https://danishsoundcluster.dk/sustainability-meeting-digital-product-pass-lca/

Life Cycle Assessment (LCA) to support design processes and improve environmental performance

MASSIMO PIZZOL, 13 March 2023, online

Digital product pass & LCA Sustainability network meeting

AALBORG UNIVERSITY

Today

- Who we are and our work with LCA
- Shortest possible intro on LCA
- Life cycle thinking of sound appliances
- Use and abuse of LCA
- Learn LCA from us

WHO WE ARE AND OUR WORK WITH LCA

Massimo Pizzol
Prof.

- Env. Scientists
- 15 more years in LCA
- Prospective assessment of technology
- Uncertainty analysis
- Green and blue bioeconomy
- Teacher

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https://vbn.aau.dk/en/persons/117459/projects

AALBORG UNIVERSITY (AAU)

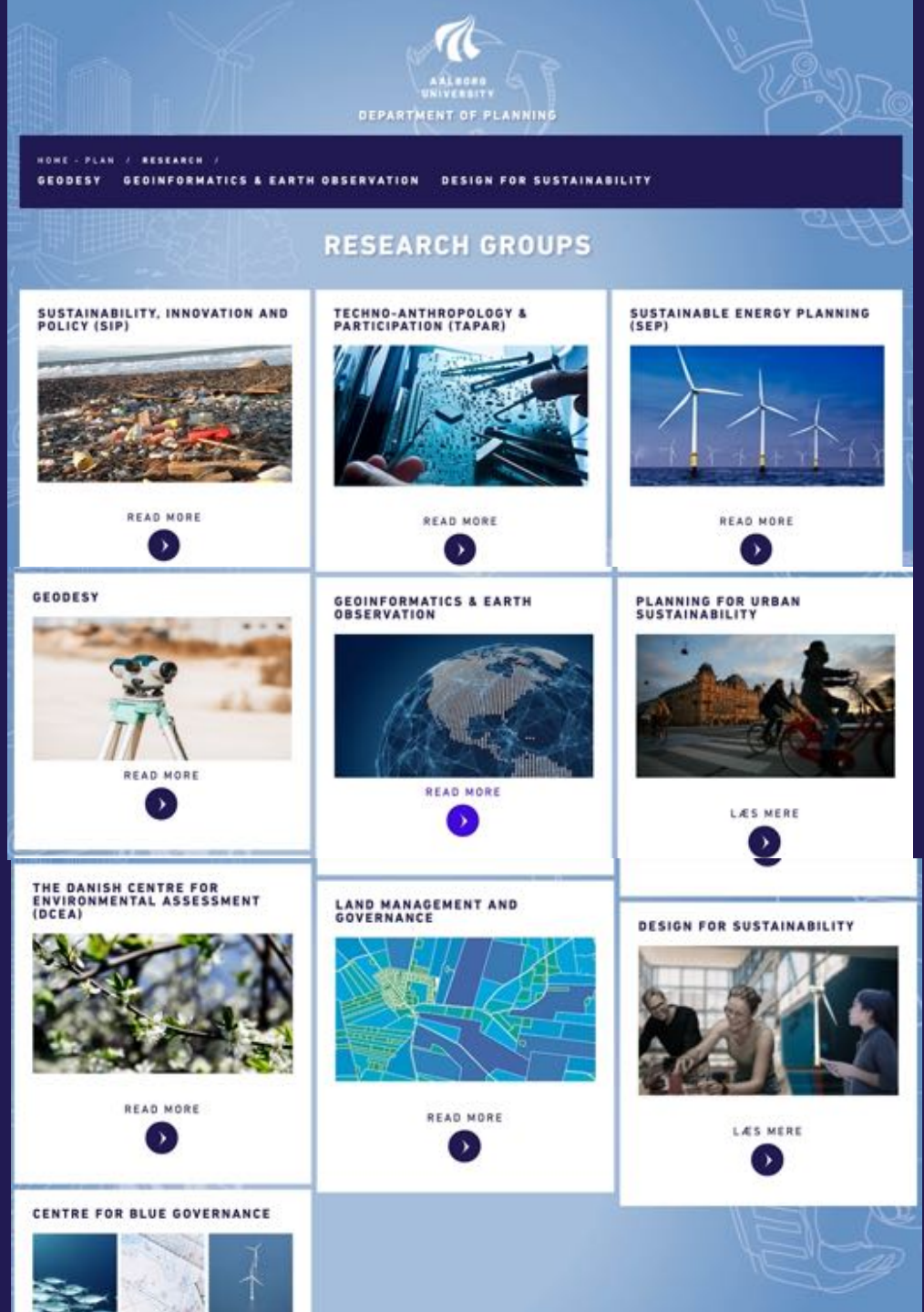
1974 The answer to a regional challenge

- Regional need for education, growth and employment
- Approx. 2,100 students and 250 researchers
- Humanities, social sciences, engineering and natural sciences
- Business collaboration = basis of AAU's DNA
- Problem-based, project-organised learning (PBL)

2020 AAU provides "Knowledge for the World"

- AAU makes up 10% of the Danish sector - measured on revenue
- 23,400 students and 2,230 researchers/teachers
- Humanities, Social Science, Engineering and Science, IT and Design and Medicine
- Education and business collaboration across Denmark
- The preferred collaboration partner of the Danish business sector
- Internationally recognised for our problem and project based learning
- Interdisciplinary focus
- No. 23 i among the world's best young universities (under 50 yrs) (Times Higher Education 2020)
- No. 4 among the world's best engineering programmes (MIT report 2018)
- Best engineering university in Europe and No. 6 in the world (US News 2020 ranking)
- Largest intake on IT programmes in Denmark (bachelor intake: 25 % of all IT-students in Denmark)

