

How can multiple background scenarios be consistently incorporated into one LCI background database?

C. Harpprecht^{*,1,2}, B. Fuchs¹, B. Steubing²

¹German Aerospace Center (DLR), Institute of Networked Energy Systems, Department of Energy Systems Analysis, Stuttgart, Germany

²Institute of Environmental Sciences (CML), Department of Industrial Ecology, Leiden University, The Netherlands

*carina.harpprecht@dlr.de



1. MOTIVATION

Problem statement

- Combining background (BG) scenarios crucial for prospective LCA
- BG scenarios often developed by many different researchers
- Combining several BG scenarios is complex due to:
 - LCA scenario data are complex due to underlying models, assumptions, length of excel files, etc.
 - BG databases, original or futurized, are inherently complex

⇒ Inefficient to double-check and understand scenario data manually

⇒ Guidance needed to support quantitative consistency during scenario incorporation

Research question

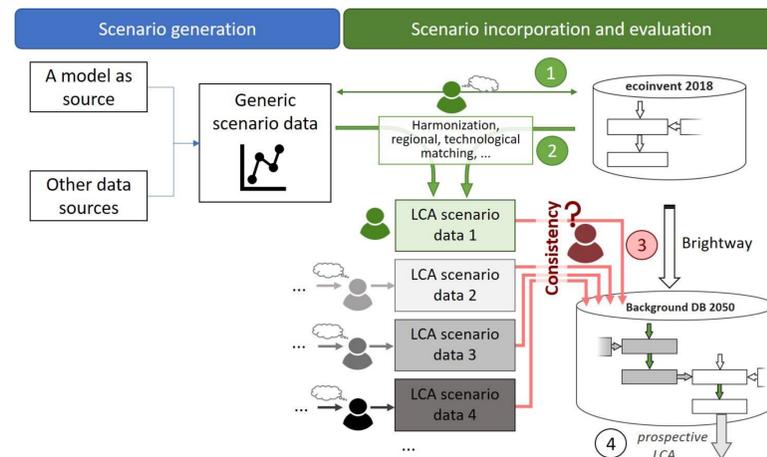
How can we control whether several background scenarios from different sources are incorporated into one background database consistently, i.e., without causing any unwanted modifications?

Research goals

- Conceptualizing the problem of combining several background scenarios in ③
- Definition of archetypes of conflicts and possible solutions

Focus: quantitative consistency

- addresses final data used for modifying DB in ③
- Excluding: step ① & ②
 - match of qualitative assumptions between scenarios
 - calculation of final scenario values

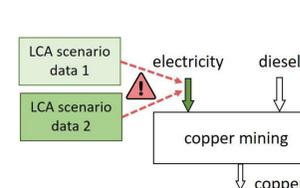


Steps of incorporating a BG scenario into a background database (BG DB) for prospective LCA

- Identify relevant parameters, flows & processes
- Create scenario data applicable to BG DB = LCA scenario data
! Practitioner's choices
- Produce adapted DB with LCA scenario data
- Scenario evaluation = LCA calculation with Scenario DB

3. RESULTS

Archetype 1: same flow is changed



Detection:

- Check whether flow appears twice in scenario data

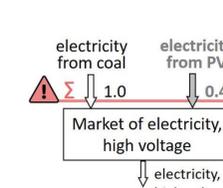
Handling:

- If scenario values are the same → continue, but inform
- Else → provide list of flows → practitioner needs to adapt scenario data

Applies to:

Cat. I	Cat. II	Cat. III
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Archetype 2: ∑ market shares ≠ 1



Detection:

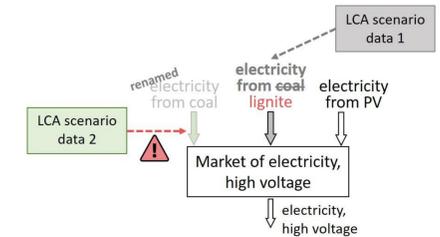
- Calculate sum of inputs into markets

Handling:

- If sum ≠ 1 → provide list of markets → practitioner needs to check for edge cases, e.g., due to transmission losses → adapt scenario data

Cat. I	Cat. II	Cat. III
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Archetype 3: renamed flow or process



Detection:

- Search for unmatched flow

Handling:

- provide list of unmatched flows → practitioner needs to identify "new" names → adapt names in scenario data

Cat. I	Cat. II	Cat. III
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Archetype	Detection	Handling	Cat. I	Cat. II	Cat. III
4 Same intent, but modification of different flows	Detect if reference flow of a process is changed as well as other flows of that process	<ul style="list-style-type: none"> provide list of those processes and flows practitioner needs to find a specific solution 	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5 Overlapping or missing geographies	Compare regions with geographic information	<ul style="list-style-type: none"> provide list of product groups with missing or overlapping geographies practitioner needs to find a specific solution 	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6 Structure of DB changed (and renaming of flows) → flow does not exist or is ambiguous	Search for unmatched flows	<ul style="list-style-type: none"> provide list of unmatched flows practitioner needs to identify new flows 	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7 Typo in flow definition	Search for unmatched flows	<ul style="list-style-type: none"> provide list of unmatched flows practitioner needs to identify new flows 	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

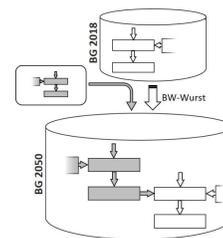
2. METHODS

1. Categorization of modifications of BG DBs

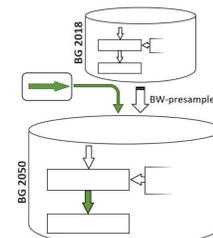
2. Within each category:

- we define different archetypes of conflicts
- where applicable, we offer suggestions how to detect and handle these conflicts

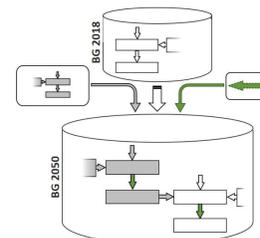
Category I: create new processes / flows
e.g. Mendoza Beltran et al. 2020



Category II: change values of existing flows



Category III: combining cat. I + II - change values of flows in new DB



4. DISCUSSION & CONCLUSIONS

- Many different archetypes of conflicts can occur → need for a comprehensive list
- Hard to detect all conflicts and to provide automatization of conflict handling → tool for a 100% reliable consistency check and conflict handling is very challenging

Recommendations:

- Guidelines required to standardize harmonization and incorporation of scenario data → to support process of checking consistency of scenario data (quantitatively and qualitatively)
- One central platform providing consistent scenario data → to support consistent scenario combinations

Acknowledgements:
We would like to thank Marc van der Meide and Brenda Miranda-Xicotencatl for their feedback.

References: Mendoza Beltran, A. et al. (2020). When the background matters: using scenarios from integrated assessment models in prospective LCA. *Journal of Industrial Ecology*. Lesage, P., Mutel, C., Schenker, U., & Margni, M. (2018). Uncertainty analysis in LCA using precalculated aggregated datasets. *Int. Journal of Life Cycle Assessment*.

