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sustainability consulting + software

TREASoURcE

Model-based LCSA in the TREASoURcE project

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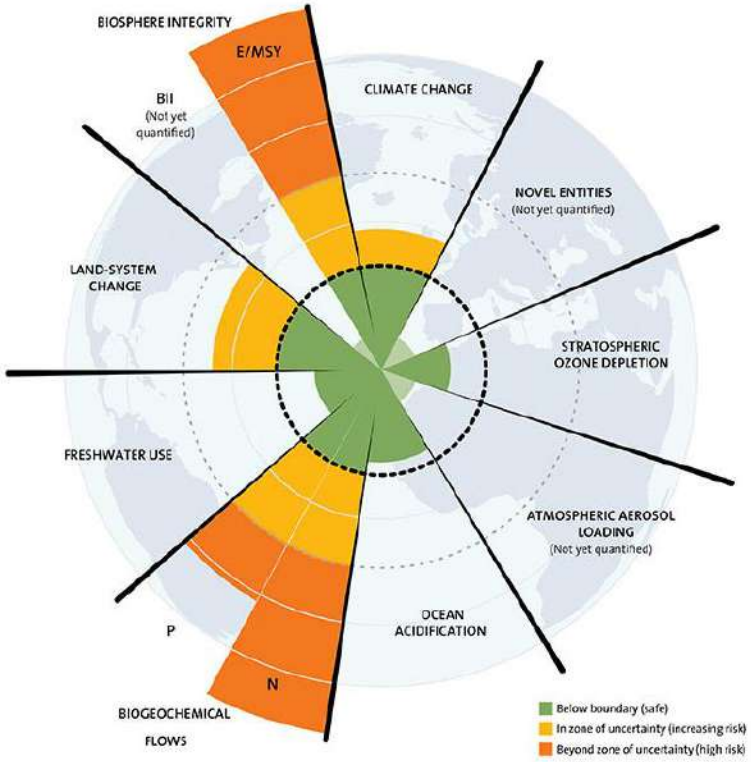
Content

- Sustainability and LCSA
- System dynamics and sustainability modeling
- Conclusion and outlook

Sustainability and LCSA

Sustainability

- Brundtland commission (1987), for sustainable development : "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*"
- So, sustainability refers to a multi-dimensional and dynamic system that needs to be maintained: *not exceeding certain boundaries*



https://www.stockholmresilience.org/research/planetary-boundaries.html

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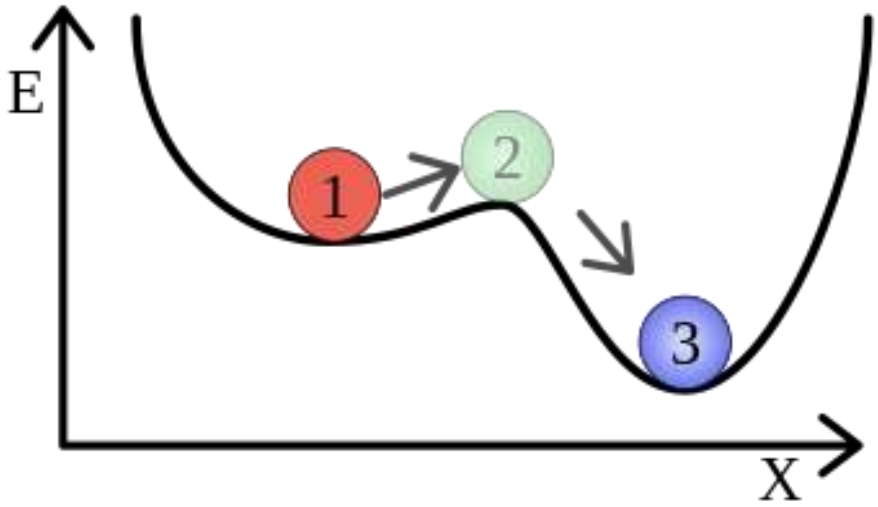
Sustainability

→ Sustainability is about the stability of a system under pressure



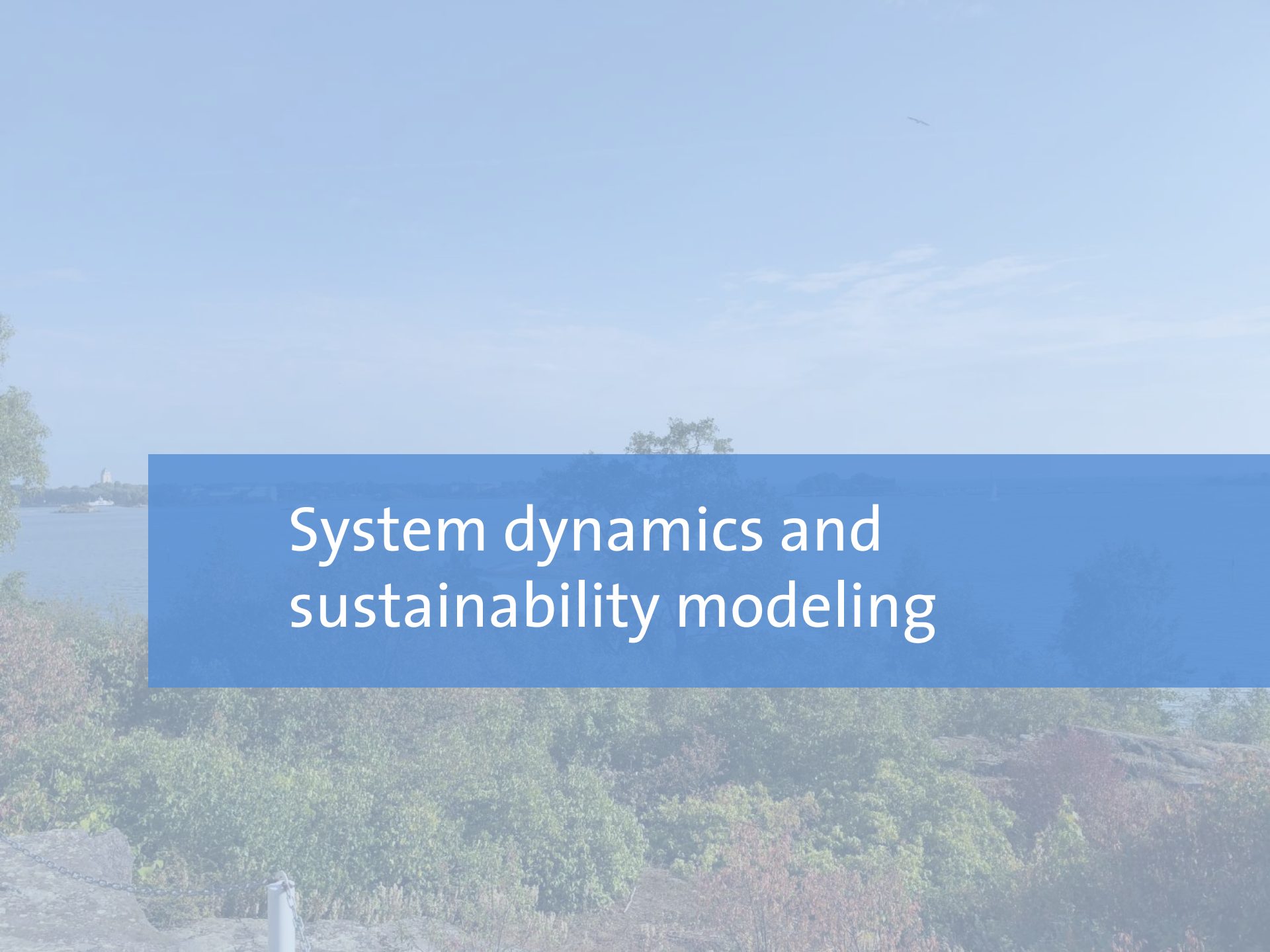
Life Cycle Sustainability Assessment, LCSA

