POLITECNICO MILANO 1863

What role for LCA as a decision support tool?

LCA Webinar

Polimi LCA Network - Junior Researches Group

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LCA NETWORK POLIMI

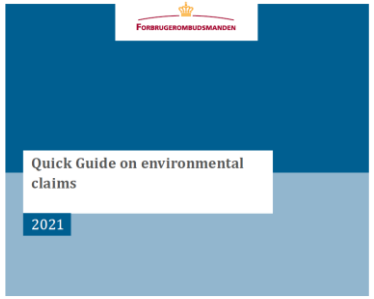
Once upon a time…the SETAC Code of Practice (1993)

One of the prime objectives of carrying out a LCA outlined was "*to provide decision-makers with information which defines the environmental effects of these activities and identifies opportunities for environmental improvements*" (SETAC, 1993)

Nowadays LCA is an **established decision support tool**

BUSINESS SECTOR

E.g. Danish Consumer Ombudsman (2021)



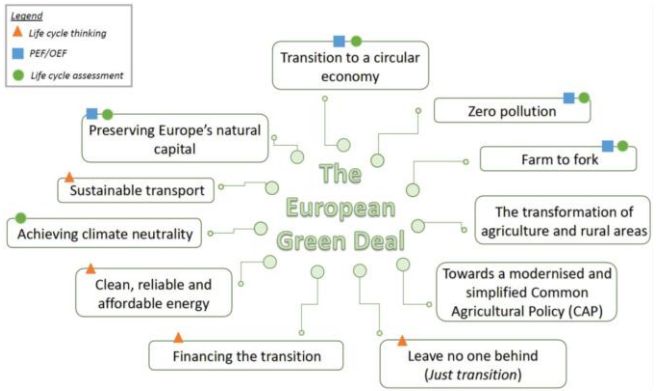
General claims *are positive claims about your company or products, such as 'green', 'climate friendly', 'environmentally friendly', 'sustainable' etc.*

If you use such claims in your marketing without also stating why the company or products are, for example, climate friendly or environmentally friendly, ***you must be able to substantiate the general claim based on a life cycle analysis of your products***

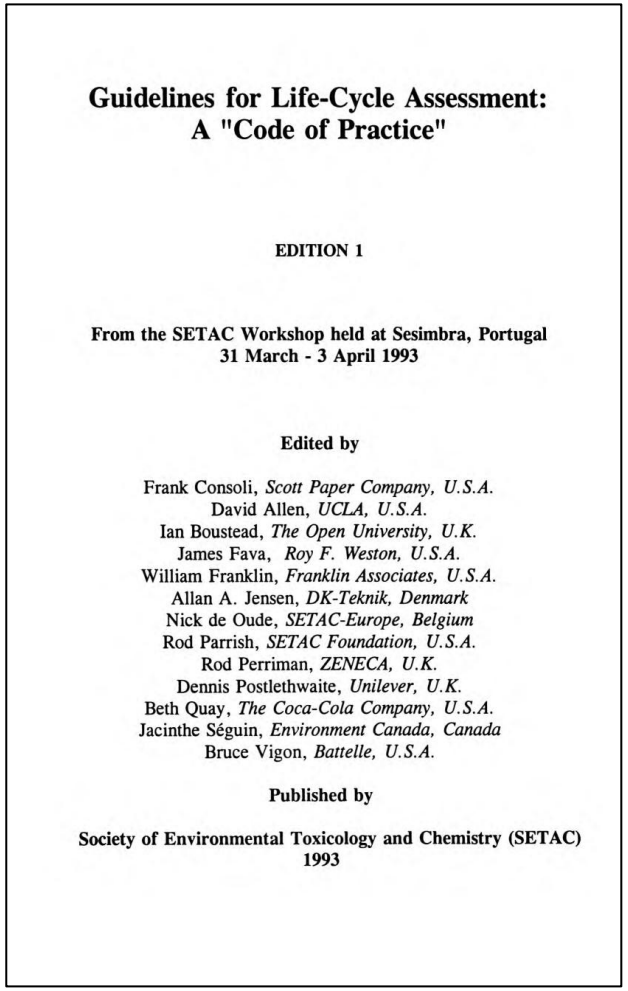
https://www.consumerombudsman.dk/

POLICY MAKING

E.g. European Green Deal



Sala et al (2021) Int J LCA 26:2295-2314



Guidelines for Life-Cycle Assessment: A "Code of Practice"

EDITION 1

From the SETAC Workshop held at Sesimbra, Portugal 31 March - 3 April 1993

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What is LCA (Life Cycle Assessment)?
A method to *understand* potential environmental impacts

LCA is a central method for producing knowledge about the environmental impacts of goods and services, ultimately supporting more environmentally sustainable forms of production and consumption with two-fold aims: **to *understand*** and **to *address*** product environmental impacts (c.f.ISO 14040-44).

