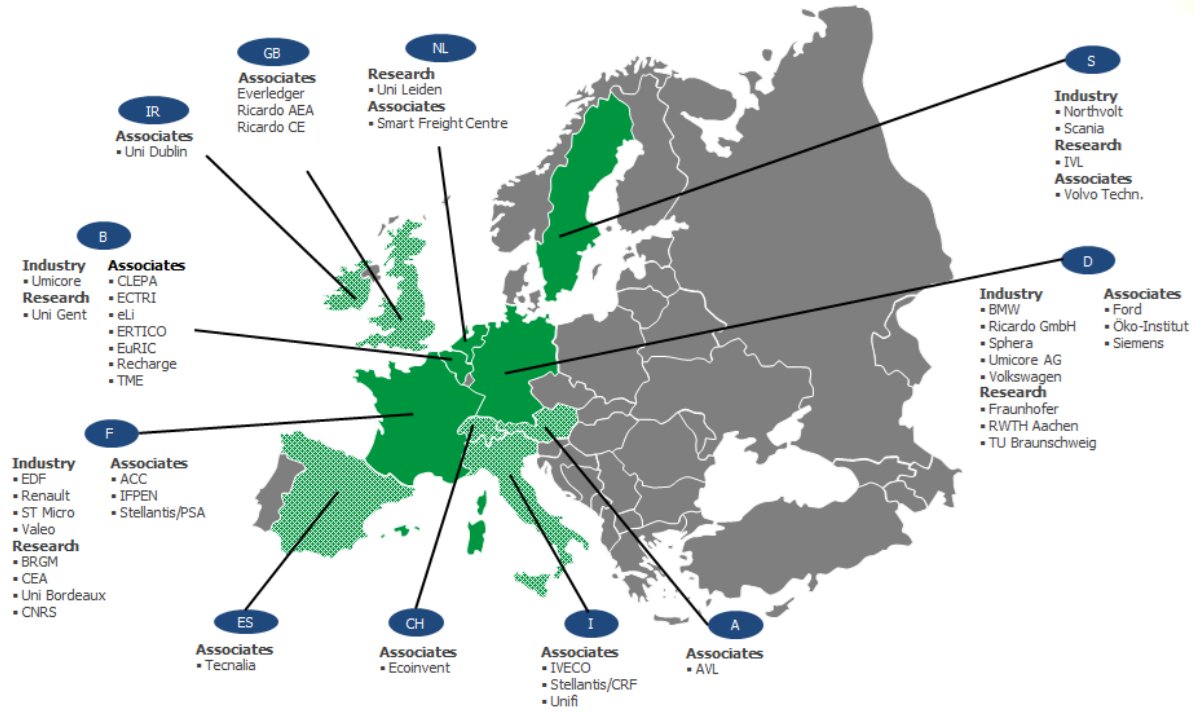
20 Beneficiaries
11 Industrial Partners
9 Research Partners

24 Associated Partners

4 Wider consultation groups

Commonly accepted and applied single LCA approach for zero-emission road transport

- Conceptualize and demonstrate a single, European-wide real-data LCA approach for zero-emission road transport
- Harmonization of methodologies, tools and datasets
- Elaborate an ontology and framework for a European-wide LCI database
- Conceptualize LCI data management and update along the life cycle and along the supply chain
- Paving the way for LCA-based product and business development
- Consensus building across all stakeholders



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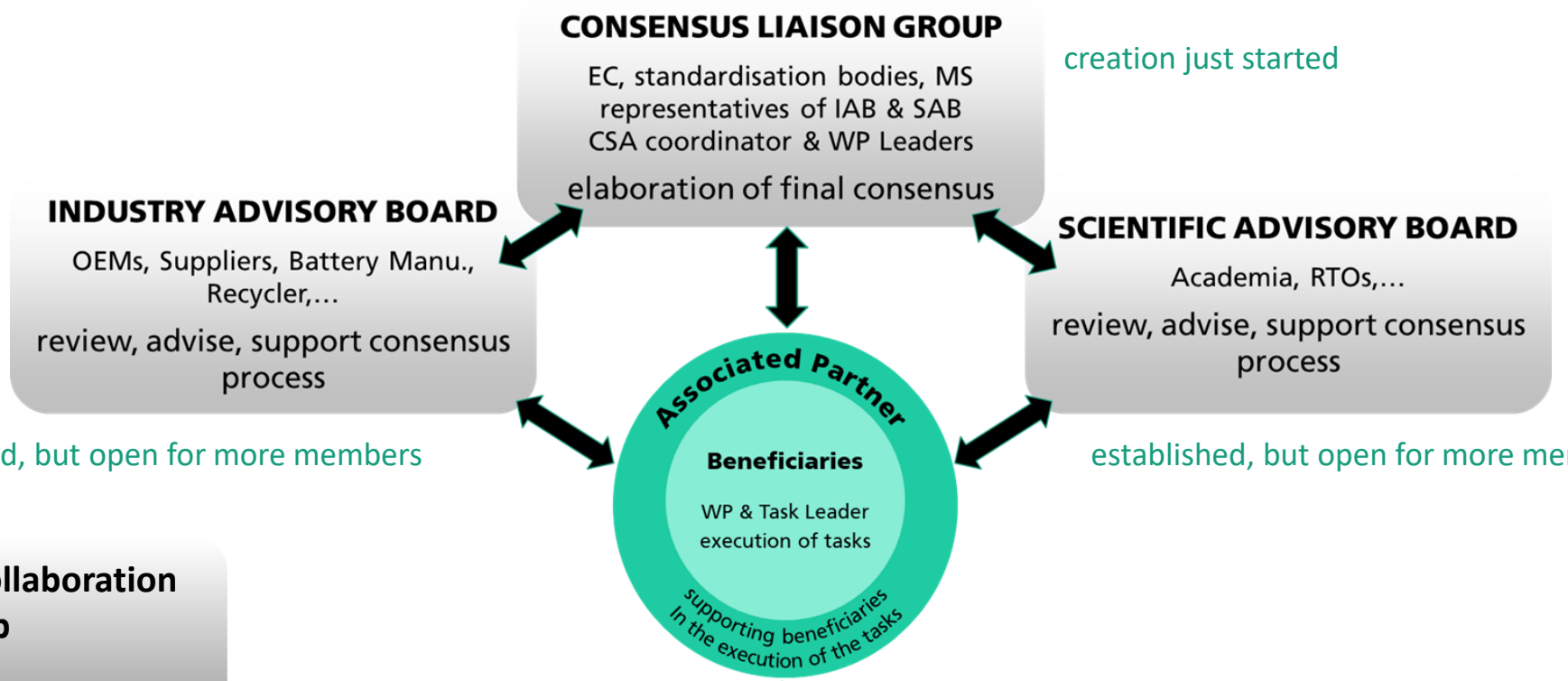
Broadening consensus building