- Combination of three dimensions of sustainability, environmental impacts, economic impacts, social impacts: LCA, LCC, S-LCA
- Often-cited formula:

$$LCSA = LCA + LCC + S\text{-}LCA$$

Limitations

Thresholds? Relations? Linear approach! Leads to recommendations with limited feasibility and replicability



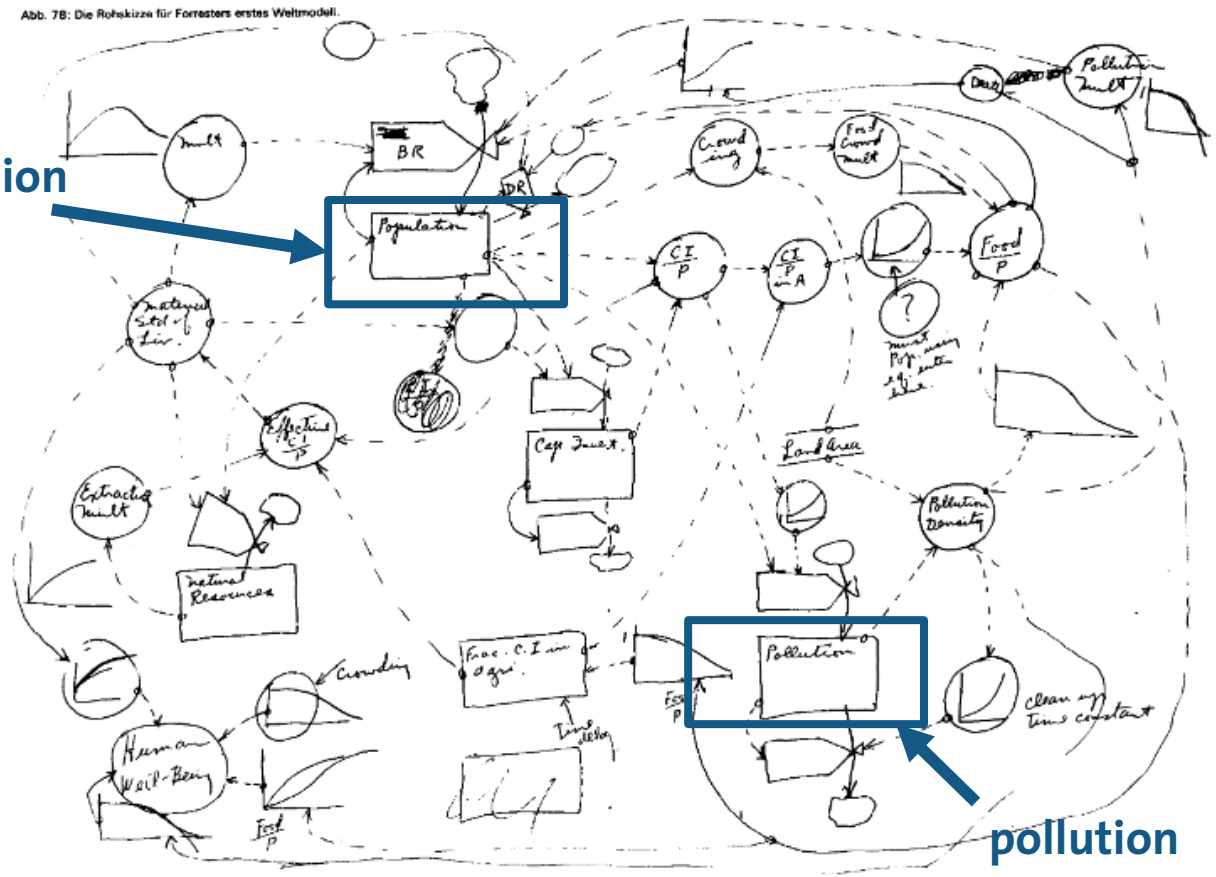
System dynamics and sustainability modeling

System dynamics

- Idea: modeling a system as a combination of stocks and flow rates
- Any system(!)
- Scope and level of detail totally up to the modeler

