The 12th International Conference on Life Cycle Management

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DLR Deutsches Zentrum für Luft- und Raumfahrt
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State of the art review: Investigation of various modelling strategies for chemicals in the field of synthetic resins

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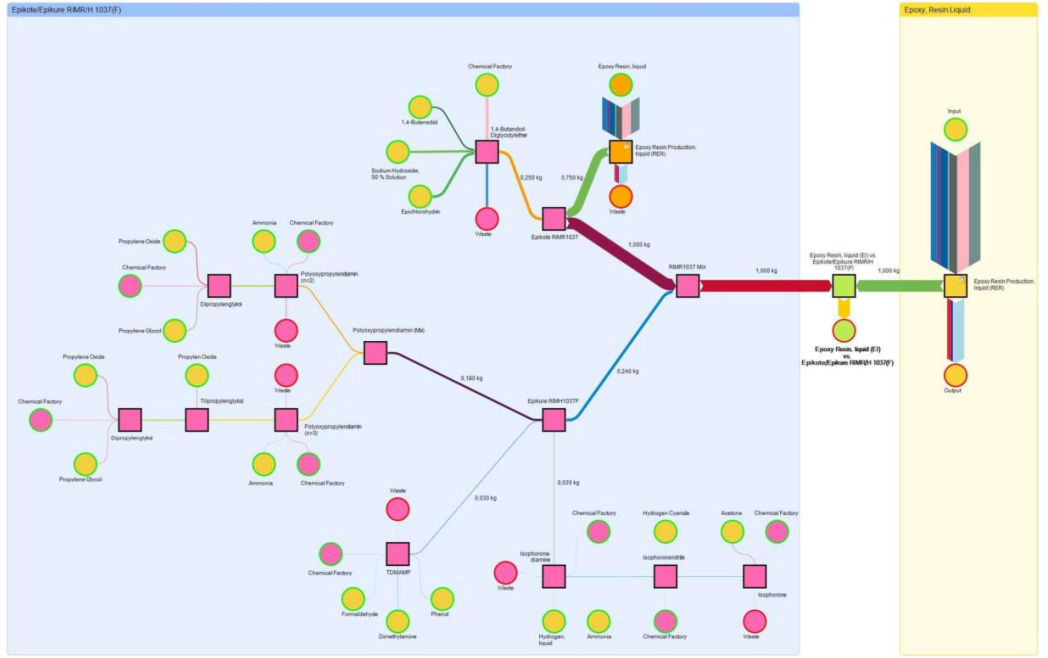
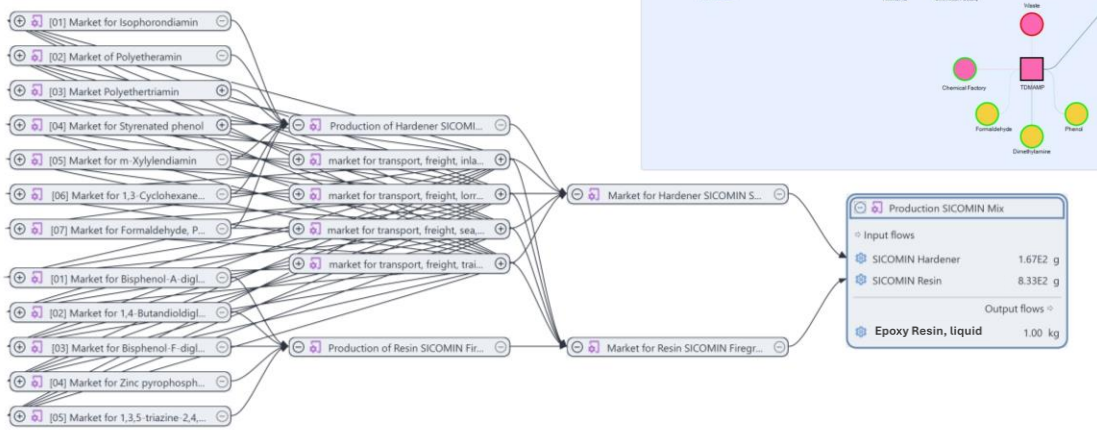
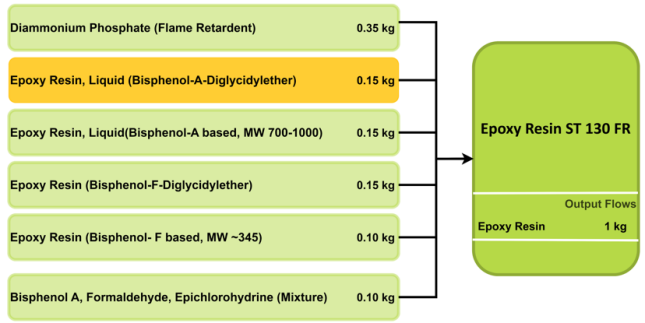
Agenda