Getting different stakeholders involved



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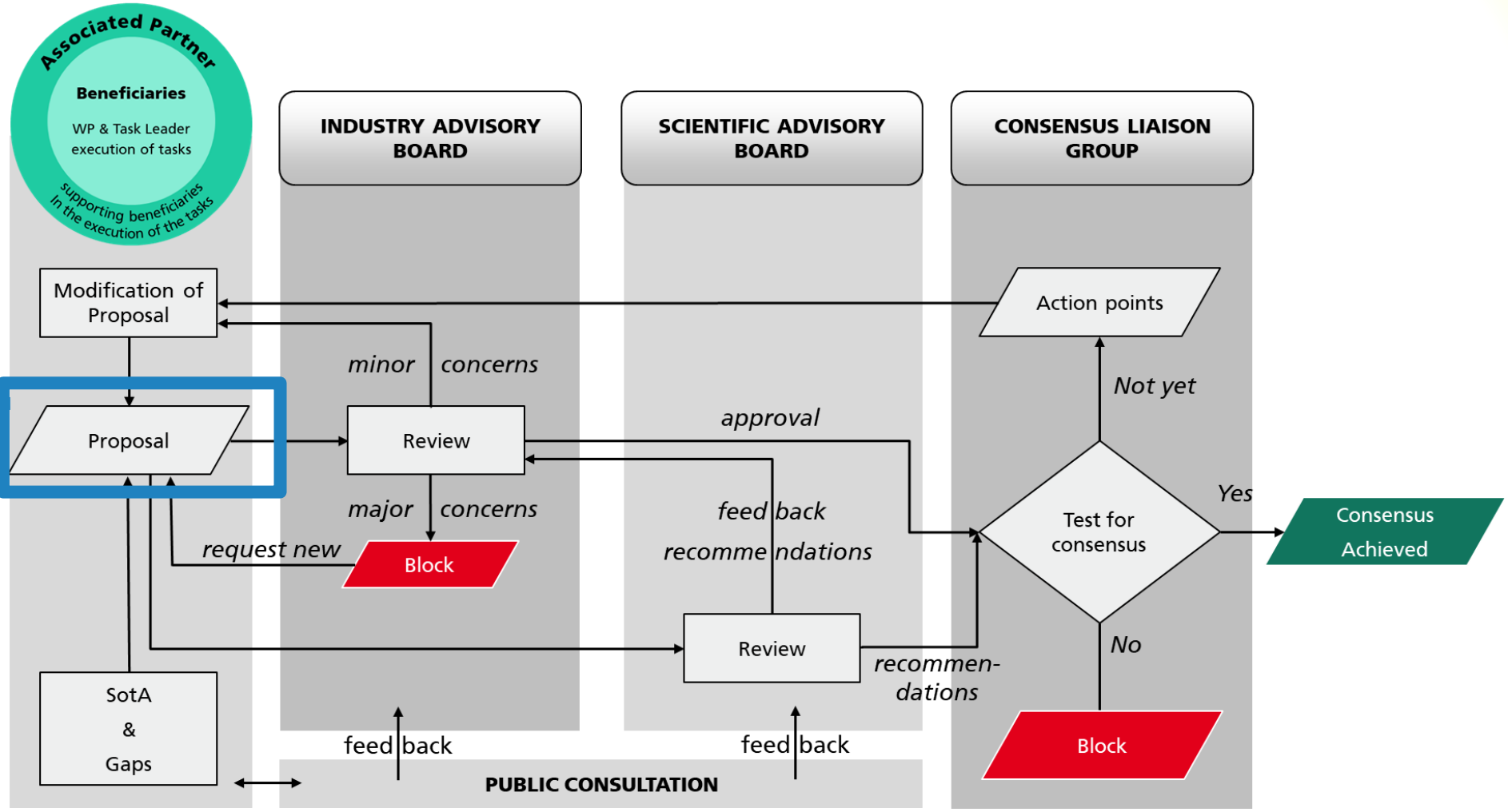
Boradening consensus building

Decision Making Process



3rd Loop is launched!

