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Theme: Valorization of
LCA results in a Life
Cycle Management
perspective

Thinking and designing sustainably from the very beginning – Potentials and challenges of integrating LCA in early product development and innovation processes

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Intro- duction

- Decisions made in early product development and innovation processes have a significant impact on the environmental footprint of a product throughout its life cycle.
- Integrating Life Cycle Assessment (LCA) early into product development processes can be an effective way to support environmental decision-making.
- Sustainability analysis in early product development is often omitted in conventional product development processes, due to high uncertainties, variability and low data availability.

In order to develop an innovative approach, we systematically analyzed requirements and desired outputs of LCA, as well as available inputs for LCA in three generally applicable early development phases.

Overview of investigated early development phases

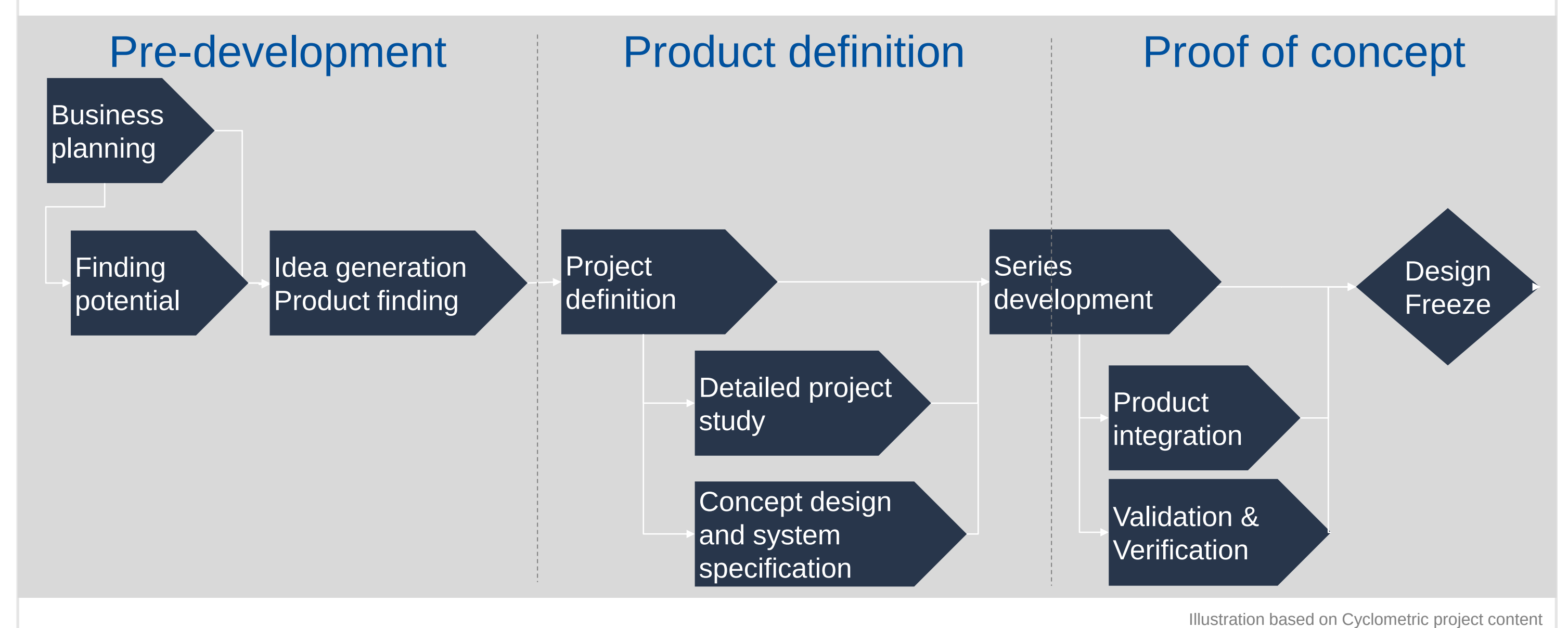
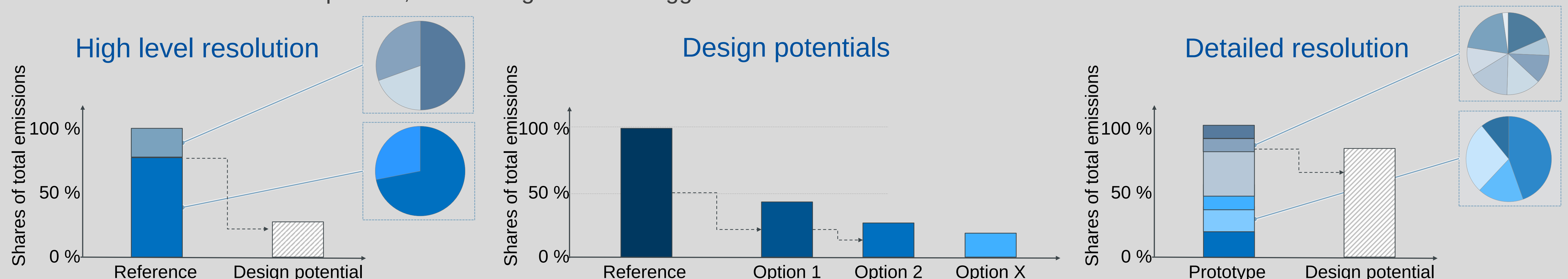