System dynamics and sustainability modeling

- Forrester et al. 1970's: a model of the entire world

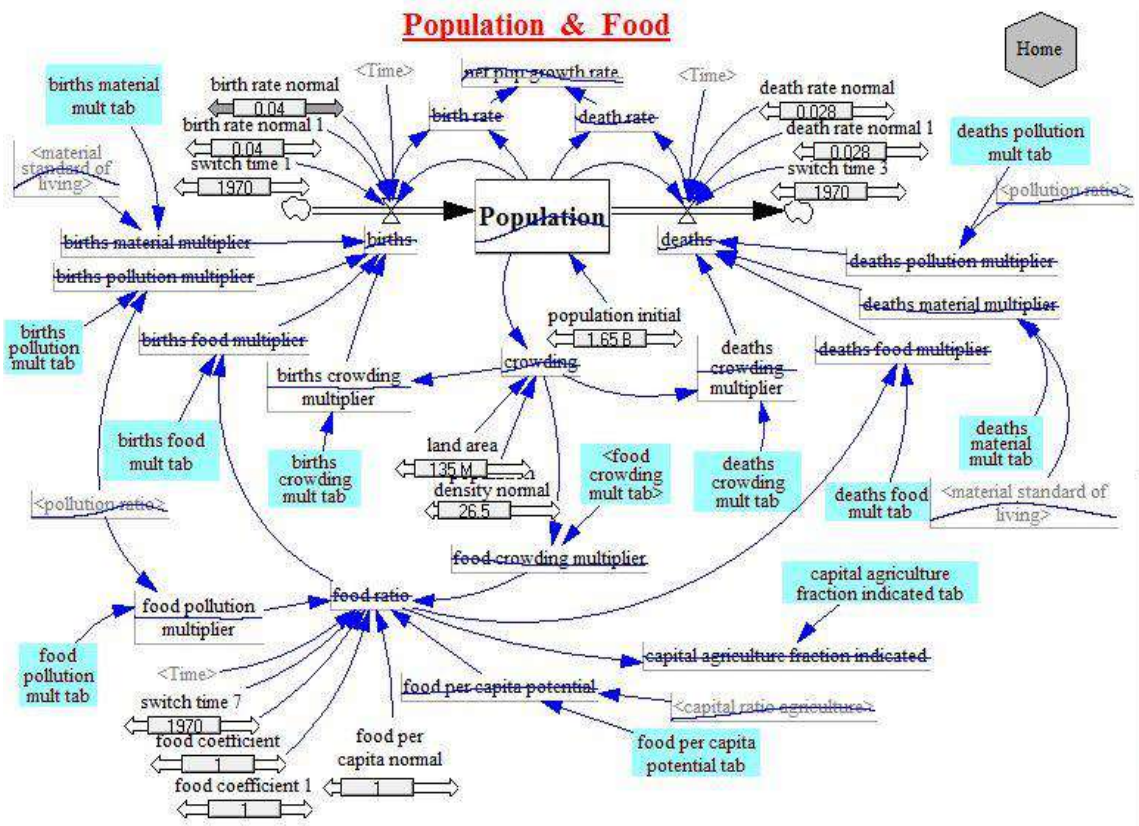


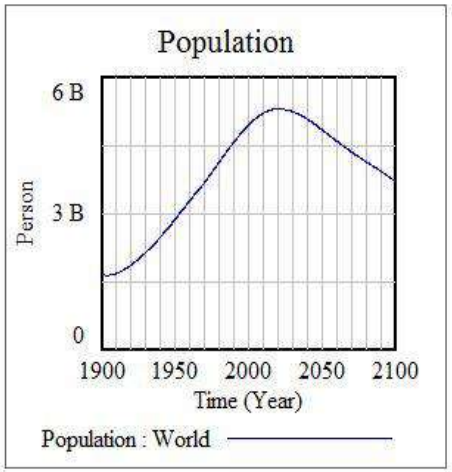
population

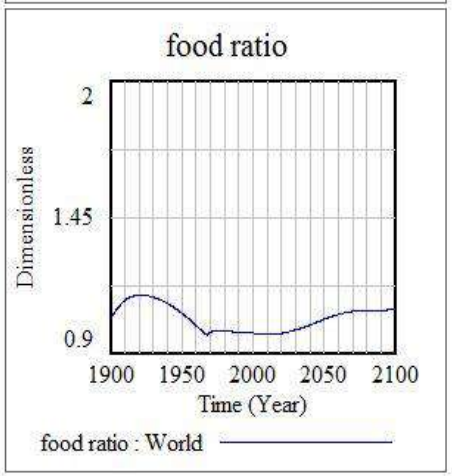
pollution

Forrester, Jay W. (1971). *World dynamics*. Cambridge, Mass : Wright-Allen Press

System dynamics







Forrester, Jay W. (1971). *World dynamics*. Cambridge, Mass : Wright-Allen Press; In Software: Vensim

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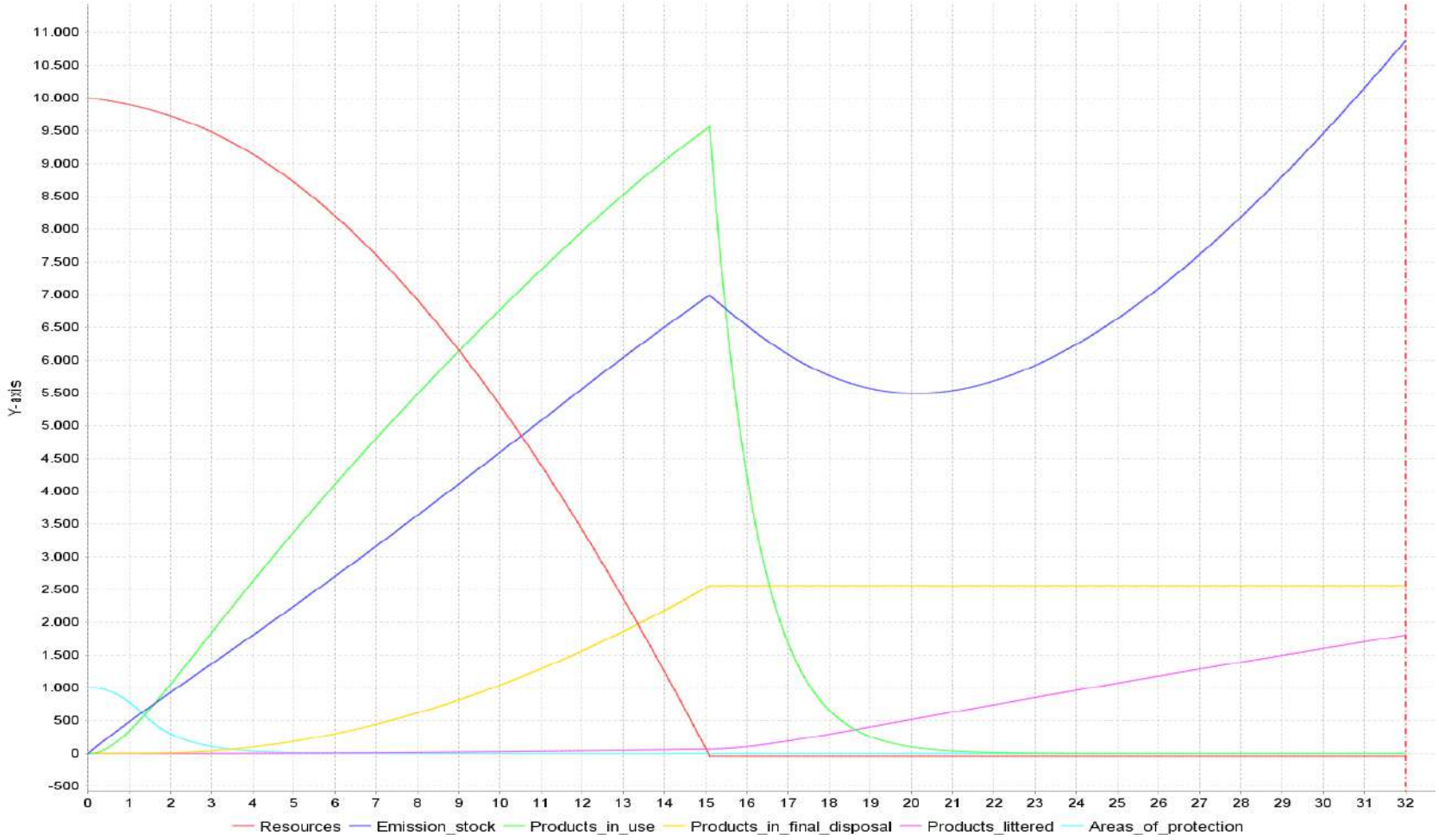
System dynamics and sustainability modeling