Some objectives (S1 2024):

- build a wider consensus based on 2023 WP2 proposal
- keep developing the project's LCA approach

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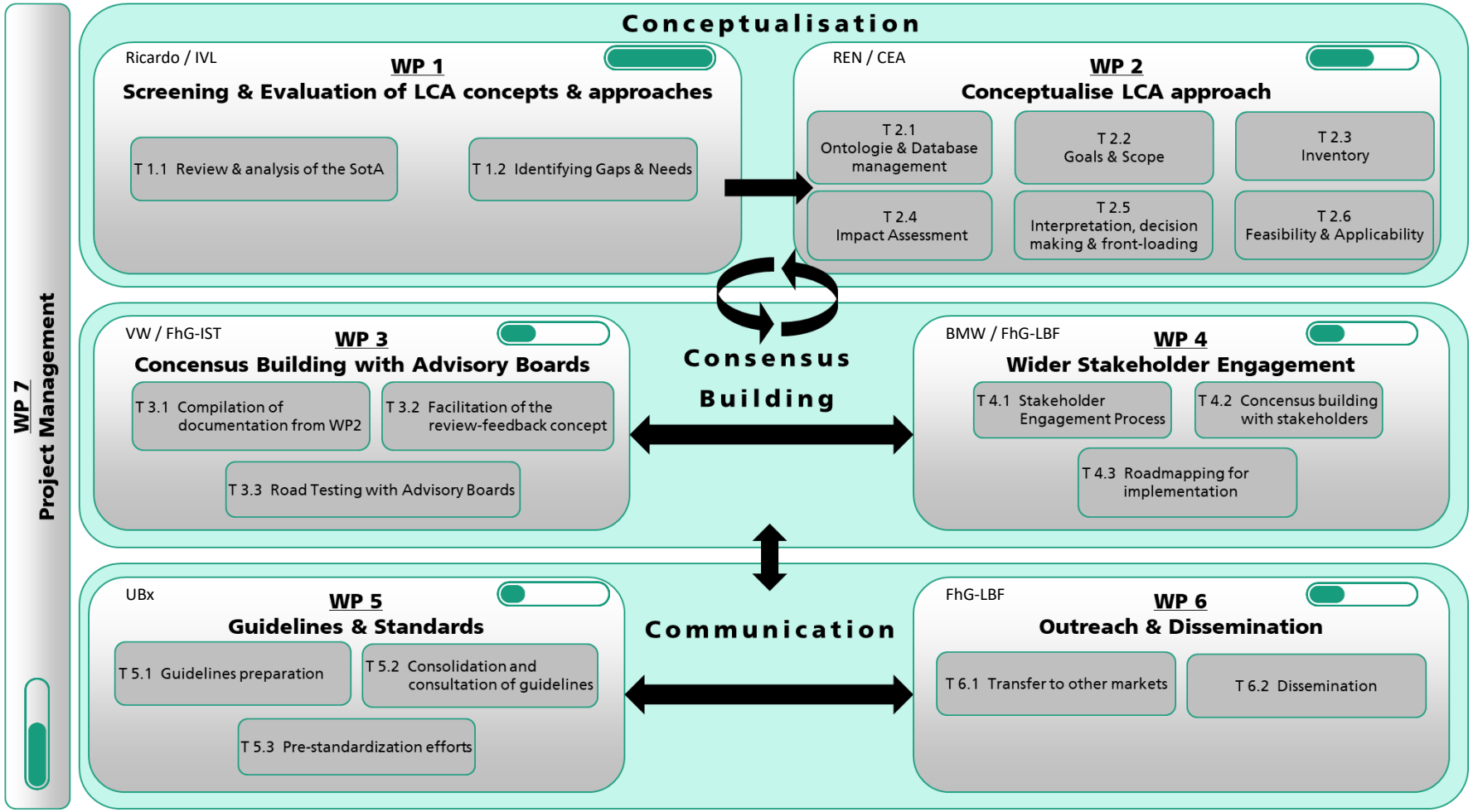
Work Package Structure



Progress indicator

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Review & Analysis of the SotA (I)

Goal and Scope Definition

Aspect		
Functional Unit	**Distance-based** functional unit (vkm, pkm, or tkm)	• **Capacity-based** (kWh or MJ) • **Throughput-based** (kWh or MJ) • **Mass-based** (kg of battery)
System Boundary	**Cradle to grave**	• **Cradle to grave** • **Cradle to gate**

- Service Lifetime is crucial in determining functional unit
- Some functional units are not compatible with certain system boundary choices
- Maintainance and infrastructure (Capital Goods) are the most prone to exclusion from system boundary
- Other goal and scope aspects (intended audience, intended application,..etc) are generally overlooked

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Review & Analysis of the SotA (II)

Life Cycle Inventory

Aspect		
Data	• Lack of a standardised approach to **inventory data collection** • Lack of **primary data** is a big obstacle • Data quality and availability varies according to life stage • LCI databases: ecoinvent, MLC (former GaBi) databases, GREET	
Electric Energy Modelling (Use stage)	• LCI datasets: **EU average grid mix/ Country-specific/ residual grid mix** • **Future grid mixes** (i.e. the change over the vehicle lifetime, not just static sensitivities) are not discussed enough despite importance	
Multifunctional processes	• A distinction is usually found between **EoL and upstream processes** • Studies are relatively vague on choices to deal with multifunctionality • **Allocation** is the main choice in co-production • Five choices in EoL: **CFF*, Cut-off, Avoided burden, 50:50, APOS**	