AALBORG UNIVERSITET

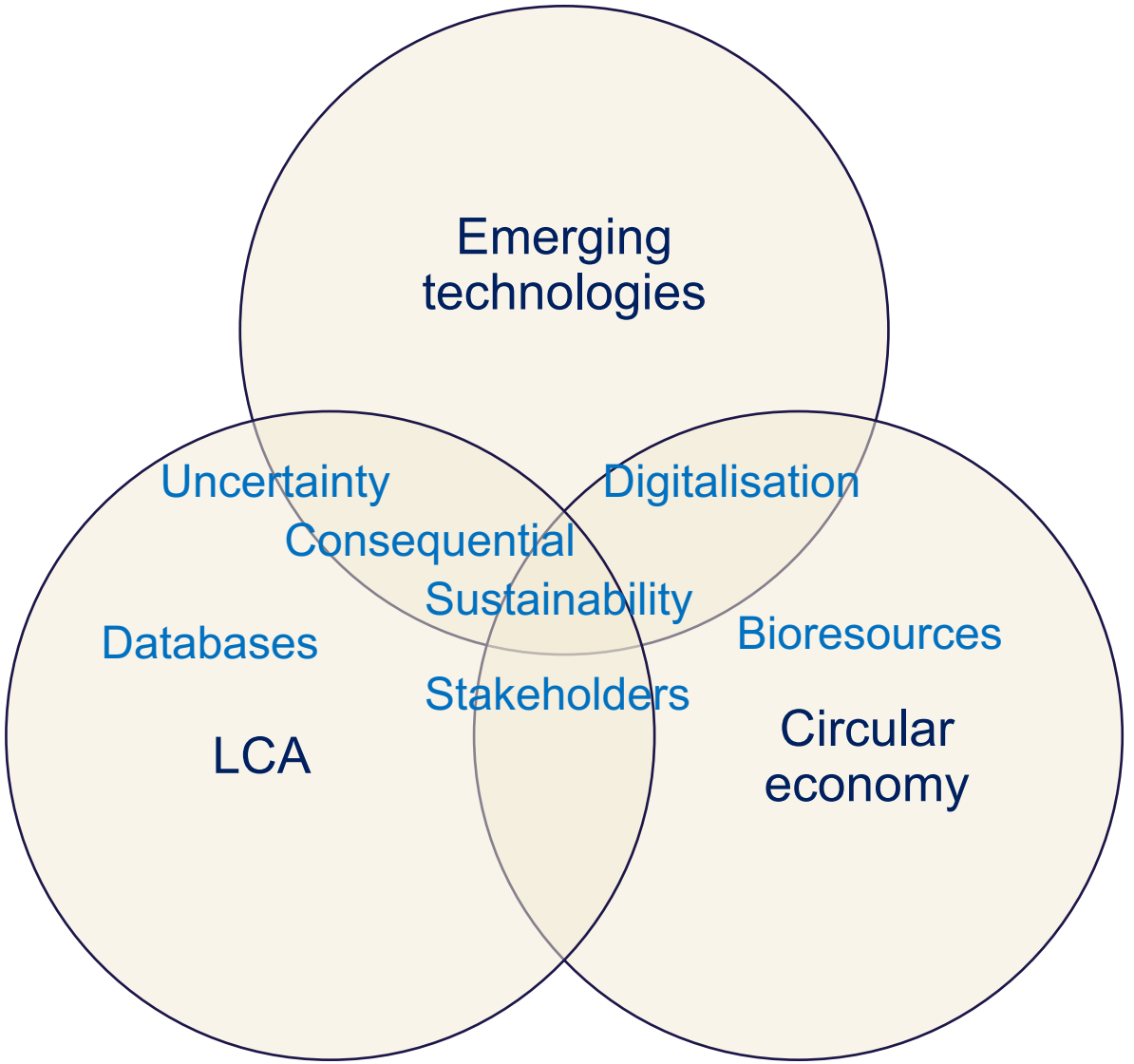


https://www.en.plan.aau.dk/

AAU - The Danish Centre for Environmental Aassessment (DCEA) https://www.en.dcea.dk/

Our LCA research

- Method development
- Database development
- Emerging technologies
- Circular bioeconomy
- Guidelines analysis



LCA: THE SHORTEST POSSIBLE INTRODUCION

LCA in a nutshell

✅ **A model of a product life cycle**
- Scope: from raw material extraction to disposal
- Input: all material & energy requirement + resource use & emissions
- Output: a measure of impact across different categories

✅ A **decision support tool** to:
- Test improvement scenarios
- Make informed decision about reducing impact
- Avoid burden shifting
- Communicate to partners and clients

❌ An **objective measure** of impact or an absolute truth

LCA today

- An established methodology
- System of data, databases, and software and companies who do all those
- System of guidelines and requirements (EPD, PEF, ISO…)
- A tool widely used in industry and research alike
- The subject of continuous research

Chapter 2
The Climate Impact of the Usage of Headphones and Headsets

Tayla Herrmann, Anna Zimmerer, Claus Lang-Koetz, and Jörg Woidasky

Abstract Based on disassembly studies, a life cycle assessment of the climate impact of the wireless over-ear headphone model Jabra Evolve2 85 (without charging station) is conducted regarding the life cycle phases of manufacturing, packaging, distribution, use