LCA, computers and a sea of data to navigate

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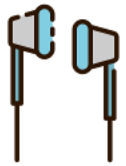
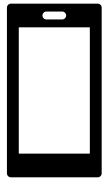
78th Jubilee Swiss LCA forum:
Life Cycle thinking = Lower Footprint?

A look into the future: LCA in 2030

A look into the future: Technology

2021





A look into the future: Data

Industry 4.0

Internet of things

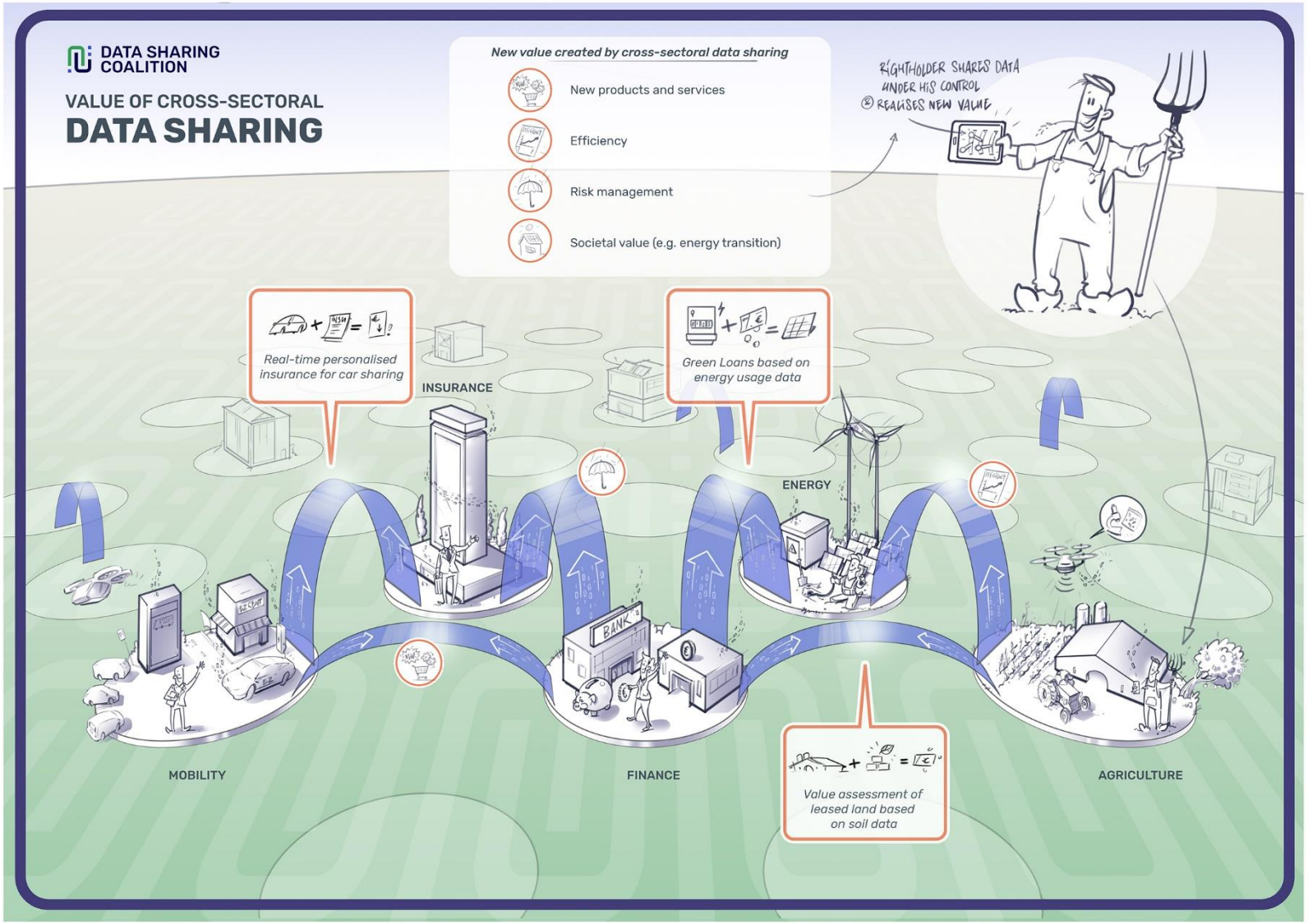
Internet of services

Automation

Artificial Intelligence

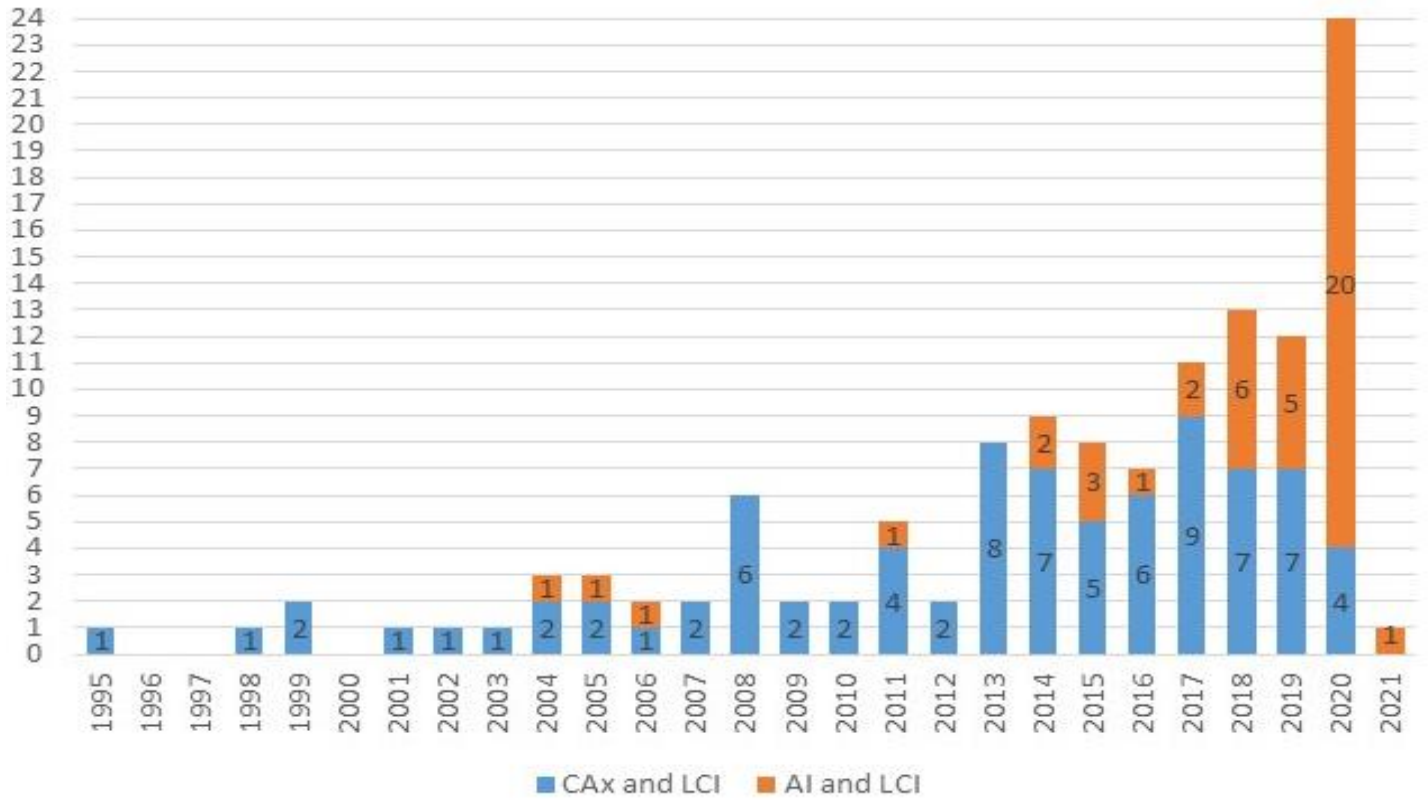
Digital twins

Big data



How can computer aided technologies and AI applications be used to compile LCIs?