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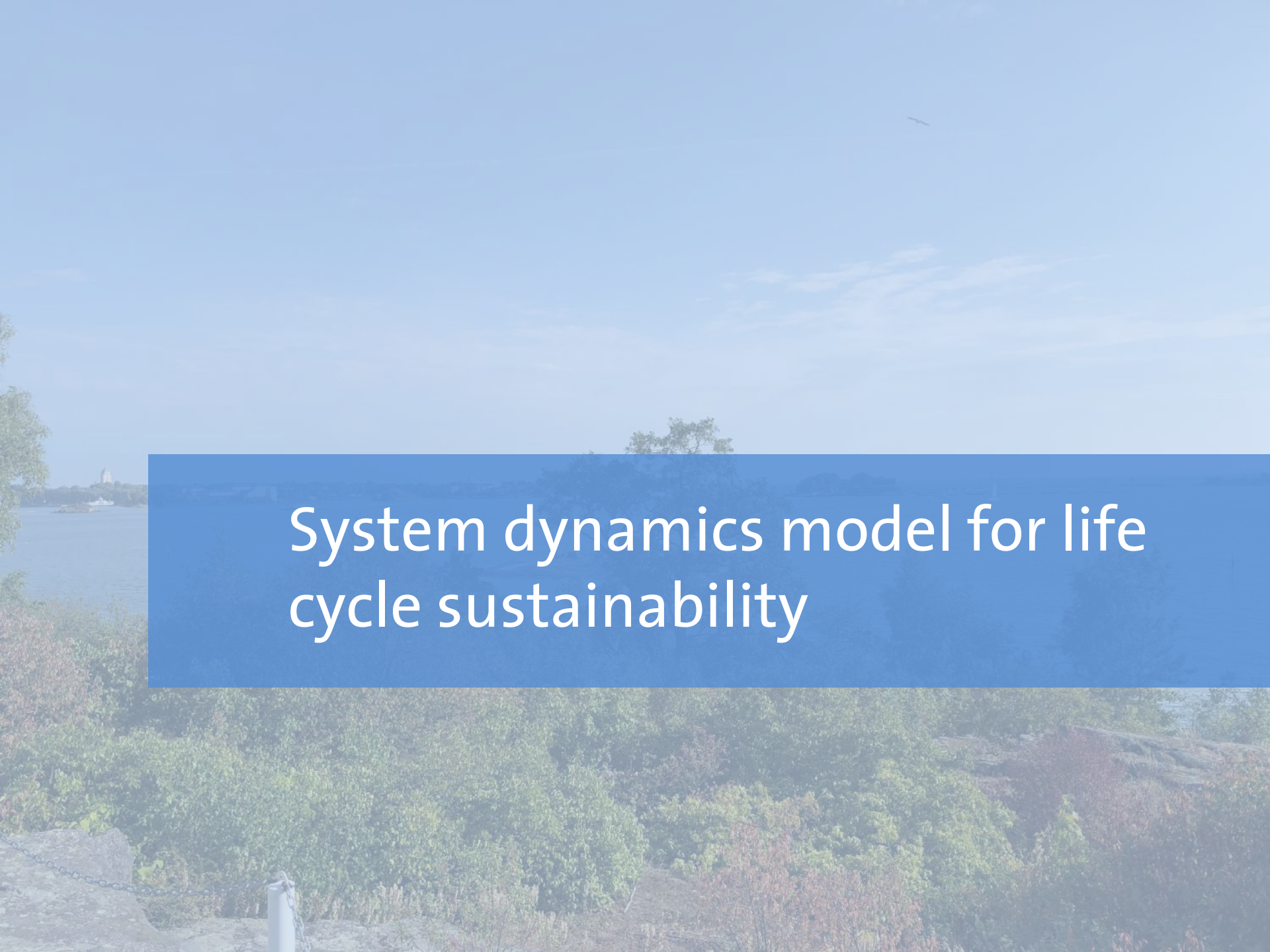
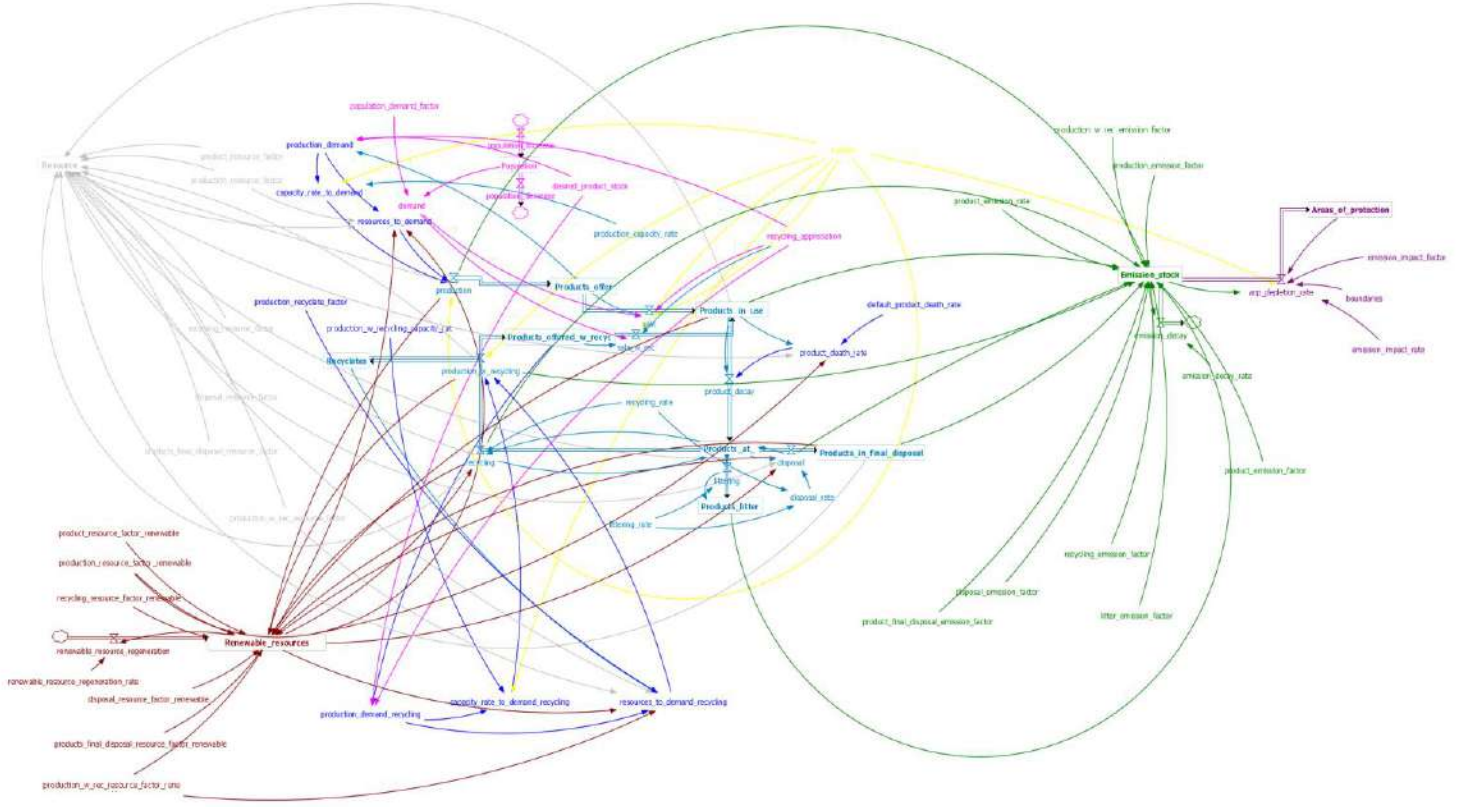


System dynamics model for life cycle sustainability

A generic system dynamics model for life cycle sustainability

We developed a model to combine system dynamics and LCSA: “model-based LCSA”.