and disposal. The total weight of all components is 280.7 g. The materials can be categorized into polymers (61.7%), metals (20.9%), circuit boards (4.8%), Li-ion battery (4.6%), foam (3.5%), cables (3.0%) and unidentifiable polymers (1.7%). The functional unit is defined as the wireless audio transmission through a stereo headphone over its lifetime. The lifecycle assessment results in a global warming potential of 12.17 kg CO_2-Eq with a contribution of the manufacturing phase of 81.2%, based on an assumed lifetime of 2,600 using hours. In the context of a sensitivity analysis, a repair scenario of a battery replacement of the over-ear headset is modelled. Assuming a doubled lifetime, the global warming potential per hour is reduced from 4.7 g CO_2-Eq/h to 2.4 g CO_2-Eq/h.

Keywords LCA · Headphones · Dismantling · Life cycle data inventory

Herrmann, T., Zimmerer, A., Lang-Koetz, C., & Woidasky, J. (2023). The Climate Impact of the Usage of Headphones and Headsets. In F. Hesser, I. Kral, G. Obersteiner, S. Hörtenhuber, M. Kühmaier, V. Zeller, & L. Schebek (Eds.), *Progress in Life Cycle Assessment 2021* (pp. 7–22). Springer International Publishing. https://doi.org/10.1007/978-3-031-29294-1_2

A typical LCA

- Define what should the product do
- Calculate impacts via an indicator
- Identify hot spots
- Assumptions
- Scenarios, and more assumptions

Takeaways:

- manufacturing main contributor,
- lifetime extension halves impacts.