Understanding the potential environmental impacts associated with product systems is not a straightforward task due to **complexity of product systems** containing many different activities, carried out by organisations and actors that are spread out geographically and temporally

The **close interaction with commercial organisations** (providing data needed to conduct LCA) + the complexity of product life cycles has historically given rise to concerns about the **validity of LCA results**

Source: Beemsterboer S (2025) How does LCA work in sustainable building practices? The case for a pragmatic philosophy of life cycle assessment. PhD Thesis .Chalmers University of Technology

What is LCA (Life Cycle Assessment)?
A method to *address* potential environmental impacts

Typical situation: comparative LCA performed on the same product alternatives can lead to different results
→ Is it due to inherent methodological choices and differences in product systems or its it rather because of the presence of actors with commercial interests that can influence the outcome of the LCA study?

To overcome this dilemma, historically most of the efforts devoted to improve the **scientific credibility of LCA**
Science-based developments in LCA have aimed:

- To **reduce the space for subjectivity** though data-driven approach and methodological standardisation
- To prioritise a scientific approach and support **comprehensive, consistent, and transparent** assessments
- To **support rational decision-making** as well as scientific and mathematical rigour in LCA

BUT
a too strong focus on scientifically legitimate method may not be practically useful for **addressing product environmental impacts → product design**, where the results of relatively accurate ex-post LCA studies typically come too late to influence the design process

Source: Beemsterboer S (2025) How does LCA work in sustainable building practices? The case for a pragmatic philosophy of life cycle assessment. PhD Thesis .Chalmers University of Technology

What is LCA (Life Cycle Assessment)? A method to *address* potential environmental impacts

The **close relation with companies also provides opportunities** for LCA practitioners to **address** product environmental impacts, since companies are both commissioners of LCA studies and attractive users of LCA outcomes owing to the potential power these organisations have to improve the environmental performance of products

→ to satisfy the twin-ambitions of *understanding and addressing* potential product environmental impacts, LCA practitioners are caught in a struggle to produce knowledge that is both a credible representation of real impacts (**scientific credibility**) and practically useful to those actors that can reduce those impacts

→ **practical utility** = **usefulness** and **effectiveness** of LCA in the context in which it is practised

There is a need to critically examine how LCA works in real-world situations, where different practical concerns, conditions and opportunities shape the application and use of the method

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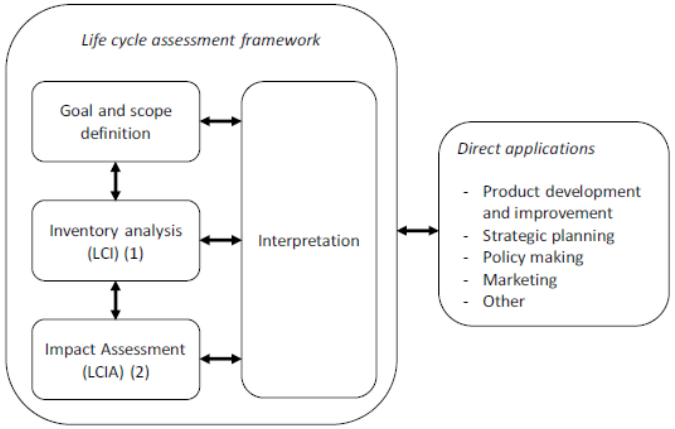
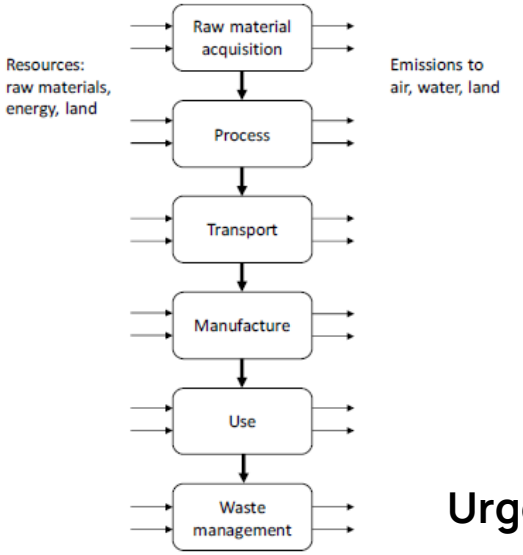
What counts as LCA?