1. Background
2. Databases
3. Challenges
4. Results
5. Conclusion

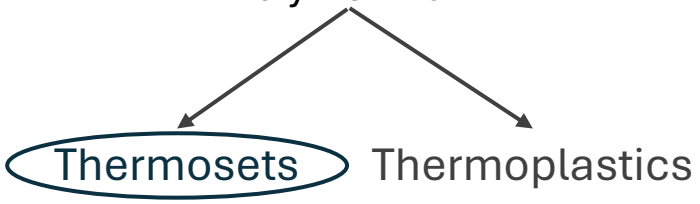


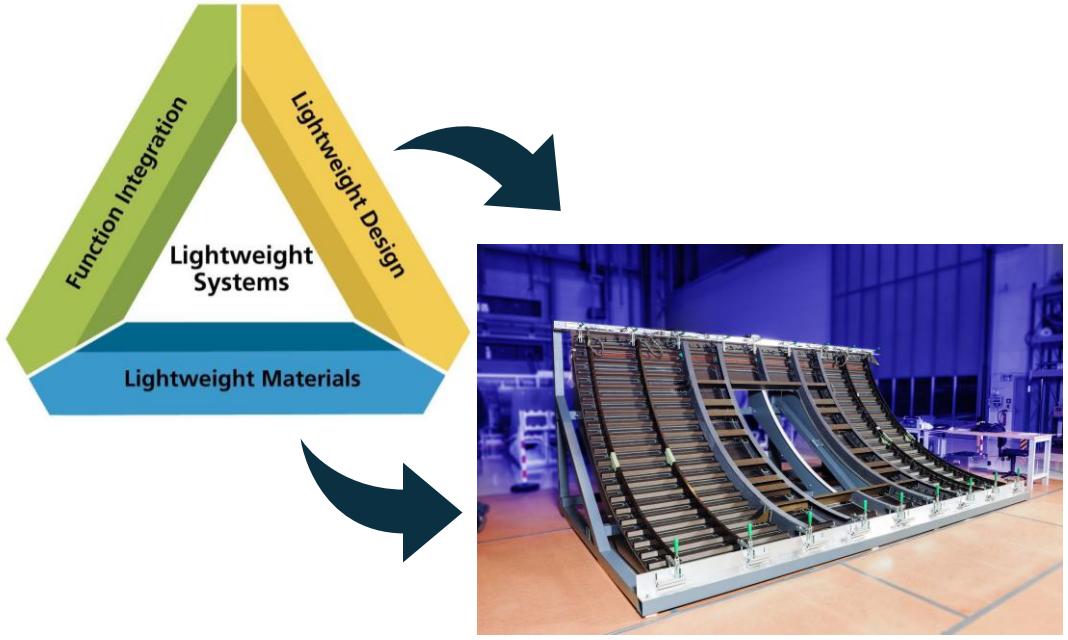




Background

- **Who we are and what we do:**
  - German Aerospace Center (DLR) - Institute of Lightweight Systems
  - **Aim:** Weight reduction of components through structures and materials
- **Fiber-reinforced Plastics:**
  - Consists of two main components
    1. Fibers
    2. Polymer matrix