Real-world example

Herrmann, T., Zimmerer, A., Lang-Koetz, C., & Woidasky, J. (2023). The Climate Impact of the Usage of Headphones and Headsets. In F. Hesser, I. Kral, G. Obersteiner, S. Hörtenhuber, M. Kühmaier, V. Zeller, & L. Schebek (Eds.), *Progress in Life Cycle Assessment 2021* (pp. 7–22). Springer International Publishing. https://doi.org/10.1007/978-3-031-29294-1_2

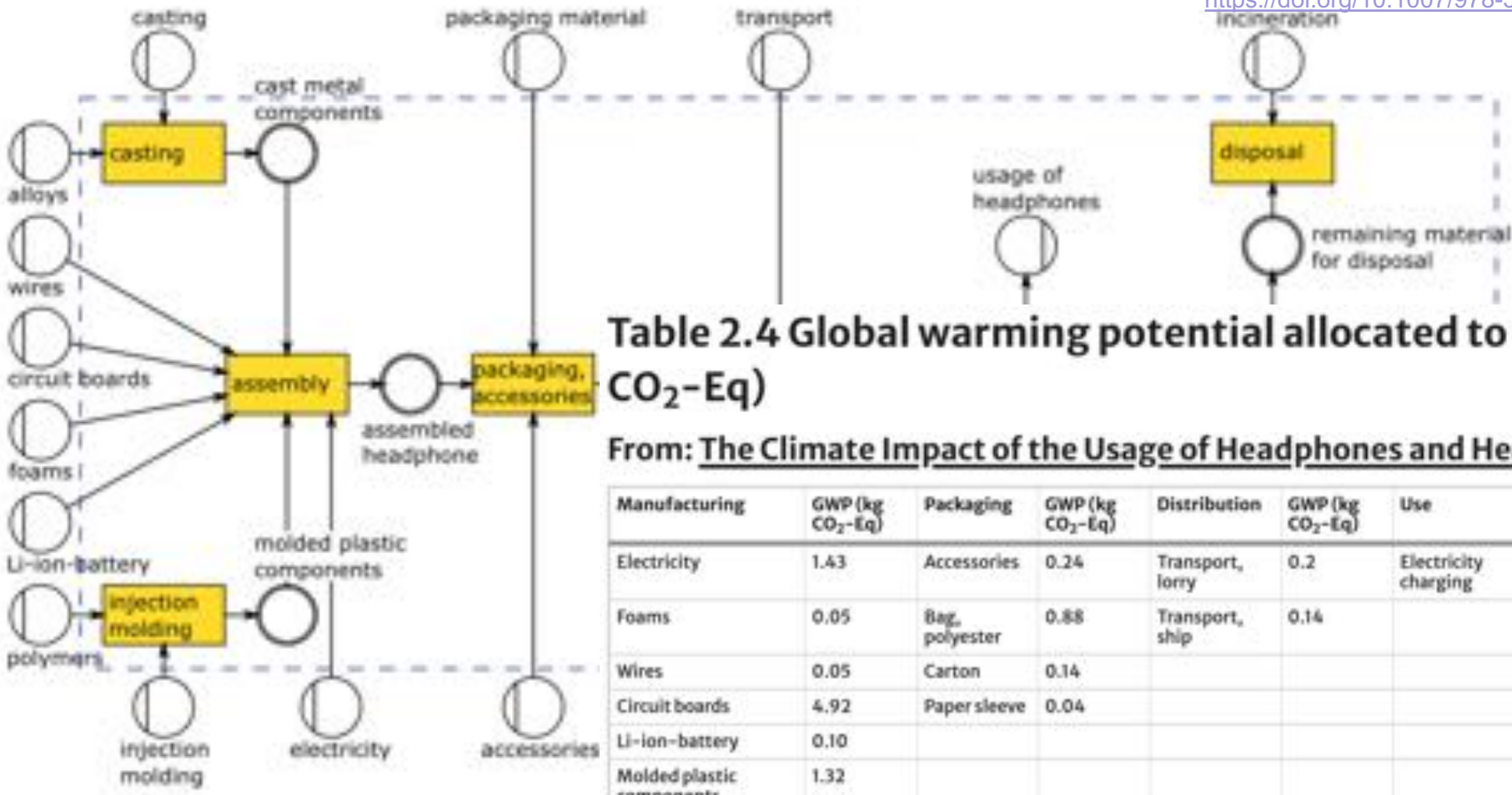


Table 2.4 Global warming potential allocated to life cycle stages (kg CO_2-Eq)