Published papers on the use of computer aided technologies (CAx) and AI for lifecycle data in the period 1995-2020



Donati et al. [Submitted]

Machine learning and data mining

	Resource extraction	Manufacturing & co	Distribution	Use,	Recycling & waste
Machine learning	1. Improve **expert systems** through collected data. 2. Project alternative LCIs compilations based on endogenous and exogenous counterfactual operating conditions.	3. **Automate flowsheet compilation** through reinforcement learning (e.g., Göttl, Grimm and Burger, 2021) 4. See ML no 1 and 2	5. Identify optimal distribution mode and **explore possible alternatives** (e.g, Li, Xu and Cele, 2019)	6. Estimate assignment of parts to middle-of-life and end-of-life treatments (e.g., Gao, Zhou and Caudill, 2002) 7. Other applications similar to CAx	
Data mining	1. Identify, prioritize and **fill data gaps** through data pattern recognition and clustering in a LCI database 2. Identify possible alternative flows and processes based on similarities to other LCIs or CAx models 3. Discover rules in ancillary data used to create expert systems (e.g. farmer, operation and consumer surveys) 4. Support calculation of uncertainty distribution based on ES and alternative LCI generated with ML.				

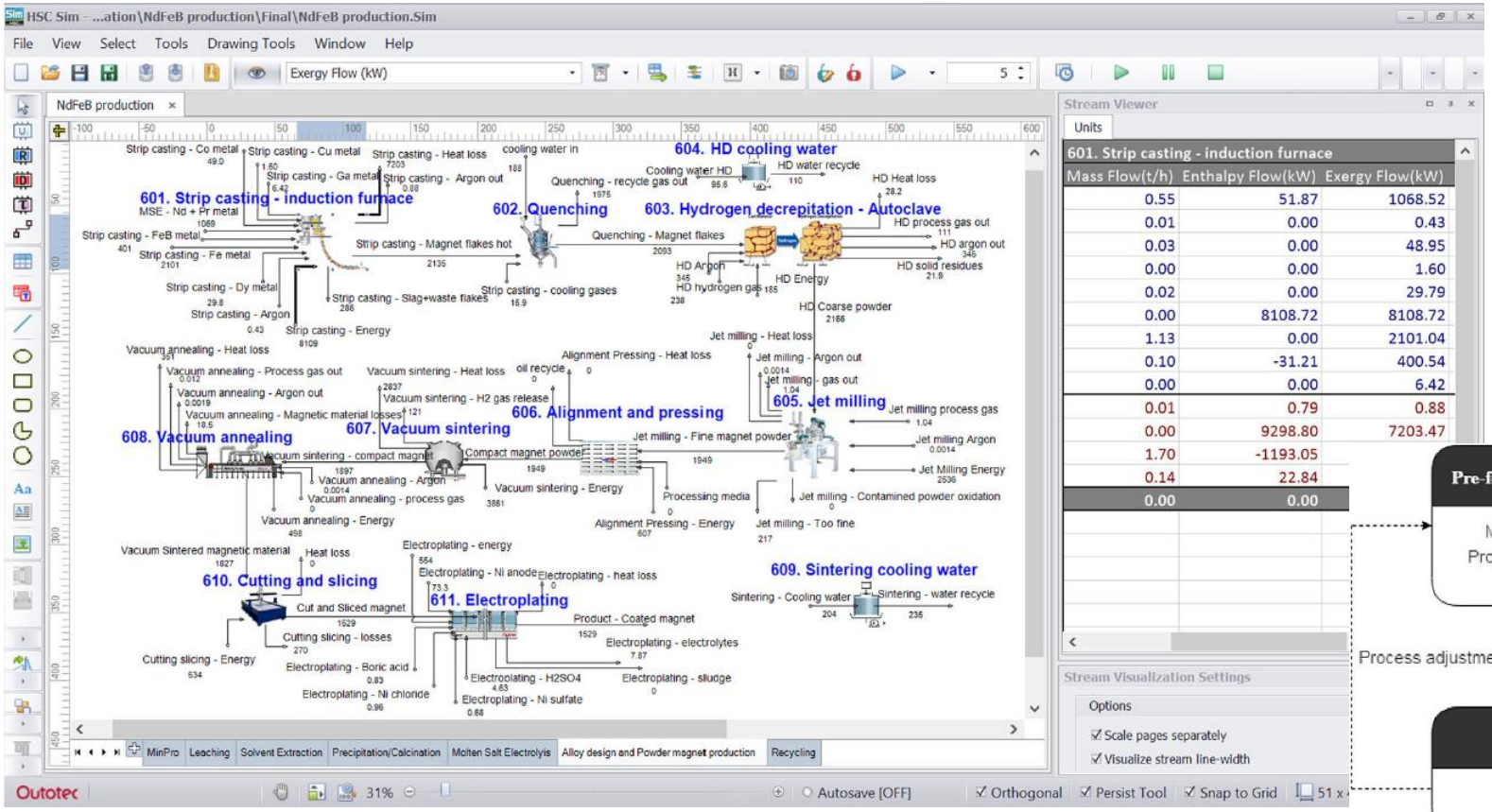
Abbreviated from Donati et al. [Submitted]