Source: DLR – Institute of Lightweight Systems

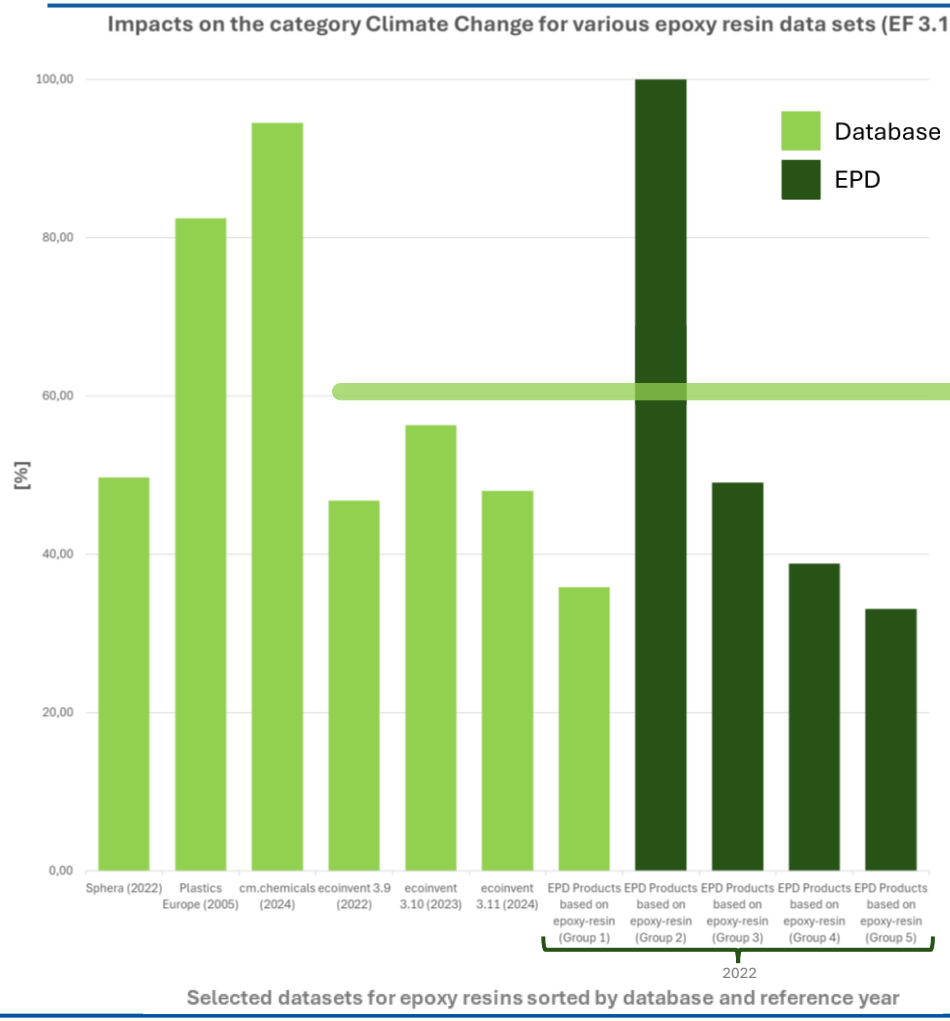
DLR Institute of Lightweight Systems

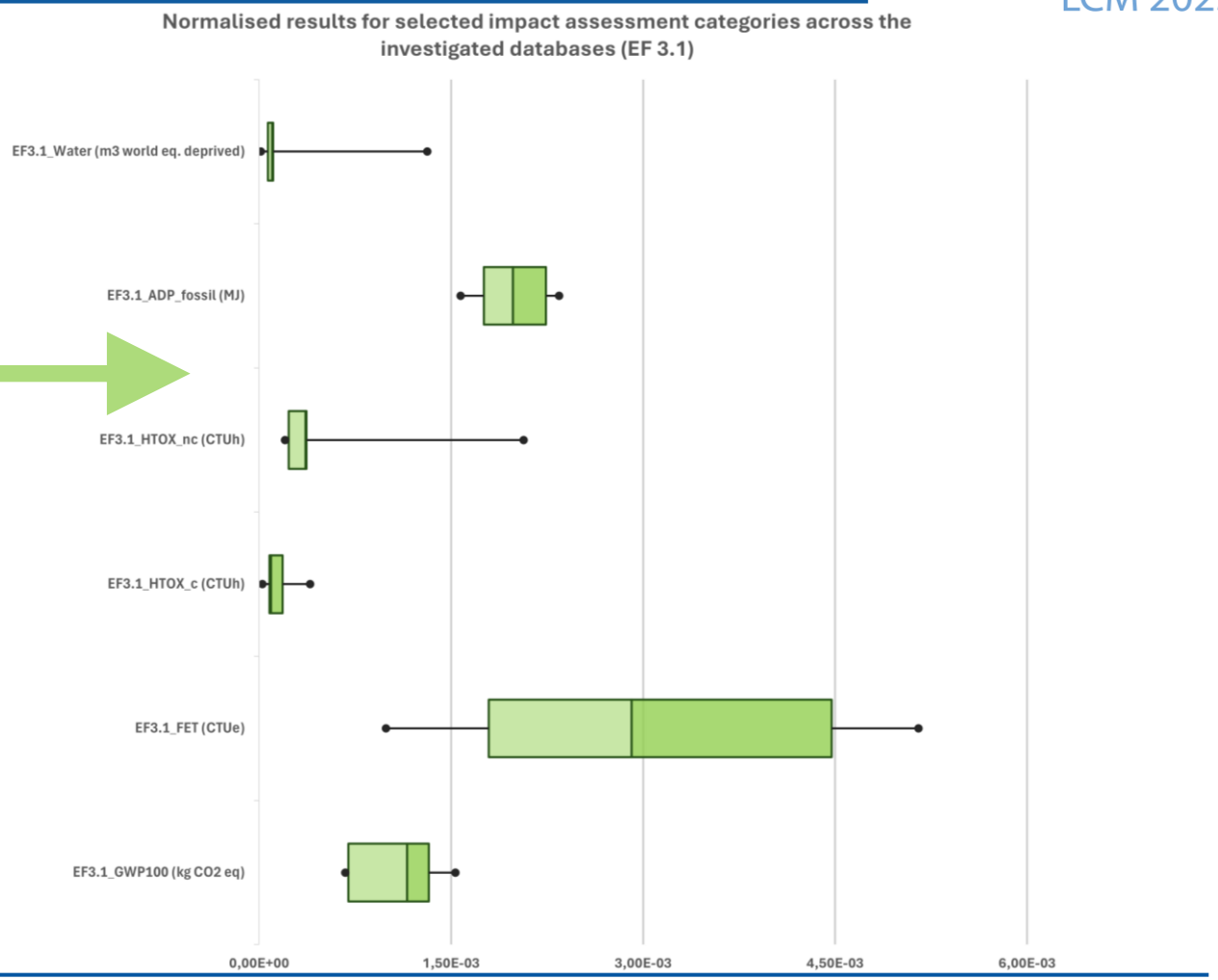
ECO

Databases

- Investigated databases and their modelling principles
  - **Ecoinvent:** *The ecoinvent database version (part I): overview and methodolgy*
  - **Sphera:** *Sphera Managed LCA content – LCA Databases Modeling Principles 2025*
  - **cm.chemicals:** *cm.chemicals database-methodology document V2.01*
  - **Plastics Europe:** *Eco-profiles program and methodology V 3.1*
  - **ESA-LCA Database:** *ESA-LCA Handbook*