LCA procedure



LCA model



	Definition	*Included*
1	LCA report	Relevant outcomes of an LCA study Relevant methodological choices
2	LCA study outcome	All outcomes of an LCA study All outcomes of each LCA phase: goal and scope, LCI, LCIA, interpretation All methodological choices in each LCA phase
3	LCA study process	All activities and processes involved in the four phases of an LCA Interaction with commissioner, data-providers, and other relevant stakeholders Direct supporting activities
4	LCA practice	Carrying out an LCA study Using an LCA report, LCA outcome, and LCA process for learning, decision-making, LCT, LCM, and other life cycle practices. Direct and indirect supporting activities, including the organisation of LCA capacity and related interactions

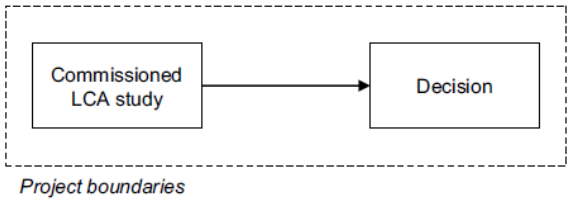
Urgent need to better understand the complexity of decision-making processes!

Source: Beemsterboer S (2025) How does LCA work in sustainable building practices? The case for a pragmatic philosophy of life cycle assessment. PhD Thesis .Chalmers University of Technology

The decision-making process and LCA in product development project

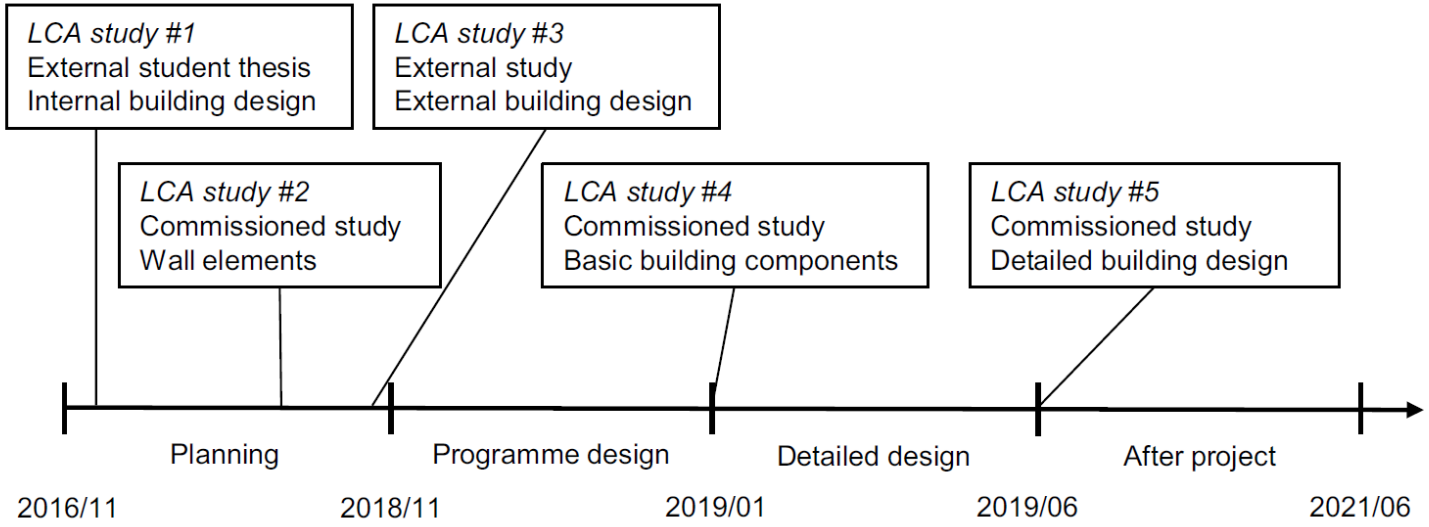
Substantive effectiveness is demonstrated when LCA use leads to environmentally beneficial changes in a product system