Building information modelling

Source: ACCIONA 2020

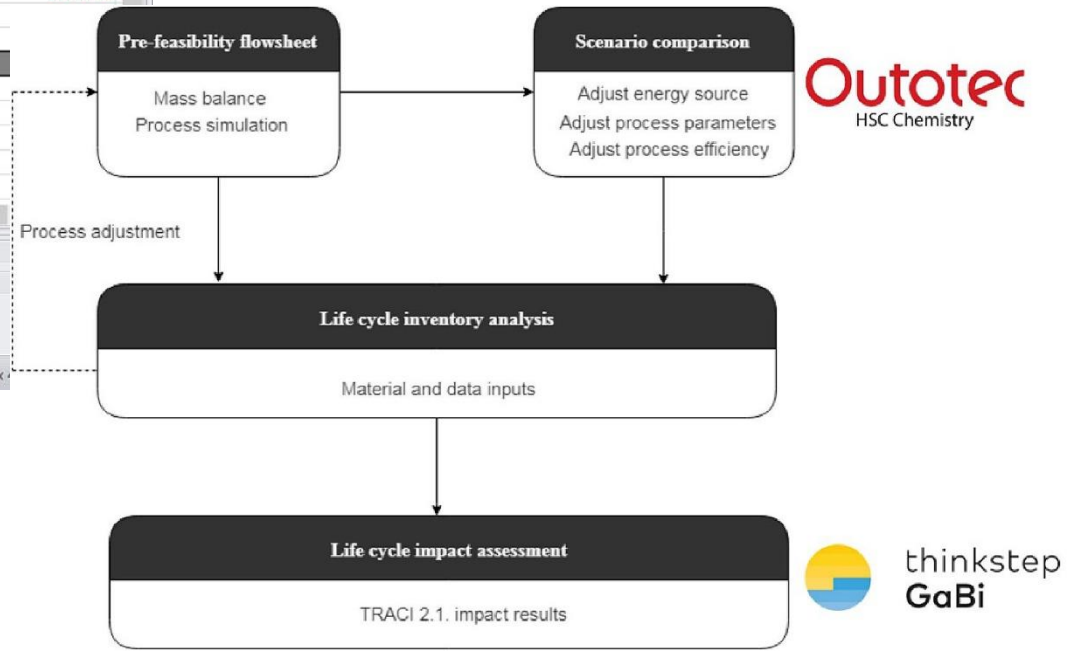
Source: HISER 2018