Differences across Databases

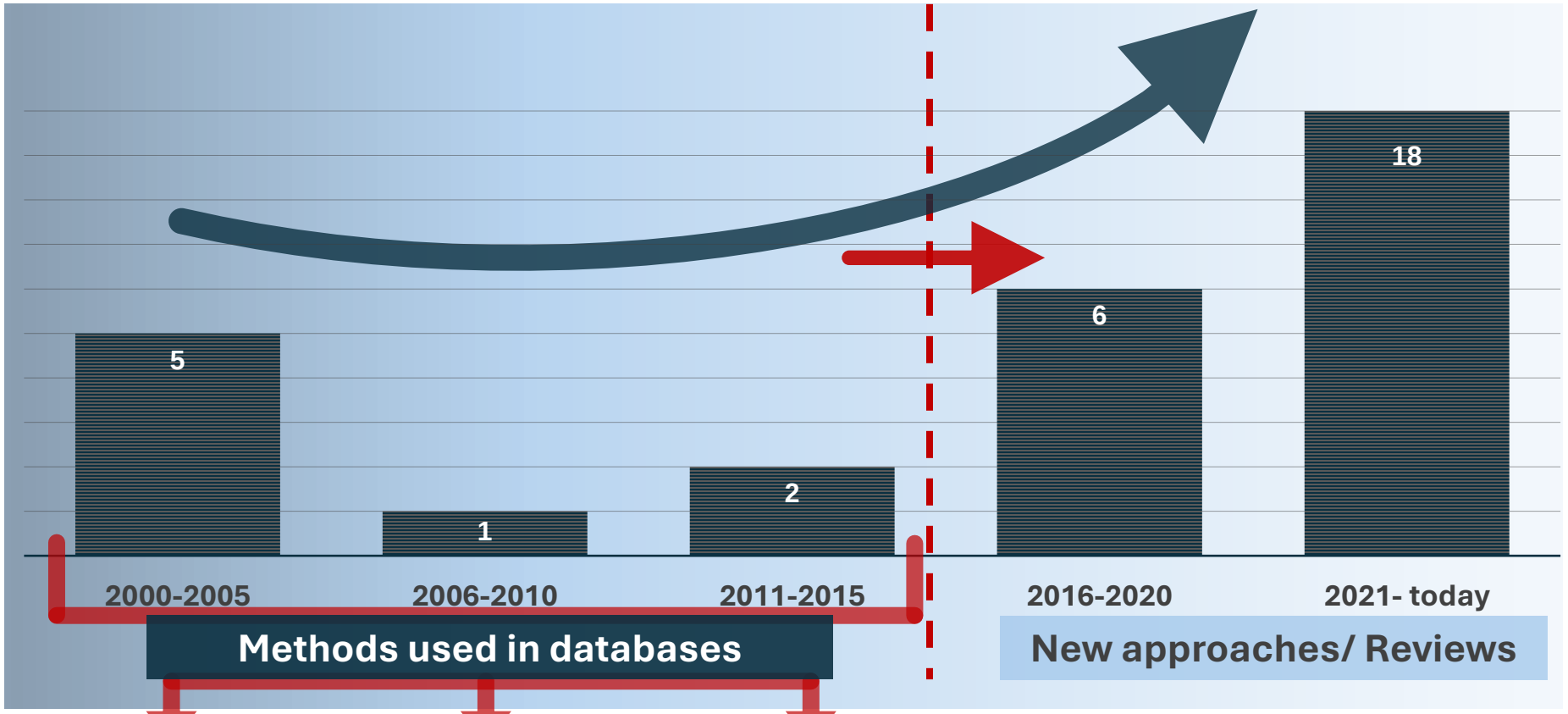




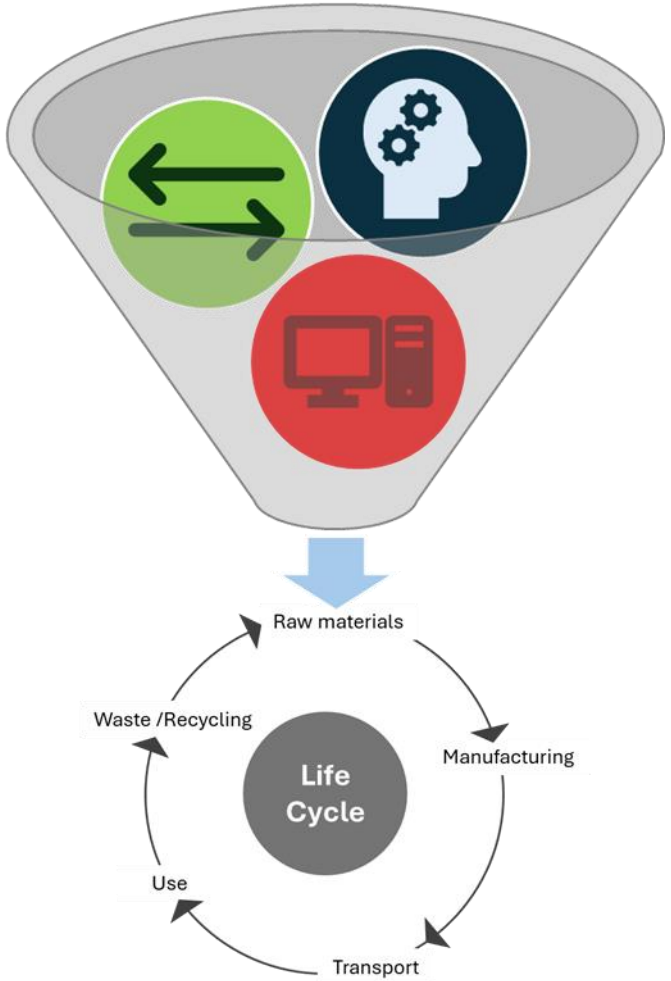
GWP100 = Climate Change Global Warming Potential 100 years, ODP = Ozone Layer Depletion, HTOX_c = Human Toxicity Carcinogenic effects, HTOX_nc = Human Toxicity Non-carcinogenic effects, PMF = Particulate Matter Respiratory Effects, inorganics, IRP = Human Health Ionizing Radiation POCP = Photochemical Ozone Creation, AP = Acidification Freshwater and Terrestrial Acidification, TEP = Eutrophication Terrestrial, FEP = Eutrophication Freshwater, MEP = Eutrophication Marine, FET = Ecotoxicity Freshwater, LU = Land Use Soil Quality Index, ADP = Abiotic Resource Depletion

Identified Challenges

Publications - Analysis and Trends



Identified methods



Grouped into three categories:

Knowledge-based approach:

- Data(sets) are created via contacts in the industry (*primary data*)
- Assumptions based on knowledge from various specialist groups
- Literature sources are consulted

Proxy-based approach:

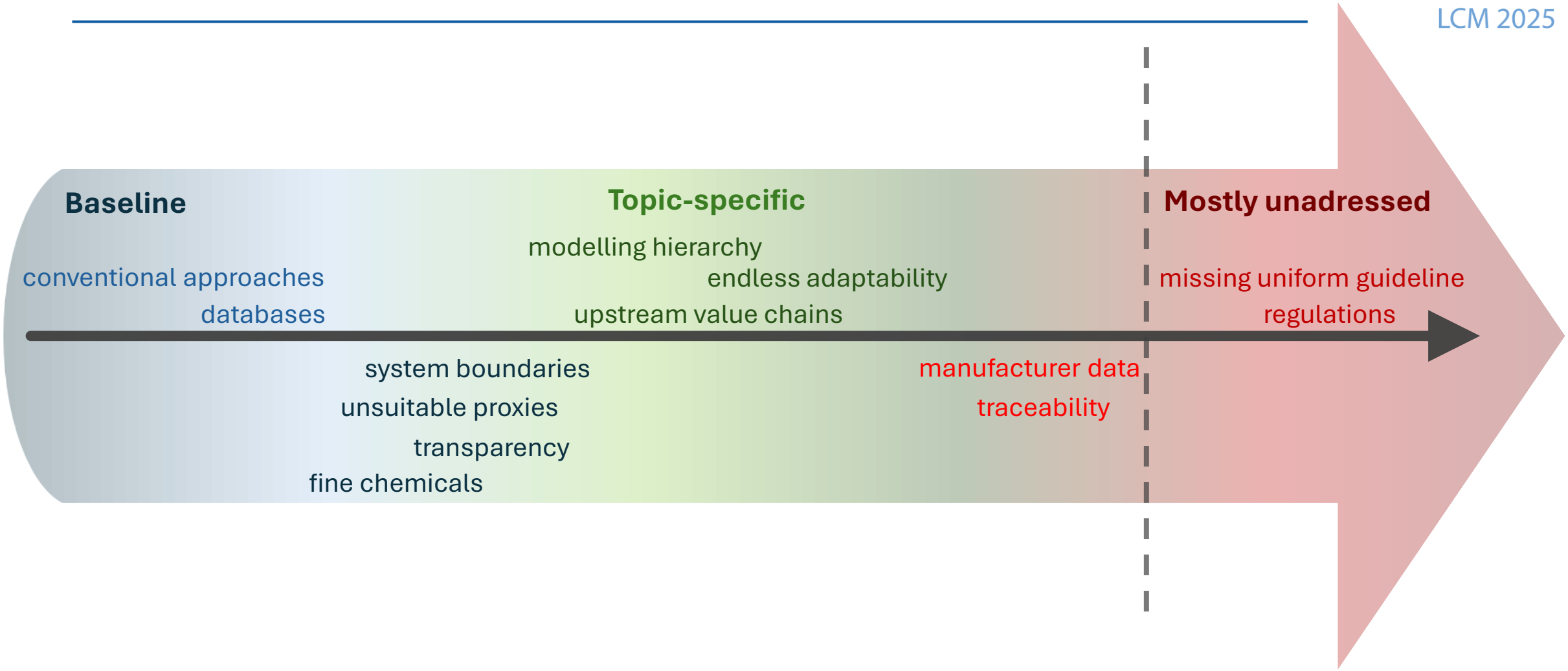
- If data sets are not available, certain proxies are selected
- If necessary, LCI via retrosynthesis tools[1]
- Proxy is preferred to the creation of the own data set

Simulation-based approach:

- Generation of the LCI or parts of the LCI via computer-aided simulations
- Could go hand in hand with retrosynthesis

[1] A method currently being further developed by carbon minds
https://carbon-minds.webinargeek.com/on-demand-webinar-scope-3-1-emissions-for-chemicals-getting-data-taking-action-1?cst=channel

Outcome


Baseline
conventional approaches
databases
Topic-specific
modelling hierarchy
endless adaptability
upstream value chains
system boundaries
unsuitable proxies
transparency
fine chemicals
Mostly unadressed
missing uniform guideline
regulations
manufacturer data
traceability

Take Home Messages

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- ✓ The high **variance in synthetic resins** makes it difficult to compile a comprehensive life cycle inventory
- ✓ **Different data sets** for the same resin can vary considerably in the environmental impact categories, making it difficult to draw conclusions
- ✓ The **number of publications** in the field of chemistry **has increased** significantly in recent years
- ✓ **New methods and approaches** should not be neglected in databases
- ✓ Uniform **modelling hierarchy and regulations** can help to compare conducted Life Cycle Assessments

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