Illustration based on Cyclometric project content

In our systematic analysis, clear gaps are identified in the first three product development phases. In the concept formation, when the developers (stakeholders) do not have specific information, an innovative approach can help during the decision-making process, i.e. with **digital checklists, development matrices, or fact-books**. In the product definition and concept phase, when the developers (stakeholders) know at least a list of potential materials and production processes, (best and worst sustainable) scenarios and sensitivity analysis can be a supporting tool. In contrast, conventional development processes consider environmental impact calculations mostly after the design freeze, prototype, or production. Due to various levels of information availabilities in the phases, contrasting tools are suggested.



Degree of freedom for design, potential for optimizing sustainability, uncertainty in sustainability assessments

Knowledge of design, cost for optimizing product sustainability

Qualitative / initial classification concepts

Semi-quantitative

Quantitative / high resilience

Pre-development

Starting point:

- Definition of milestones for sustainability analysis
- LCA model of an existing reference product
- Existing LCA data of reference materials and technologies

Output of suggested approach:

- Digital checklist, development matrix, fact-books, high-level LCA of reference

Purpose:

- Assessment of status quo and prioritization of improvement potentials

Product definition

Starting point:

- Design of best practices by using a development matrix
- Integration into costs analysis

Output of suggested approach:

- High level footprint of concepts, best and worst sustainable scenarios, sensitivity analysis

Purpose:

- Balancing of concepts: sustainability assessment of design options
- Integration of recycling scenarios to include life-cycle perspective into LCA

Proof of concept

Starting point:

- Decision for concept to prototype

Output of suggested approach:

- LCA of prototype

Purpose:

- Proof of concept

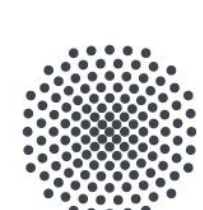
Conclusion
and industry
transfer

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To address the identified gaps in the current state of LCA integration in early development processes, our modular and adaptable approaches provide better information for decisions-support of various stakeholders. The highest level of uncertainty occurs in the beginning of product design, where at the same time most opportunities and environmental potentials can be found. Our presented approaches can lead to unlocking these potentials in early design and innovation processes. While each business has unique boundary conditions, implementation into business practice can generally be supported by similar measures: integration of sustainability goals into overall company strategy, sustainability training for relevant staff, and the implementation of tools and (semi-)automation for sustainability assessments. All these measures can help increase employee sustainability engagement and reduce the risk of added cost and effort, which otherwise would potentially slow down innovation processes.



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Cyclometric



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