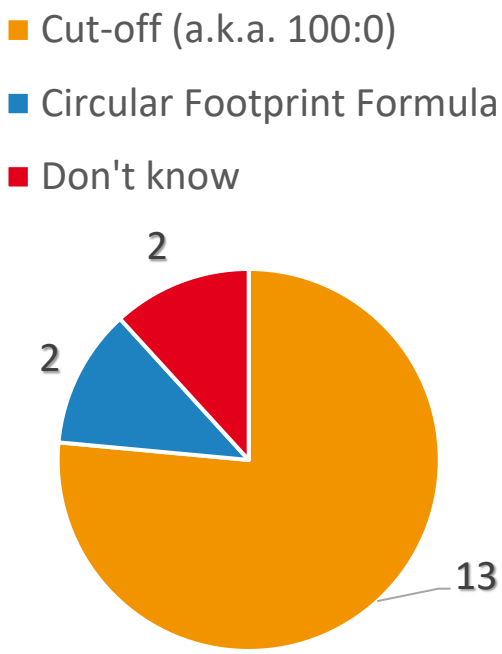

Figure 1: Answer to survey question Q: Which EoL allocation method is used in your LCA?

LCI perhaps requires the most harmonization efforts!

* CFF = Circular Footprint Formula

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Review & Analysis of the SotA (III)

Life Cycle Impact Assessment

Aspect		
LCIA method	• **IPCC GWP 100** for Climate-change-focused studies • **EF method** is recommended but rarely followed in practice • **ReCiPe and CMLIA** are very common • **Mixing impact indicators** from different LCIA methods is a common practice	
Impact categories	• **Climate Change (By far)** • Acidification • PCOF • Eutrophication	
Normalization and Weighting	• Normalization is rarely applied in individual studies • Weighting is almost absent	

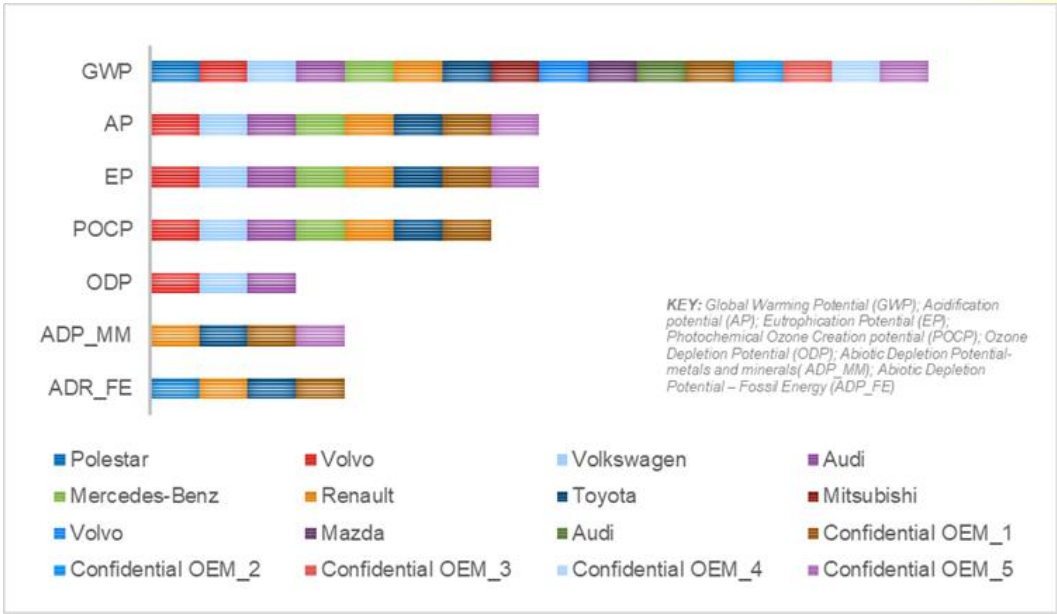

Figure 2: Environmental impact categories adopted and reported within OEM reports.
Source: TranSensus LCA D1.1

Very relevant indicators like CED, PM, RD for metals and minerals* seem downplayed.

* CED = Cumulative Energy Demand, PM = Particulate Matter, RD = Resource Depletion

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Review & Analysis of the SotA (IV)

Interpretation

Aspect		
Results reporting	**Different styles of reporting and interpretation** have been pursued by LCA practitioners in the various sources of reviewed literature	
Uncertainty analysis	• Outside academia, proper **uncertainty analysis is rarely carried out** • Usually skipped to sensitivity analyses	
Sensitivity Analysis	• Energy: use-phase consumption (e. g. regulatory vs 'real-world' driving) and **electricity grid mixes** • **Total distance driven** (mileage)	Battery **components and recycling rates**

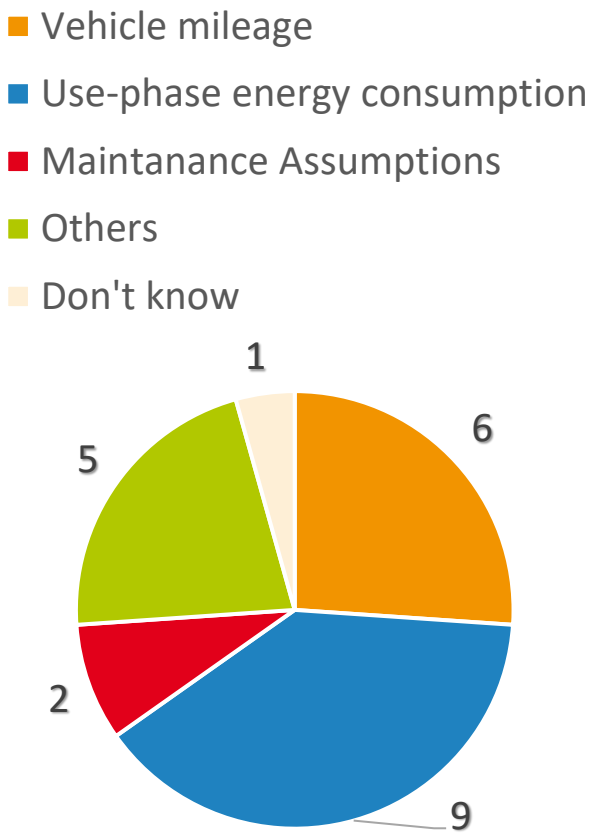

Figure 3: Answer to survey question Q: what kind of sensitivity analysis are done?