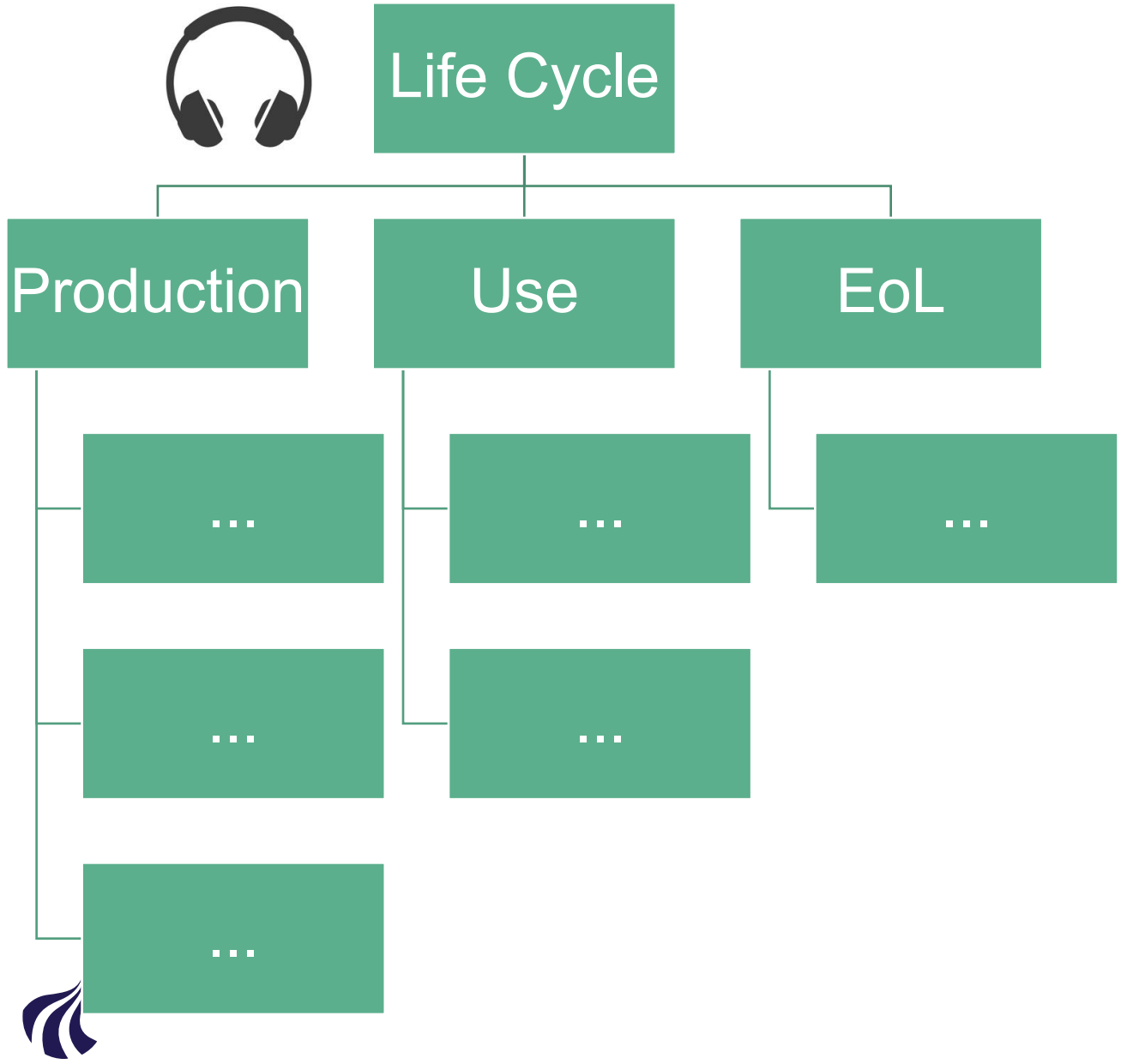
From: The Climate Impact of the Usage of Headphones and Headsets