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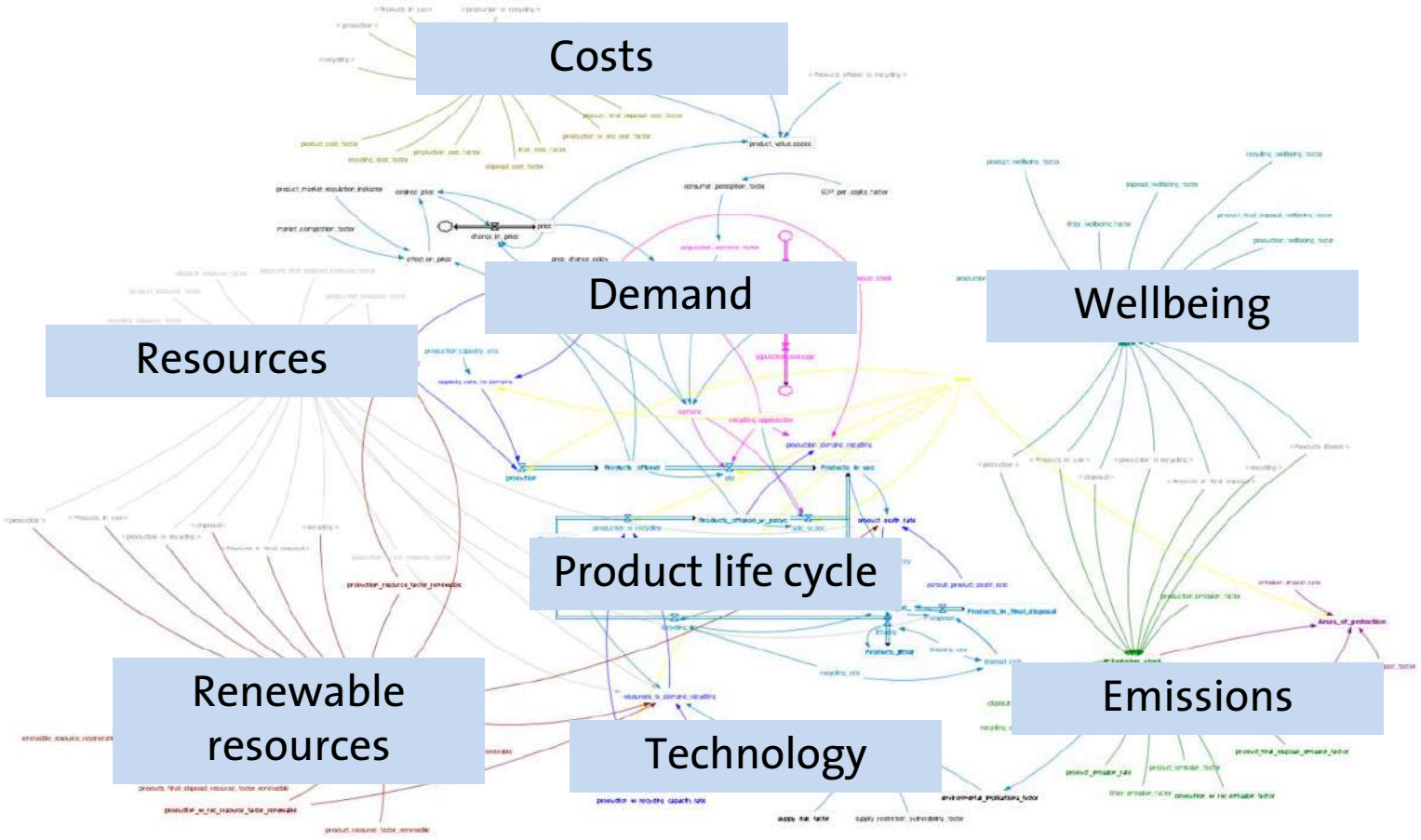
A generic system dynamics model for life cycle sustainability