Conventional linear model of LCA use



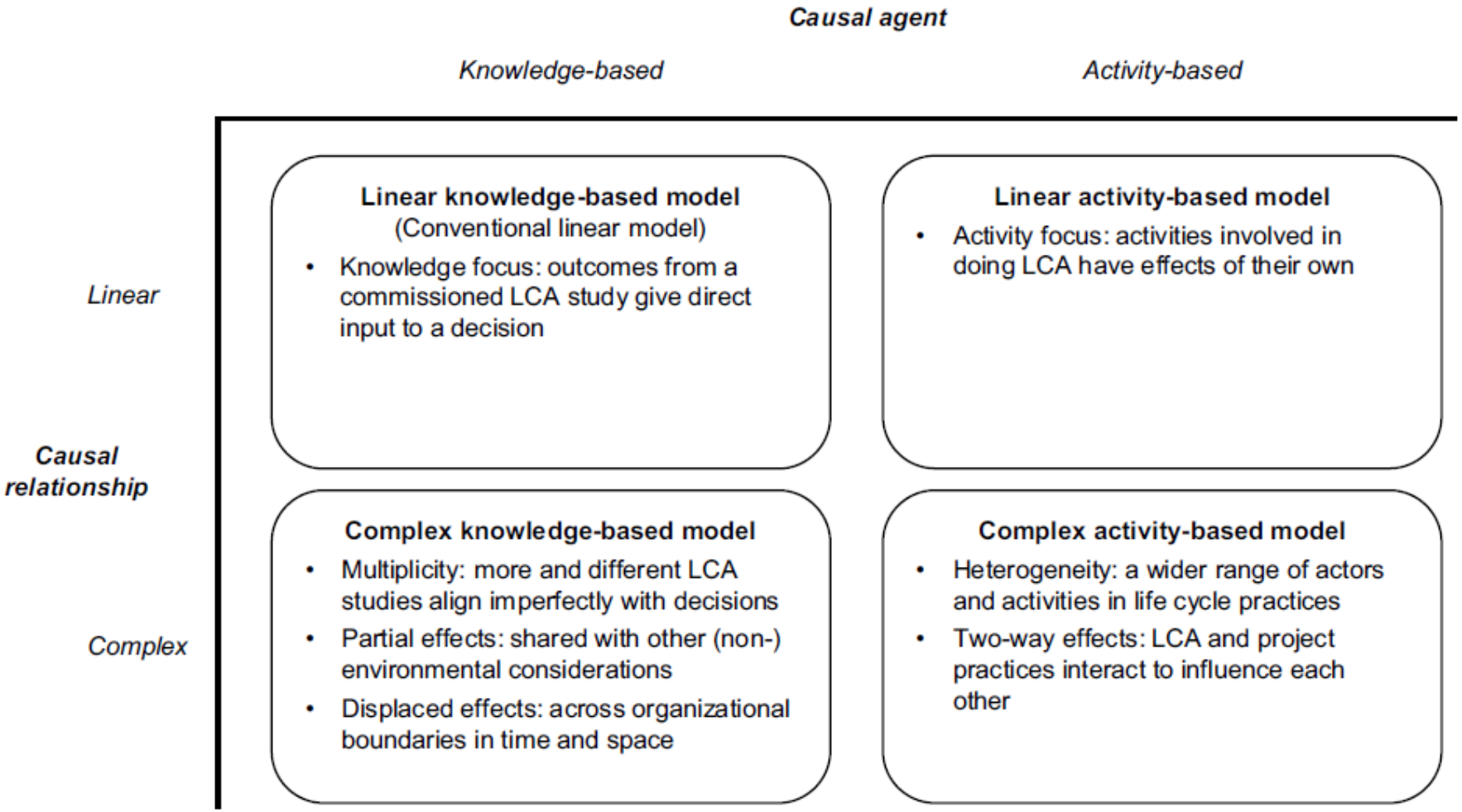
Hp: better LCAs produce better environmental information and thus lead to better decisions

Case study: building product development project



Source: Beemsterboer, S., Baumann, H., & Wallbaum, H. (2025). The myth of informed decision-making: explaining the substantive effectiveness of LCA use in a building product development project. Int J of Life Cycle Assess. https://doi:10.1007/s11367-025-02472-5