Manufacturing	GWP (kg CO_2-Eq)	Packaging	GWP (kg CO_2-Eq)	Distribution	GWP (kg CO_2-Eq)	Use	GWP (kg CO_2-Eq)	End-of-life	GWP (kg CO_2-Eq)
Electricity	1.43	Accessories	0.24	Transport, lorry	0.2	Electricity charging	0.18	Incineration	0.42
Foams	0.05	Bag, polyester	0.88	Transport, ship	0.14			Pyrometallurgic treatment	0.02
Wires	0.05	Carton	0.14						
Circuit boards	4.92	Paper sleeve	0.04						
Li-ion-battery	0.10								
Molded plastic components	1.32								
Cast metal components	2.02								
Total	9.88	Total	1.33	Total	0.34	Total	0.18	Total	0.44

LIFE CYCLE THINKING OF SOUND APPLIANCES

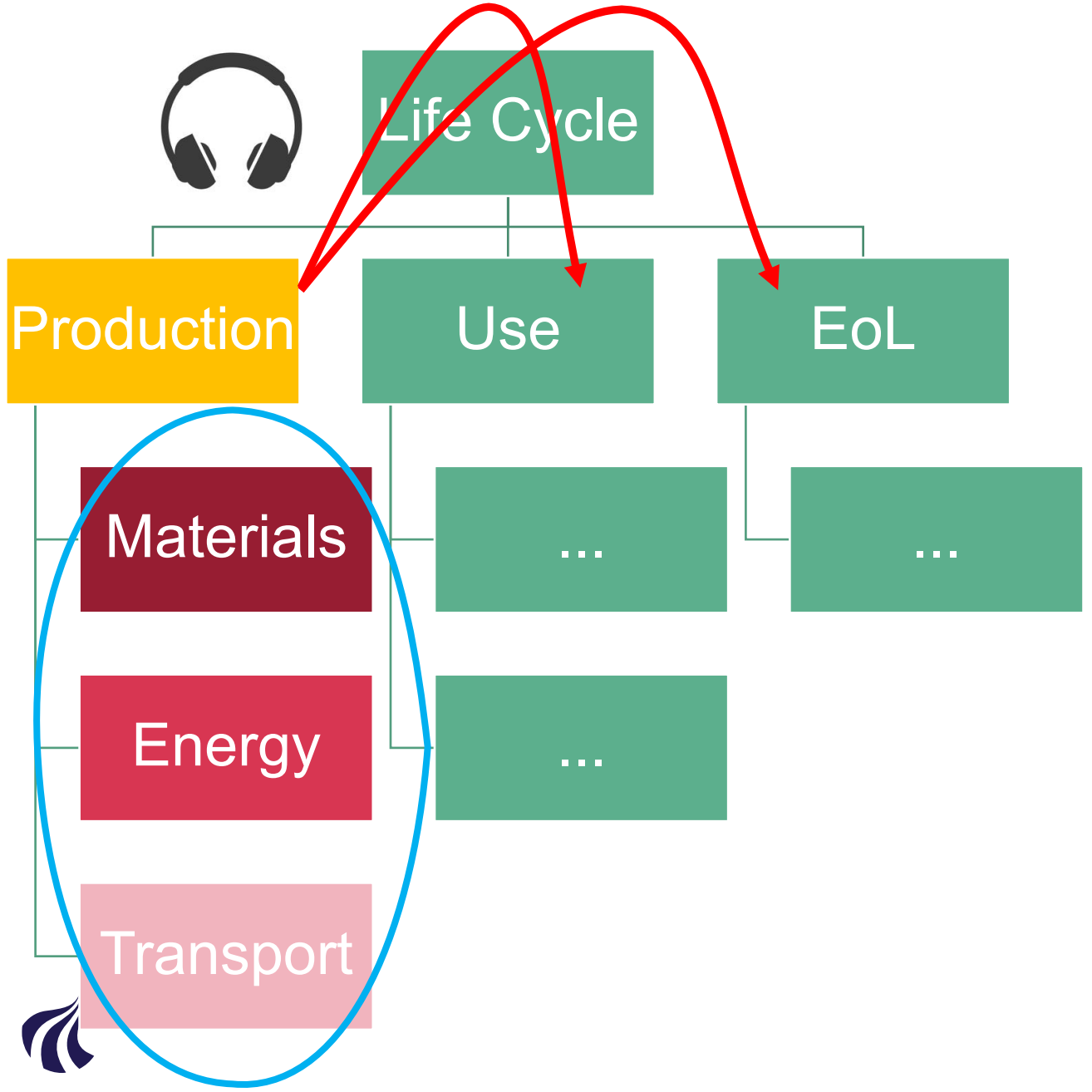
Sound appliances

- From a LCA perspective, not different from other electric appliances such TVs, refrigerators, washing machines, or computers
- Roughly three stages are important:
  - **Production**
  - **Use**
  - **End-of-life**