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Conclusions and key messages

see also D 1.1 on project homepage

- **Lack of harmonization in LCA application for ZEVs was obvious at many points**
- **Certain level of consensus was found for some aspects like functional unit however defining service lifetime is debatable**
- **The aspired harmonized approach should be policy-relevant, clear, and methodologically sound for example:**
  - Ideally cradle-to-grave LCAs should be the default;
  - Functional unit should reflect the actual service the system provides;
  - A clear data type (primary vs secondary) hierarchy should be provided for each life cycle stage;
  - Clear instructions to model and test electric-energy mixes;
  - A consistent framework to tackle multifunctionality problems in the value chain;
  - Stress on reporting relevant impact indicators like CED, PM, RD (and dissipation);….

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Top priority High-Level Needs

for Needs & Gaps see also D 1.2 on project homepage

- **Understandable**, i. e. clear scope and results to audience (including limitations);
- **Standardized**, i. e one clear, unique, TranSensus LCA method;
- **Accurate**, i. e. indicators close to the actual (true) impact values
- **Auditable**, i. e. with credible verification process (or audits) overcoming the challenge of confidentiality;
- **Accepted** by the scientific community and industrials;
- **Reliable and trustworthy**, i. e. the audience shall have confidence in the outcomes of a study

- **Of importance but though of lower priority**:

- **Aligned** with (i) current EU legislations ; (ii) currently accepted LCA guidelines and standards; (iii) international developments. However, **misalignment is considered possible** whenever this is agreed to add value;
- **Simple**, however as far as simplifications do not prevent the method to be Accurate, Auditable, Reliable and Trustworthy;
- **Transparent**, however with a good balance to be found between "**confidence in and confidentiality of**" data.

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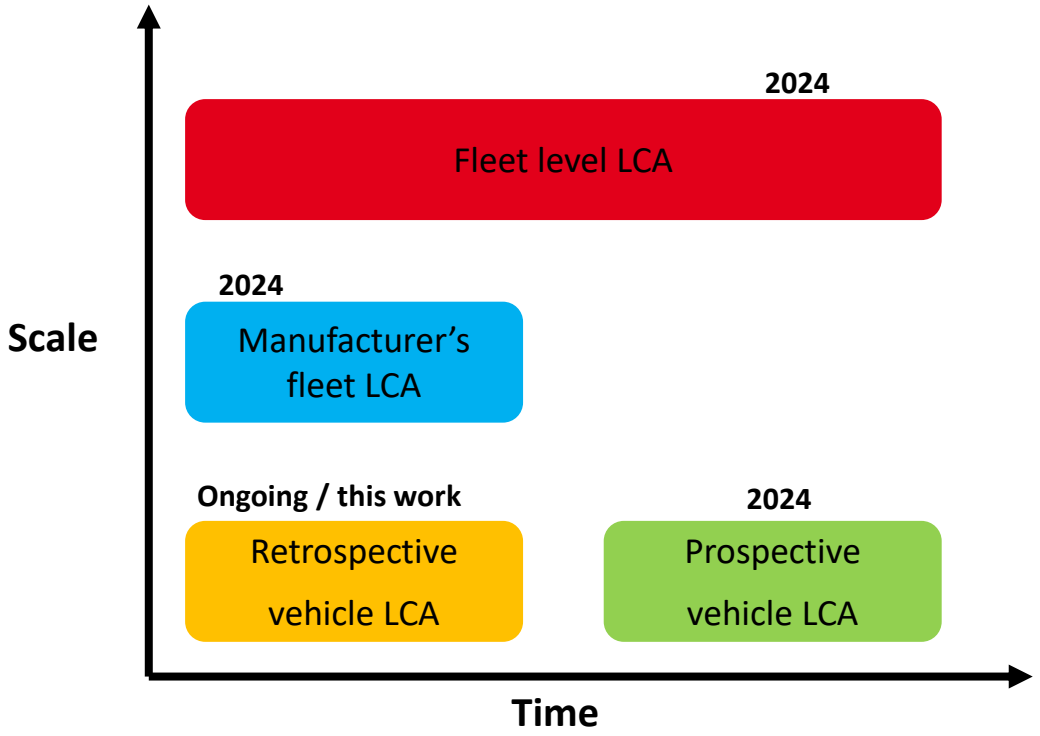
LCA types considered in TranSensus LCA

Typology and planning



Type	Definition
Retrospective vehicle LCA	Evaluation of impacts **slightly before** or **after the start of production** . A **nearly finalised bill of materials of all parts** is available to the OEM.
Prospective vehicle LCA	Conducted in the development stage and aims to estimate **impacts before the start of production (several years)** . The **TRL is low** (TRL<6) and the BOM is not completely defined.
Manufacturer fleet LCA	Aims to evaluate the **weighted impact of a series of different products introduced by a single manufacturer** . Typically it is based on a **extrapolation** of vehicle LCAs .
Macro level fleet LCA	Conducted at the **sub, national or international level** to support **economy - scale strategies .** Fleet is typically generic, i.e. representative of a variety of manufacturers

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Conceptualize an LCA approach

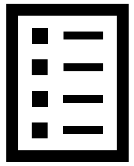
How we proceed for both scientific & internally shared building blocks

State of the art & needs and gaps **(D1.1 & D1.2)**

Discussion on methodological options

- current practise
- problem clarification
- solutions
- opinions

Tasks:
2.1 Database & ontology
2.2 Goal & Scope
2.3 Inventory
2.4 Impact assessment
2.5 Interpretation



Selection of most appropriate methodological **approaches**

Type 1: one recommendation

Type 2: reduced number of possible options

Internal WP2 **voting** on options

Qualified Majority (2/3)?