The decision-making process and LCA



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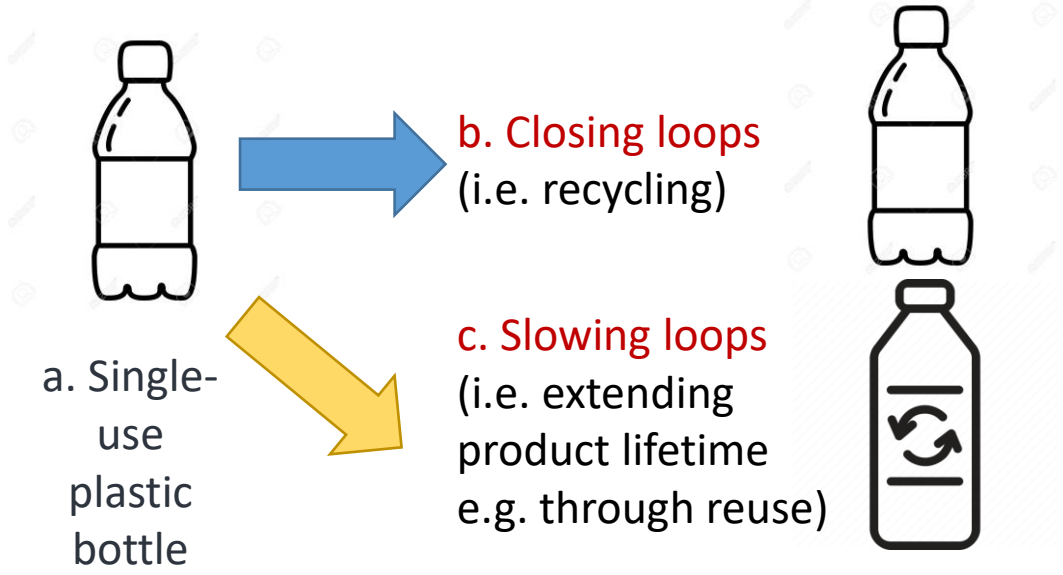
An example of complex activity-based model

LCA can model how different product systems interact with each other, but does not attend to the socio-technical dynamics taking place within and across different life cycle phases

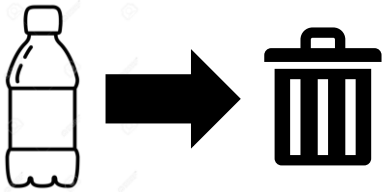
The selection of which Circular Economy (CE) initiative to implement (e.g. either recycling or reuse) requires an understanding of the broader implications in terms of actors involved, changes in infrastructures, consumers´practices
→ focus on socio-technical systems (i.e. mutually constituted by technological developments, stakeholder influences, and social norms) needed