With eight main sections



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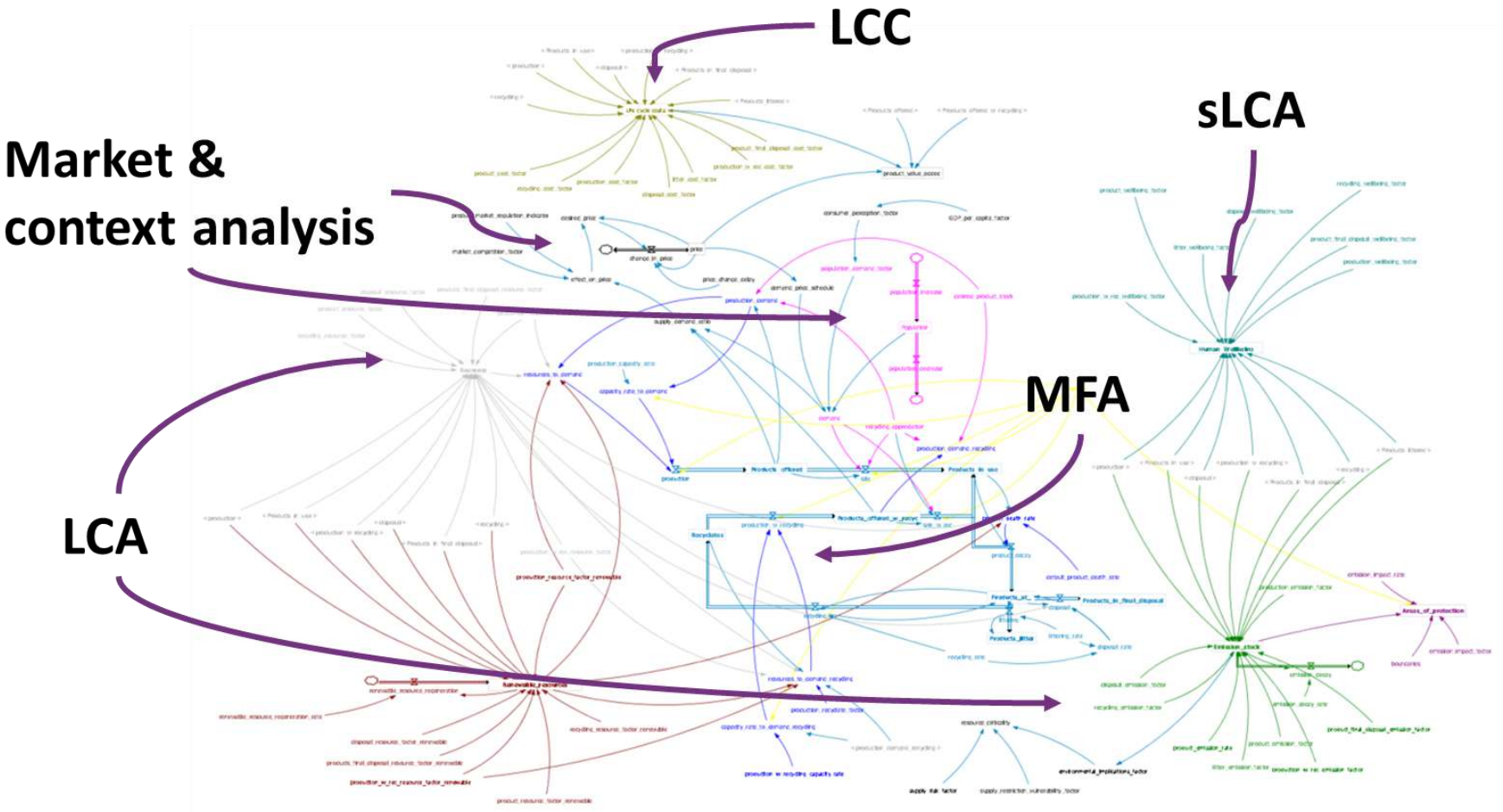
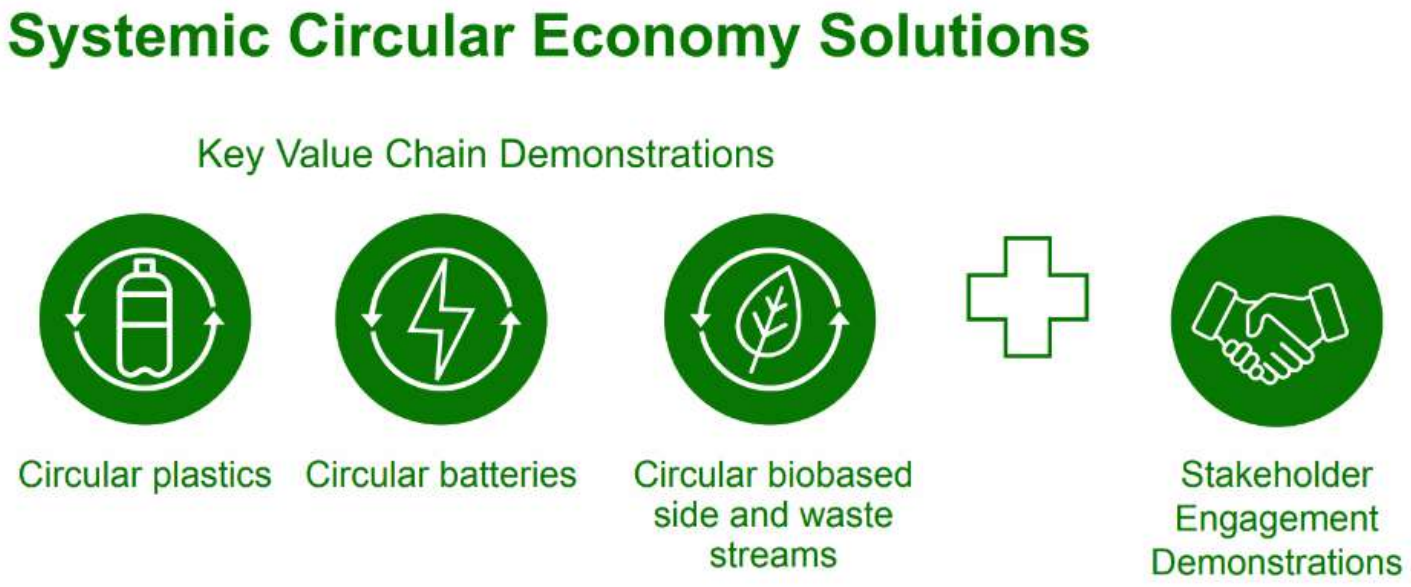
A generic system dynamics model for life cycle sustainability