✓ Part of the TranSensus building blocks

✗ Further **consortium discussions** + **consultation advisory boards**

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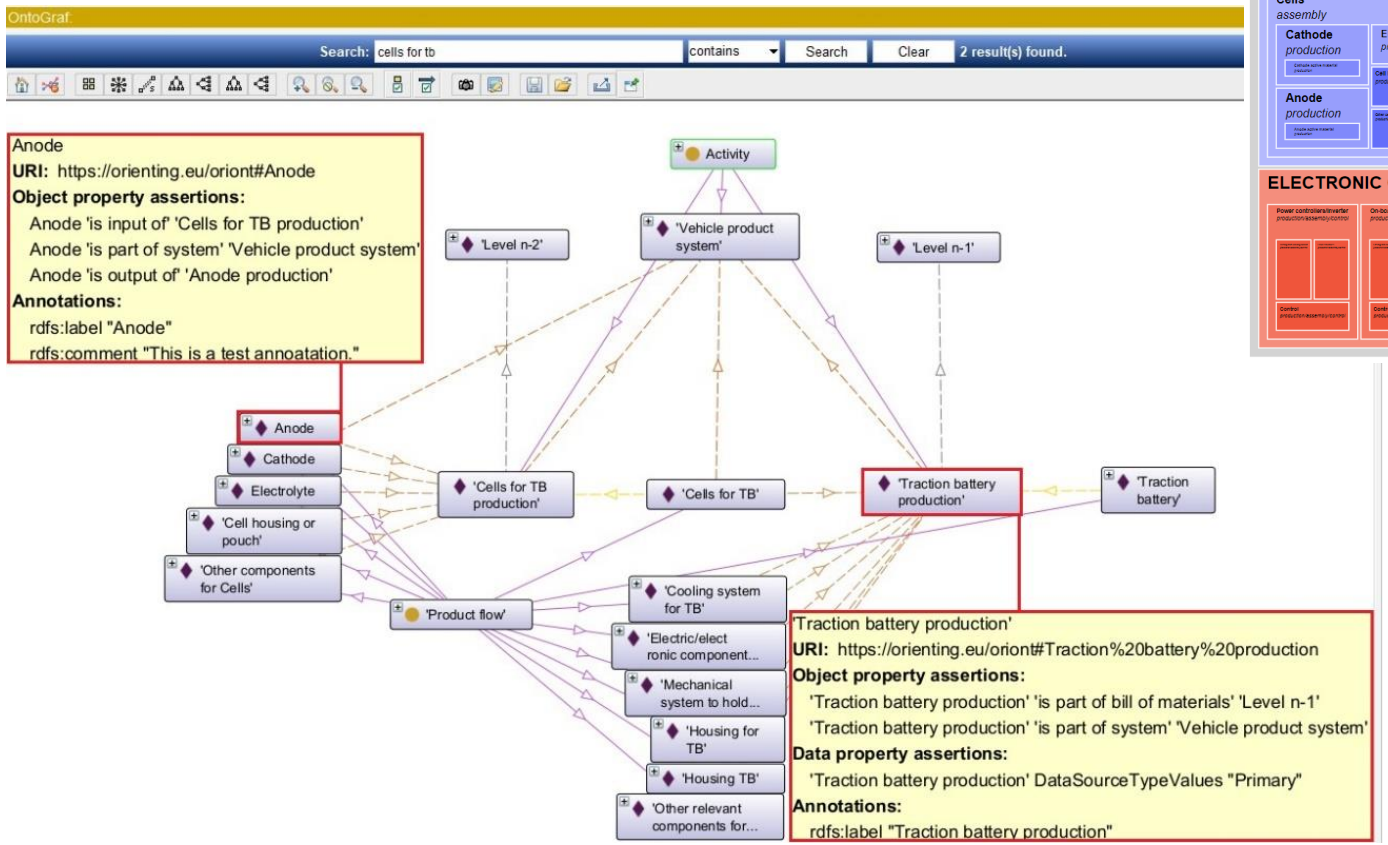
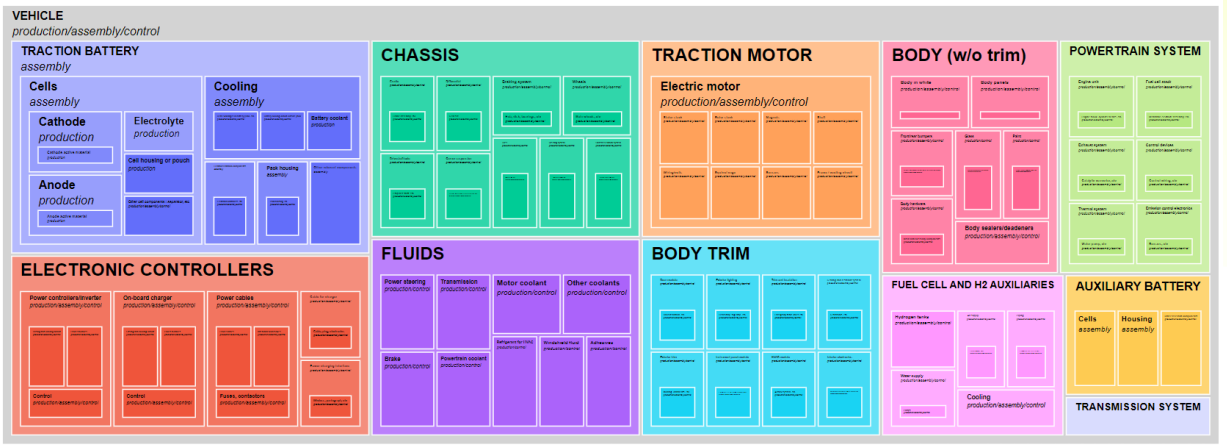
Ontology and Data Management