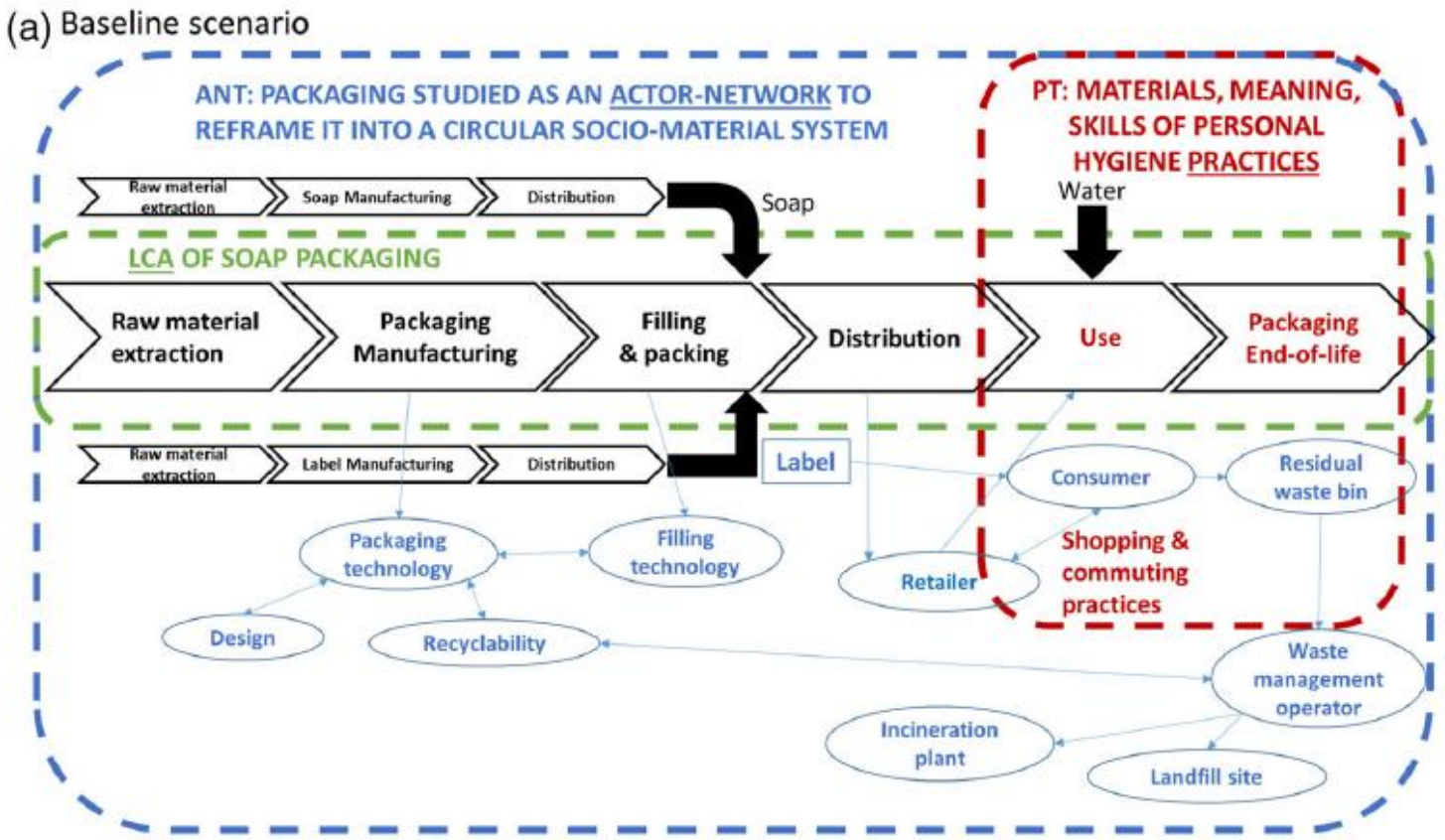
LCA can benefit with combination with socio-technical approaches such as Practice Theory (PT) and Actor-Network Theory (ANT) to improve its decision-making potential (Niero et al. 2021)

Niero et al (2021) Is life cycle assessment enough to address unintended side effects from circular economy initiatives? J Ind Ecol 25(5),1111-1120

Example: single-use plastic packaging



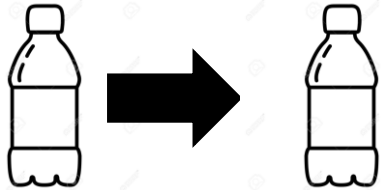
ANT asks how **actors' interests** become aligned so as to prompt or prevent people from changing their way of treating packaging and identifies the relations between human and non-human actors