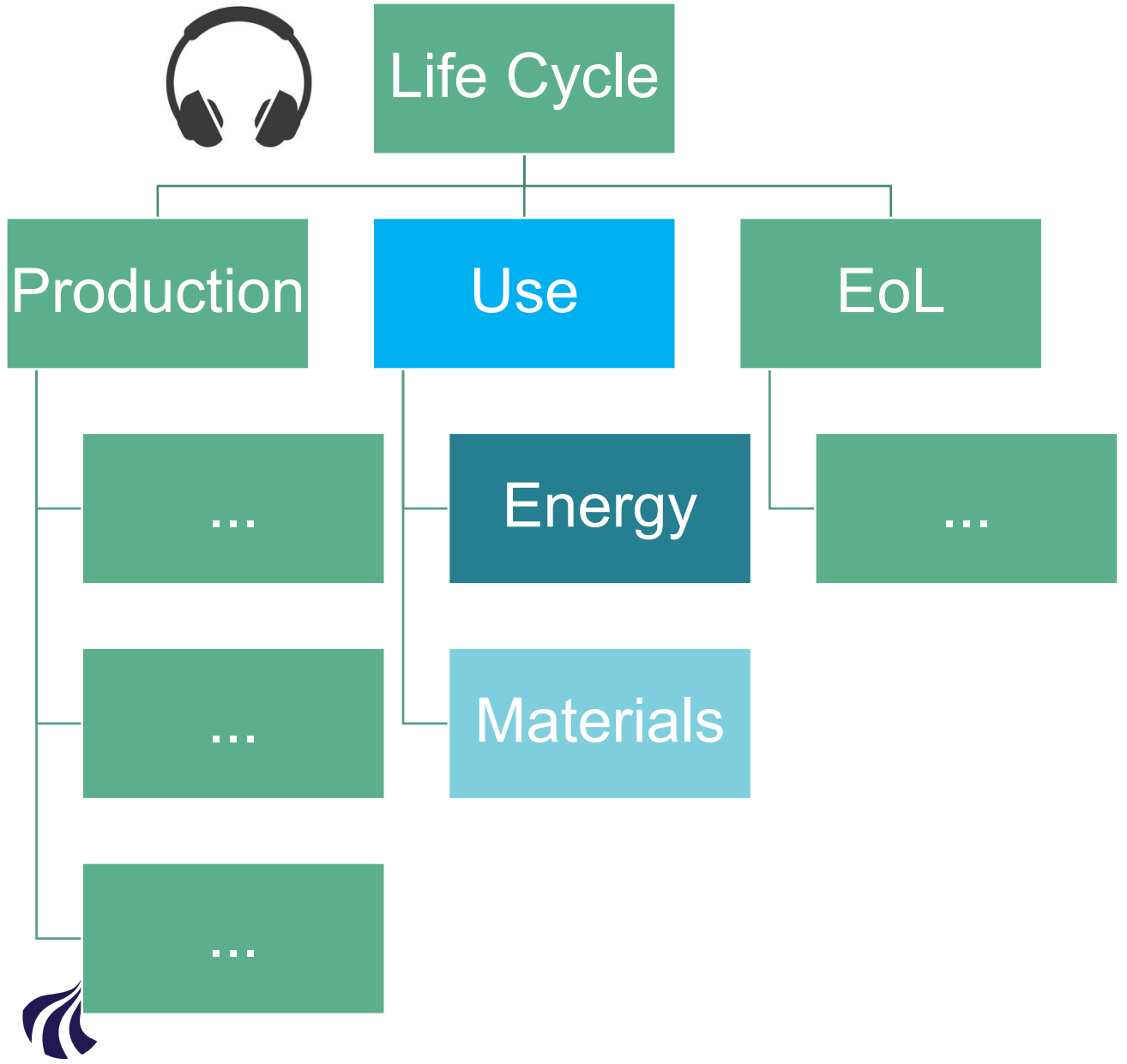
Production

- Most important in design perspective
- Choices made here cascade in later stages
- Size of impact:
  - Materials > Energy > Transport