see D 2.1 to be published soon

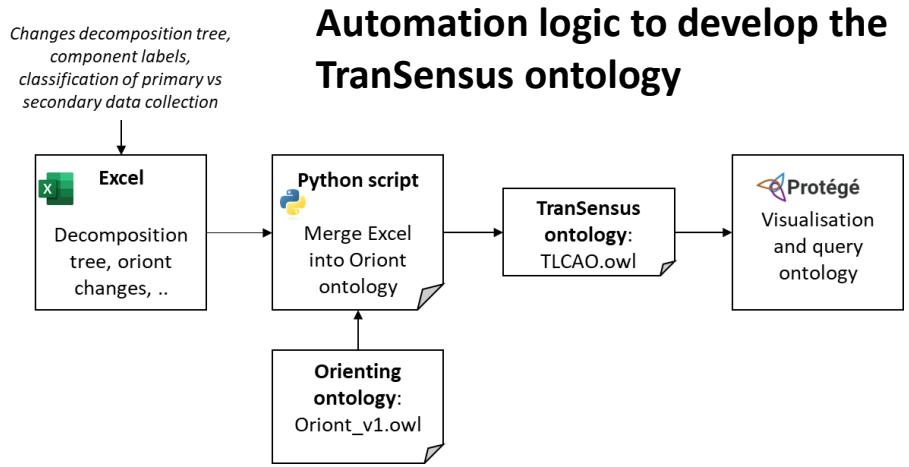
Example of visualizing relevant parts of the TLCAO



Decomposition tree on vehicle level:



Automation logic to develop the TranSensus ontology



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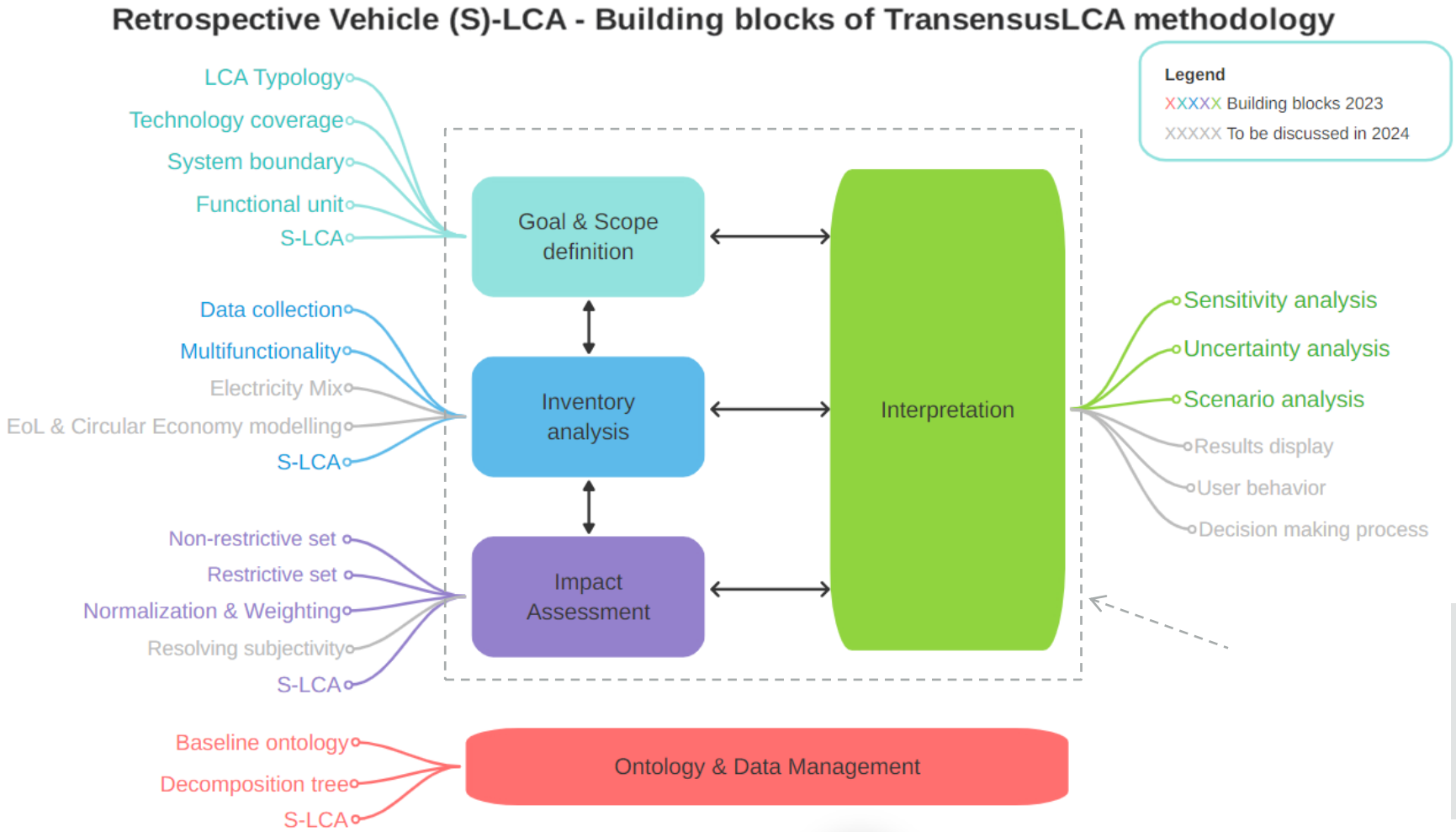
Conceptualize an LCA approach