CAD: Process simulation

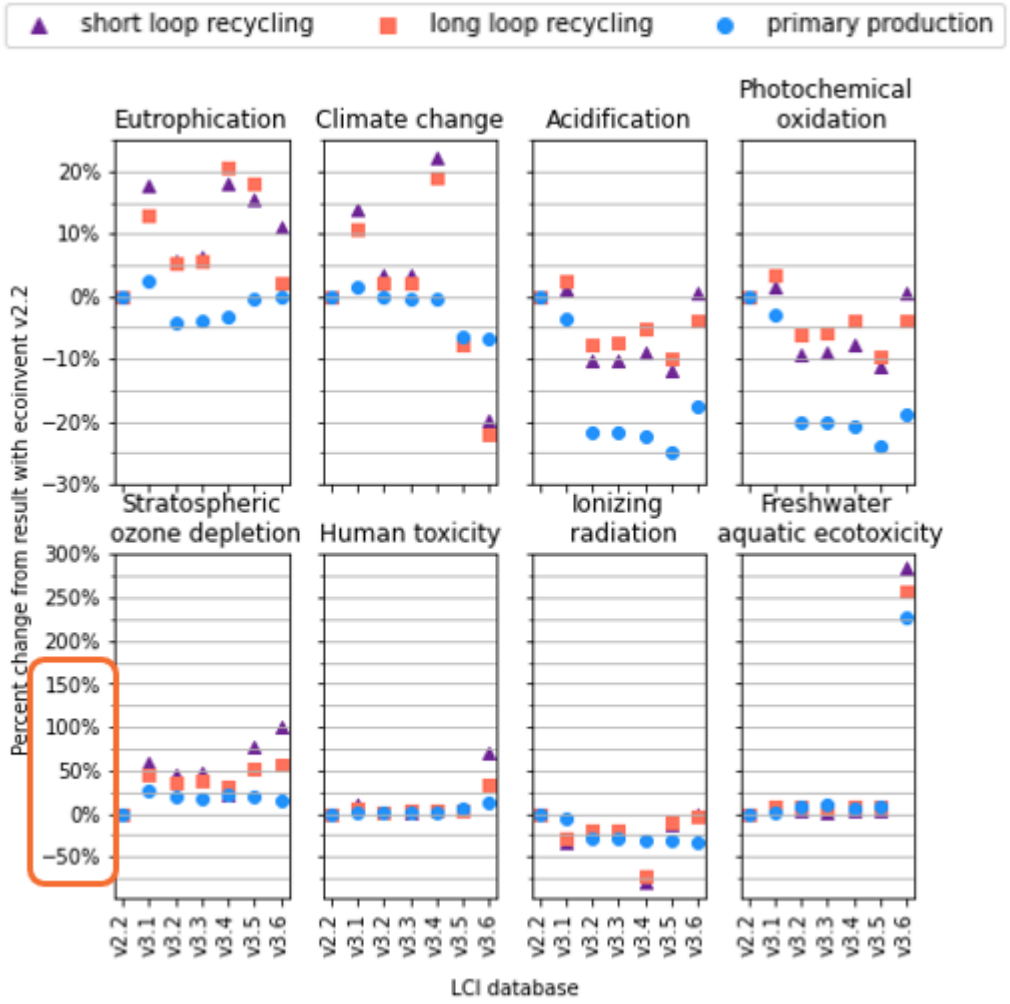


Fernandes et al. 2020

Pell et al. 2019