Data required



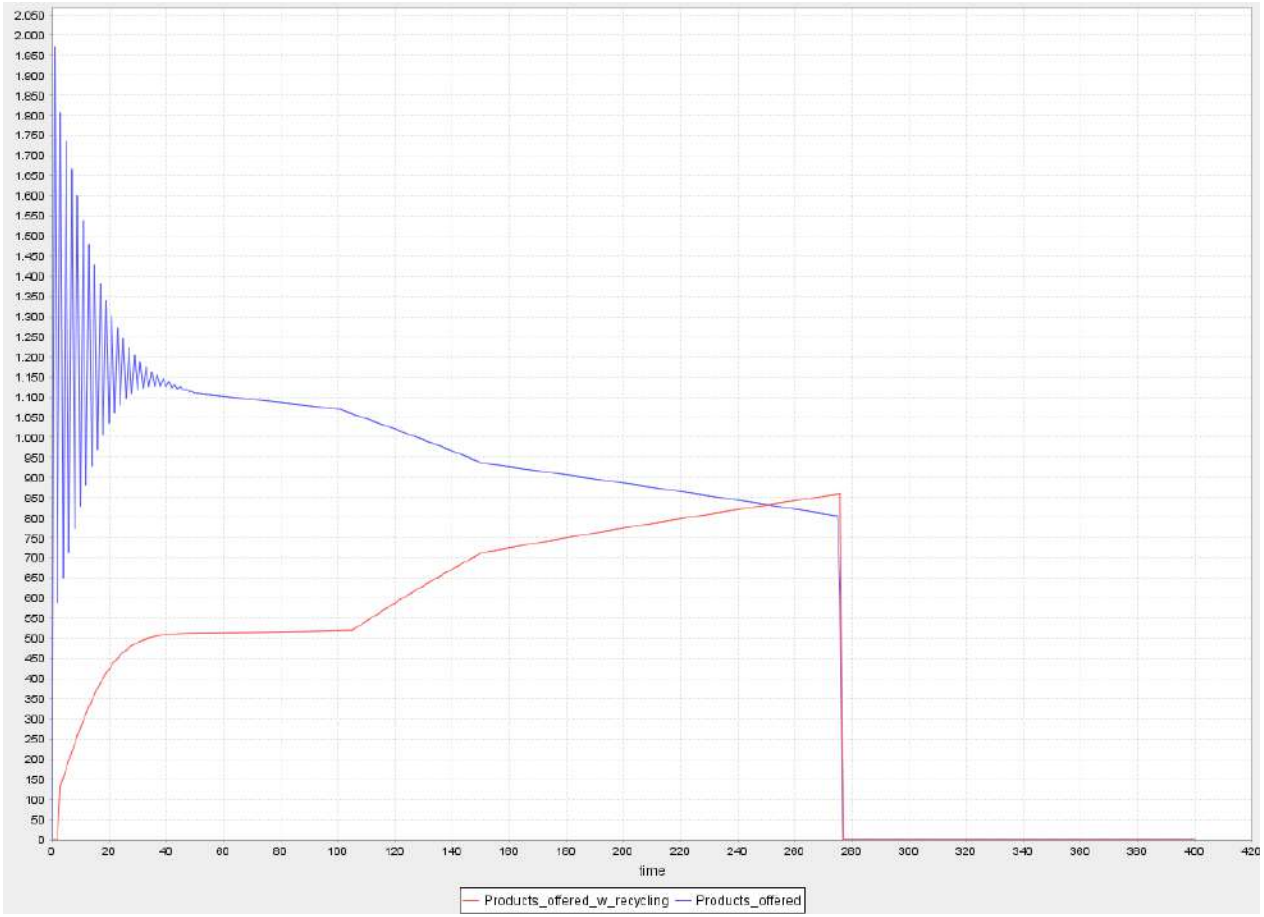
TREASoURcE

The treasure in resources: implementing circular economy practices for plastics, batteries and bio-based side and waste streams to take TREASoURcE **regions and their citizens** to the forefront of climate neutrality and circularity



Case: PET recycling in Fredrikstad, Norway, over time

Primary material production (blue) and recycled material (red)



Assumptions made for:

- Method for determining available resources allocated to Fredrikstad
- Market demand determinants
- Price determinants
- Development of recycling rates, recycling appreciation, production capacity

Data collected from:

- StatBank Norway
- Ecoinvent
- Abbasi et al. (2023): A high-resolution dynamic probabilistic MFA of 7 plastic polymers; A case study of Norway

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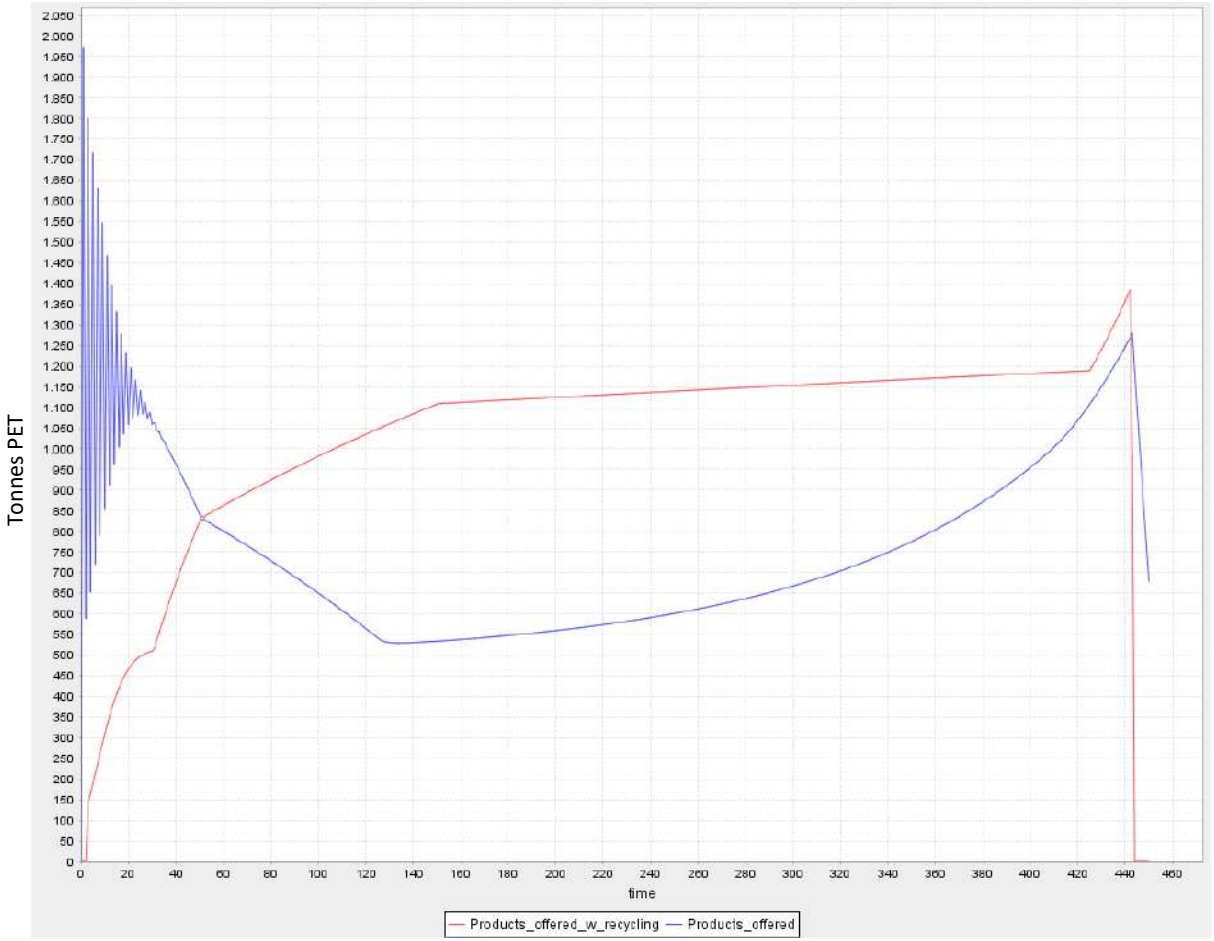
Case: PET recycling in Fredrikstad, Norway, over time

Primary material production (blue) and recycled material (red), **with higher PET recycling appreciation and rates**



- Initial recycling rate in Fredrikstad: 73.6%
- Here assumed to increase by 5% every 10 years until it reaches a stable rate of 95%.