Overview of WP2 methodological work



- Organized according to ISO 14040/44 LCA framework.
- Specific questions related to life cycle stages are treated in each step of the framework.

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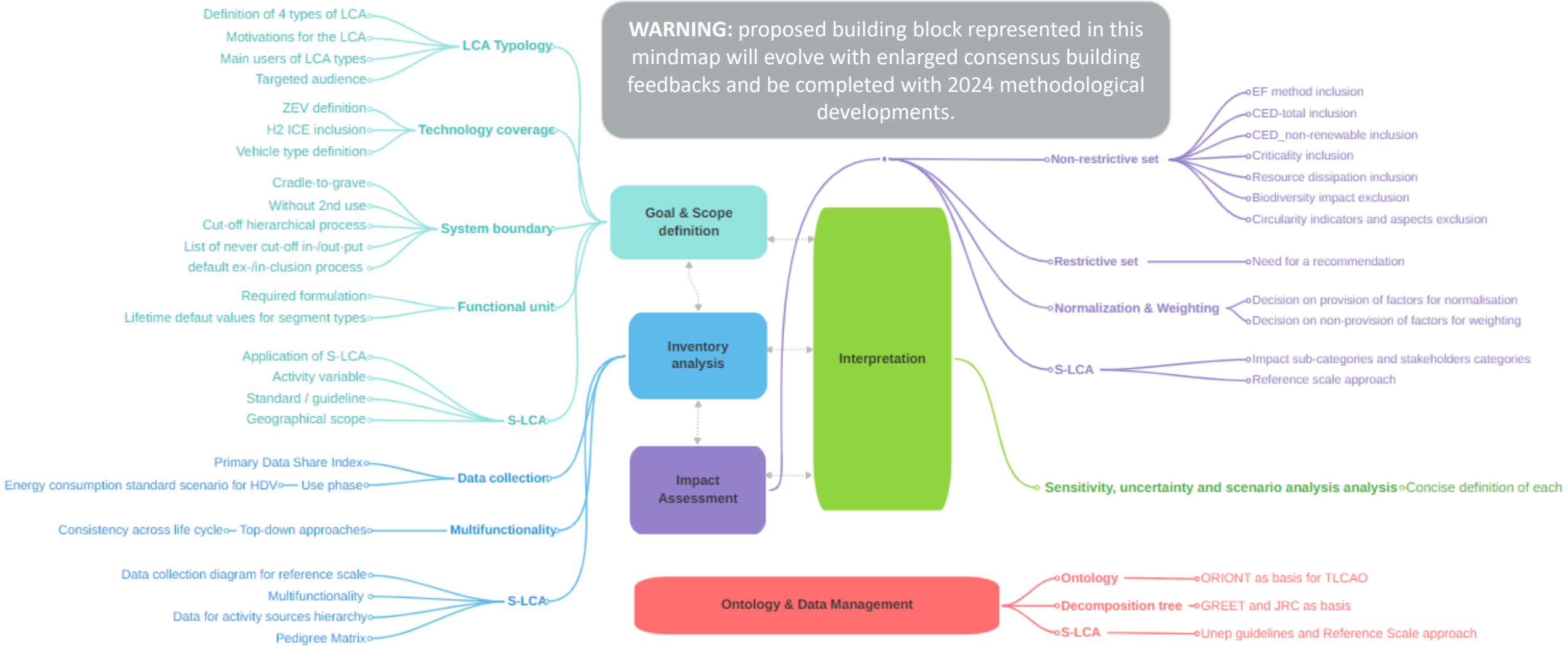
Conceptualize an LCA approach

Proposed building blocks for retrospective vehicle

WARNING: proposed building block represented in this mindmap will evolve with enlarged consensus building feedbacks and be completed with 2024 methodological developments.



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Conclusion

- Overall, TranSensus LCA is progressing well.
- The need for harmonisation has been confirmed.
- Building blocks have been conceptualised first for retrospective LCA providing guidance on
  - goal & scope definition,
  - inventory on data collection, multifunctionality and S-LCA,
  - Impact assessment,
  - Interpretation.
- Conceptualisation of the building blocks is more complex than anticipated and for some aspects a qualified majority might not be reached
  - Detailed description why qualified majority has not been reached
  - Provision of options
  - Outline of further R&D needs

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Conclusion

- We aim to be as open as possible, every interested stakeholder is welcome to get engaged with TranSensus LCA.
  - Most of the deliverables are public and will be made available on the projetc‘s homepage.

Homepage: **www.lca4transport.eu** (please register for our newsletter)

Social Media: **LinkedIn** (27) TranSensus LCA | Groups | LinkedIn (please follow us)

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