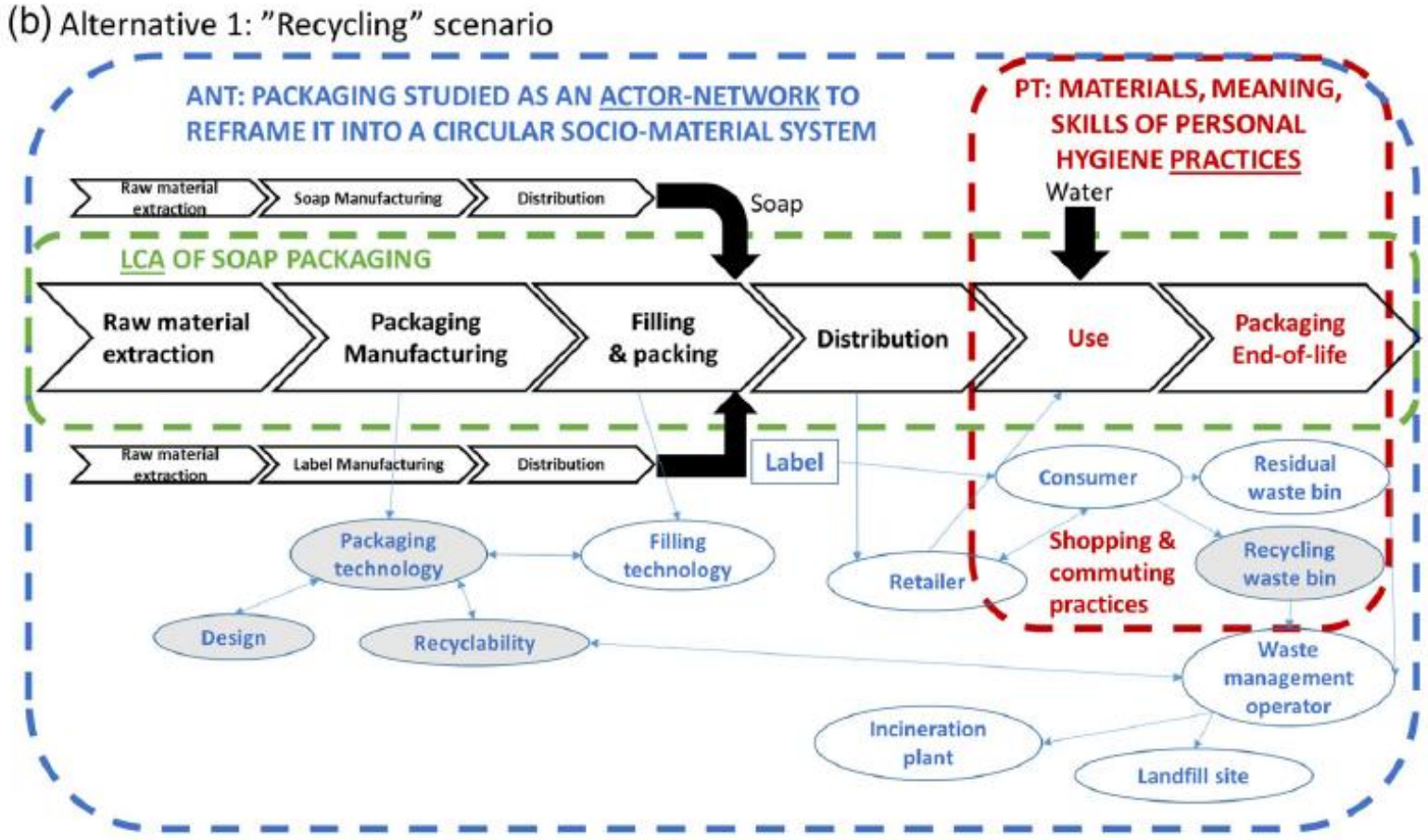
PT → practice of *showering*
(i) *meaning*: ideas about cleanliness, comfort and freshness, maybe also related to a "wellness" feeling and that products should look nice;
(ii) *skills*: skills and knowledge related to how to keep oneself clean,
(iii) *materials*: shampoo, running water, shower niche, showerhead, etc.

Niero et al (2021) Is life cycle assessment enough to address unintended side effects from circular economy initiatives? J Ind Ecol 25(5),1111-1120

Example: closing loop (recycling)



ANT: problems in sorting plastic packaging may be attributed to "bad" design and/or to the costs of sorting, cleaning



PT:
the choice of how to dispose of the plastic packaging could be investigated by considering the **motivations that move consumers to opt for either the recycling bin or the one for residual waste**