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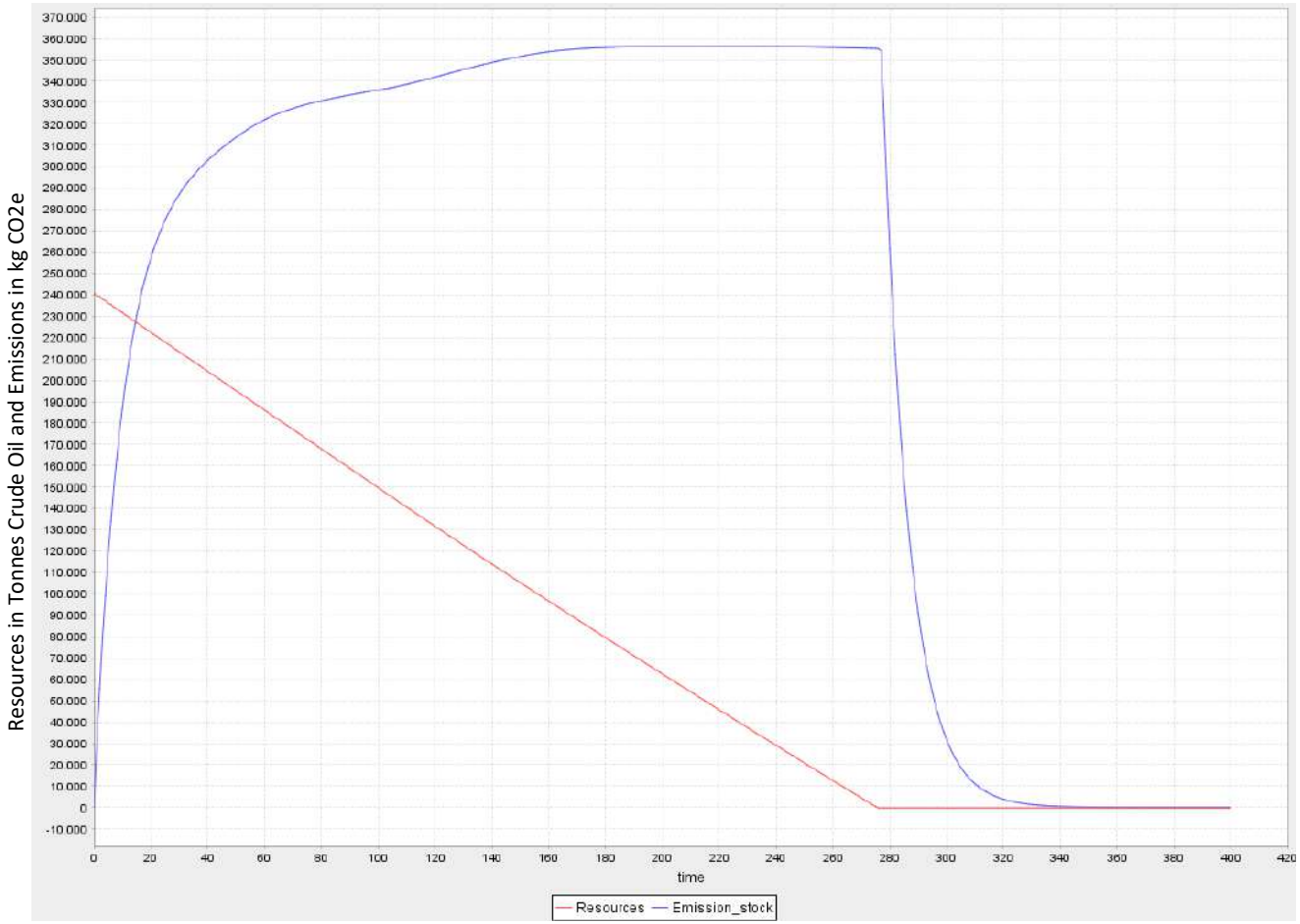
Case: PET recycling in Fredrikstad, Norway, over time

Life cycle emissions (blue) and mineral resources (red)



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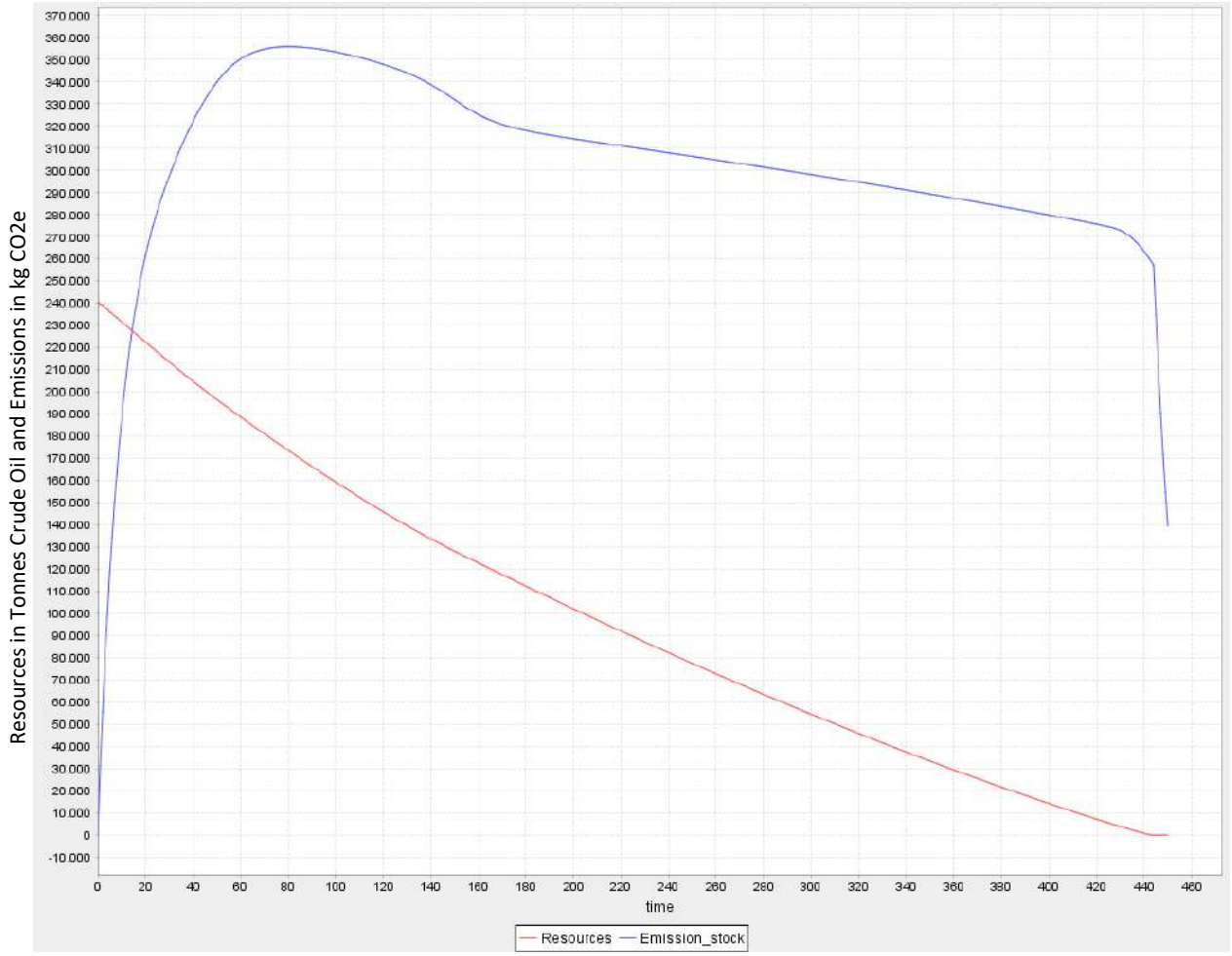

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Conclusion and outlook

Outlook

- System dynamics + LCSA = Model-based LCSA (!)
- This combination is better able to reflect sustainability, and system know-how as well.
- Promising and powerful.
- TREASoURcE: enables insights into the replicability and feasbility of solutions.
- Strong decision-making tool for sustainability strategies at all levels.
- To be tested and explored in future cases.

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Thank you!

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