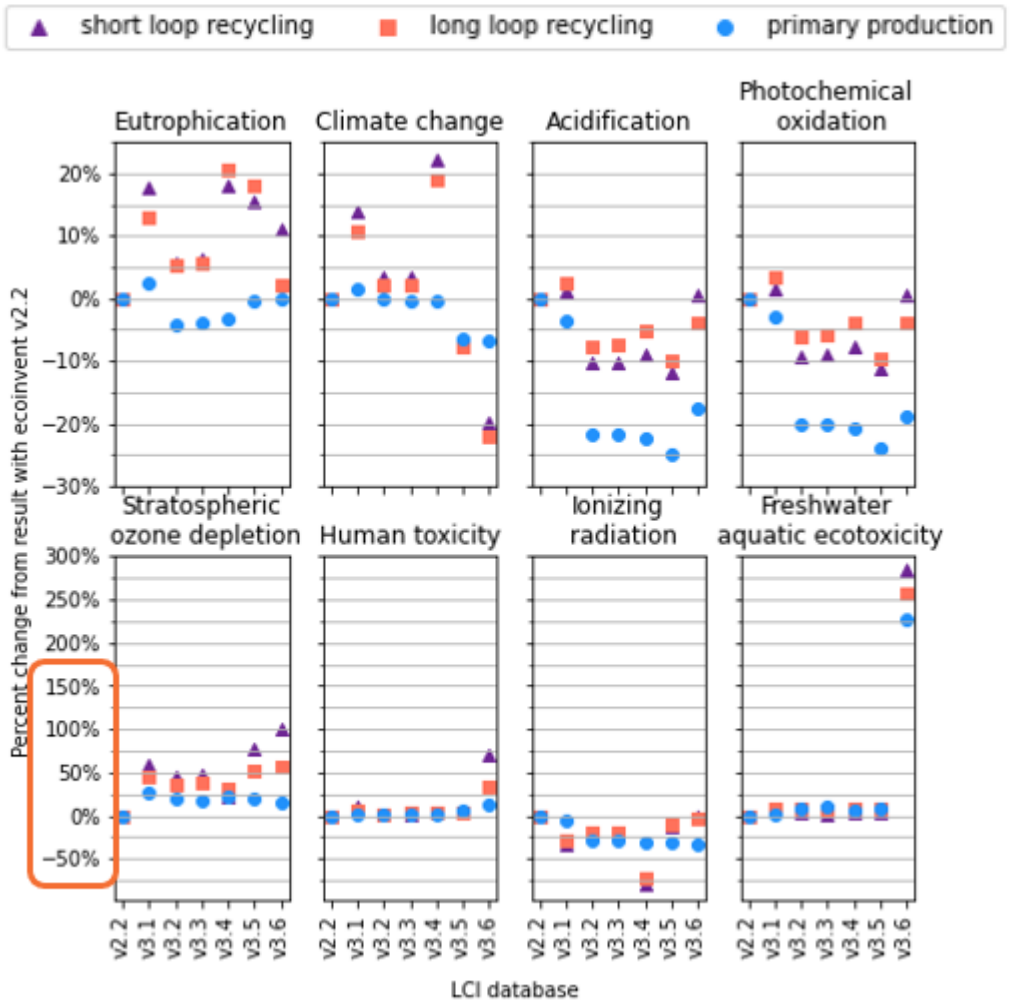
LCI databases evolve

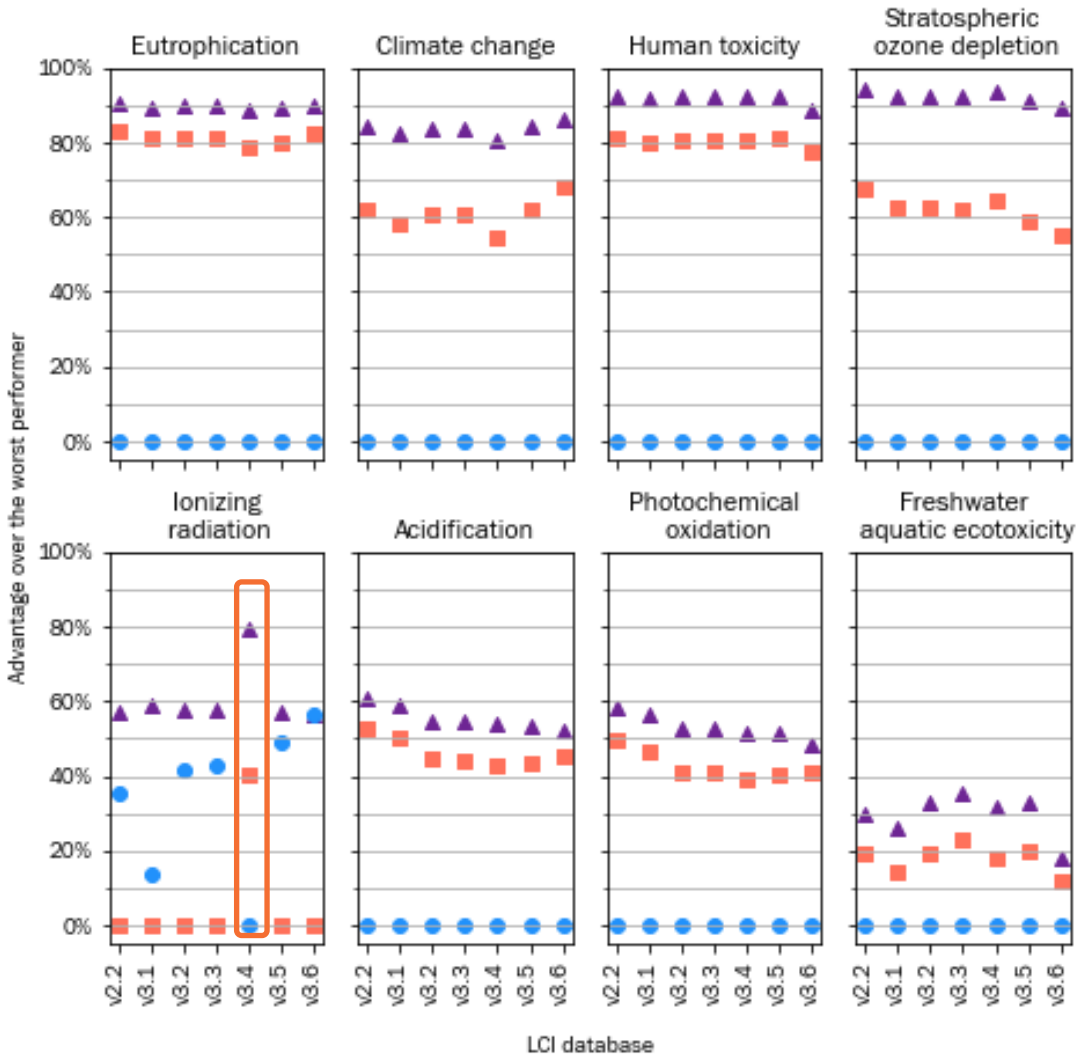


$$\text{Advantage over the worst performer}(\%) = 100 \times \left(1 - \frac{x}{x_{max}}\right)$$

Miranda Xicotencatl, et al. [In preparation]