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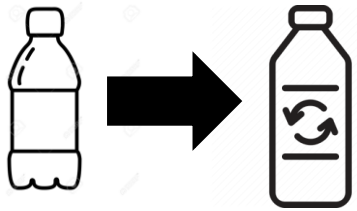
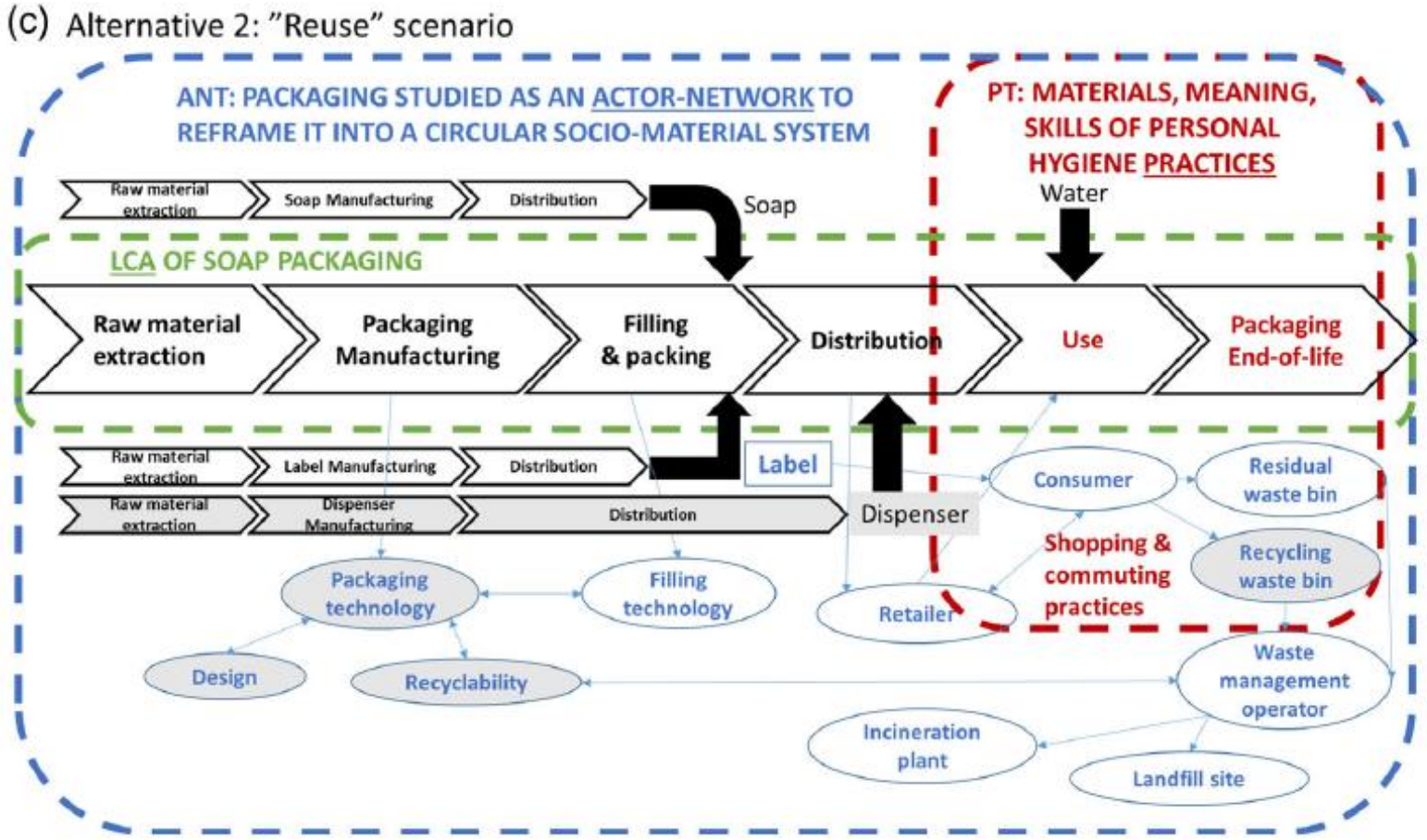
Example: slowing loops (reuse)



ANT: the **network of actors** involved and their **interests** in the establishment of a refill and take-back system needs to be investigated



PT:
availability of refills in retail shops or as direct supply at the household, which from a life cycle perspective would require including other types of packaging to transport the liquid soap and further transportation from home to shop

Niero et al (2021) Is life cycle assessment enough to address unintended side effects from circular economy initiatives? J Ind Ecol 25(5),1111-1120

What to do to improve the substantive effectiveness of LCA: how to make sure LCA can not only *understand* but also *address* product environmental impacts

- Pay accurate attention to the **definition of the goal and scope**, in particular the decision context and what is the actual decision that should be supported

- Increase the **literacy on the LCA methodology among the potential users** of the LCA results

- Consider **the contextual factors** related to analytical resources, structures, actors, and institutions
  - capacities of organisations and individuals to carry out LCA
  - structural aspects, such as product type, sector, and structural elements related to the value chain and its organisations
  - individual and organisational perceptions and activities

- Do not underestimate the importance of stage 4 (**life cycle interpretation**) even if you are close to the deadline!

Thank you for your attention!

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