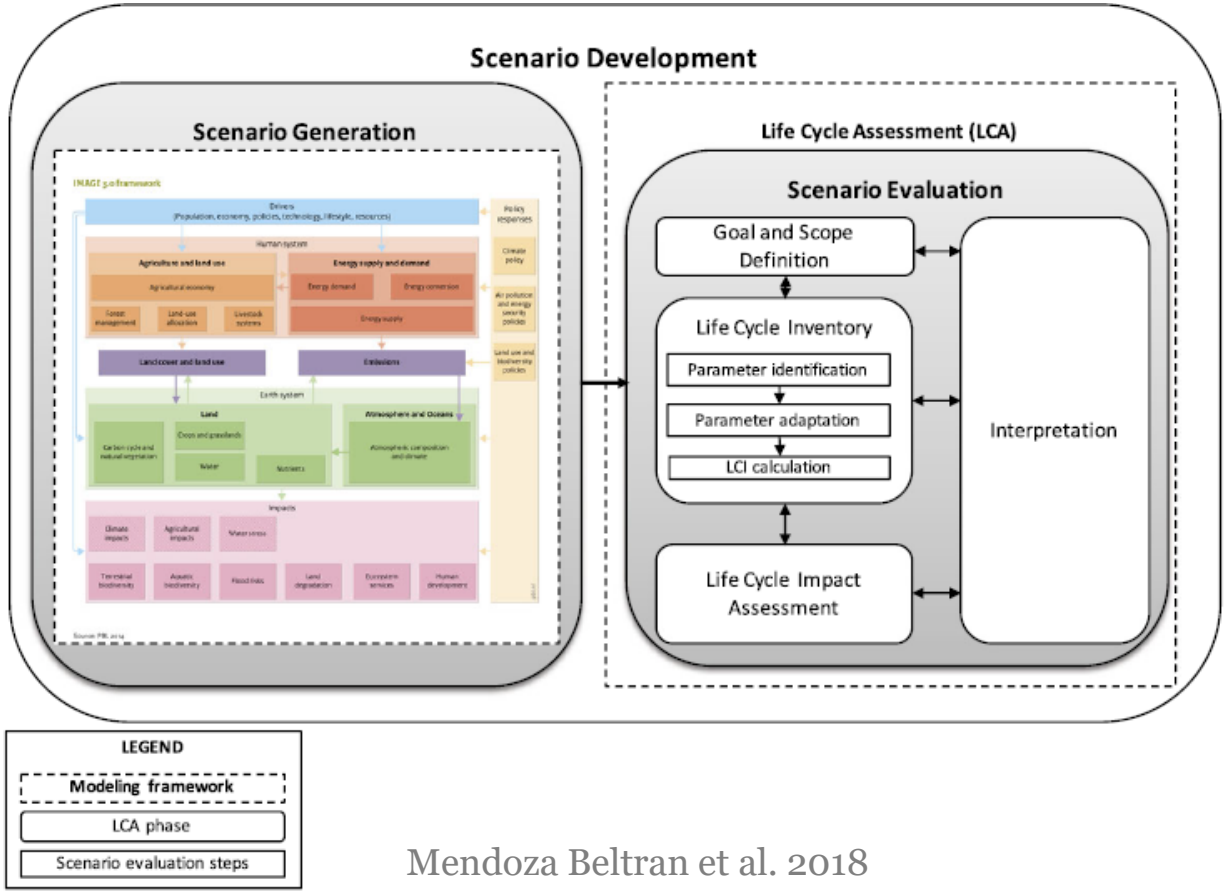
LCI databases evolve





Miranda Xicotencatl, et al. [In preparation]

Databases in the future



Mendoza Beltran et al. 2018

Environmental impacts of key metals' supply and low-carbon technologies are likely to decrease in the future

Carina Harpprecht ✉ Lauran van Oers, Stephen A. Northey, Yongxiang Yang, Bernhard Steubing

First published: 05 September 2021 | https://doi.org/10.1111/jiec.13181

From slide 3

Challenges

Differing levels of data literacy-> Streamlining of tools?
Transparency vs intellectual property protection
Navigating the sea of data:

- Cognitive load and communication of insights and limitations
- Is a high level of resolution always better?

Signposts

The future of AI is human

FAIR guidelines for research:
Findable, Accessible, Interoperable, Reusable

@ChelseaParlett

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Thank you for your attention!

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