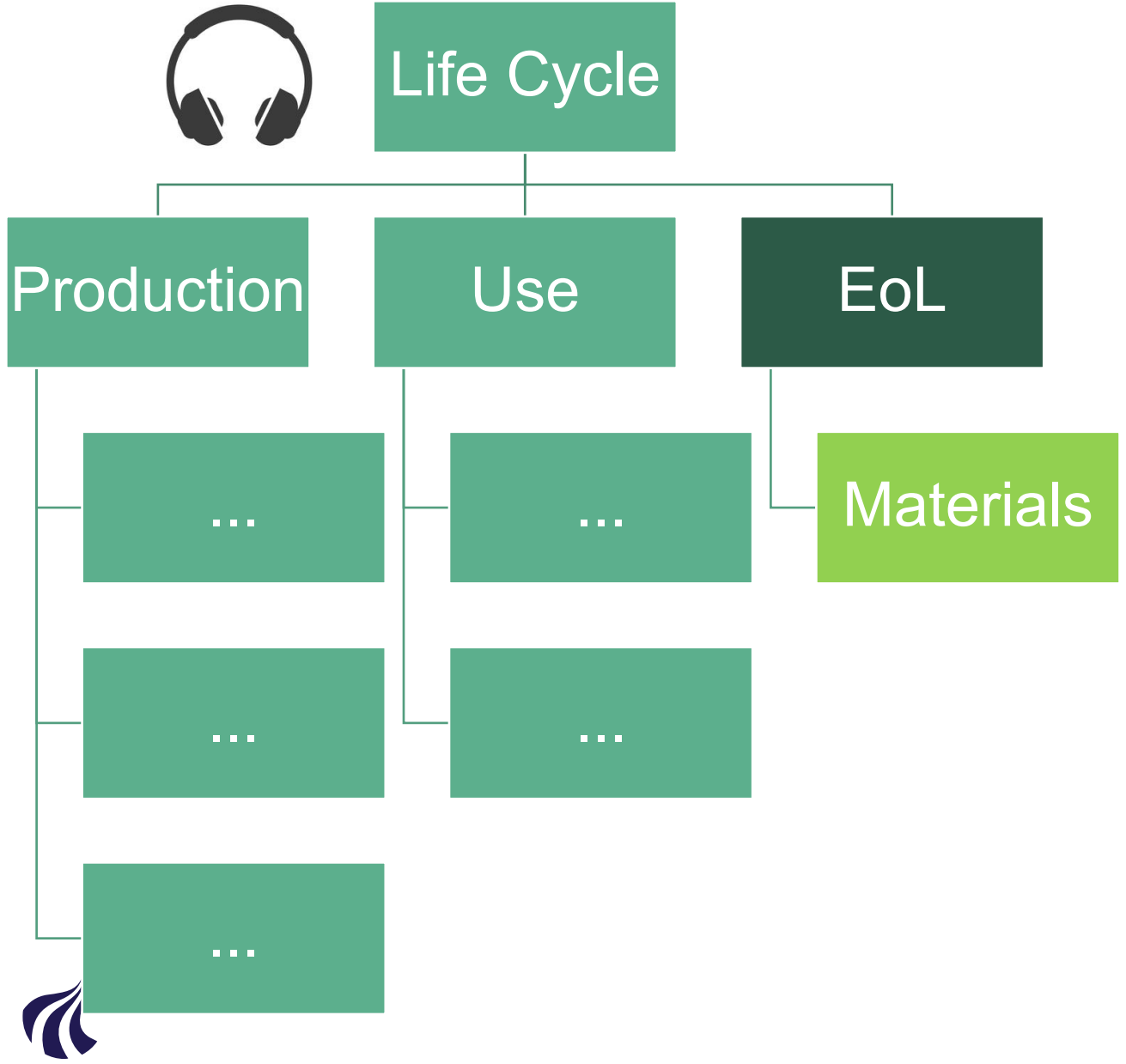
Use

- Low influence by producer
- High variability due to user behaviour
- Can be hot-spot over life cycle due to energy use
- Materials only relevant for maintenance (more important with repair! circular economy)
- Lifetime is key parameter (link back to production)

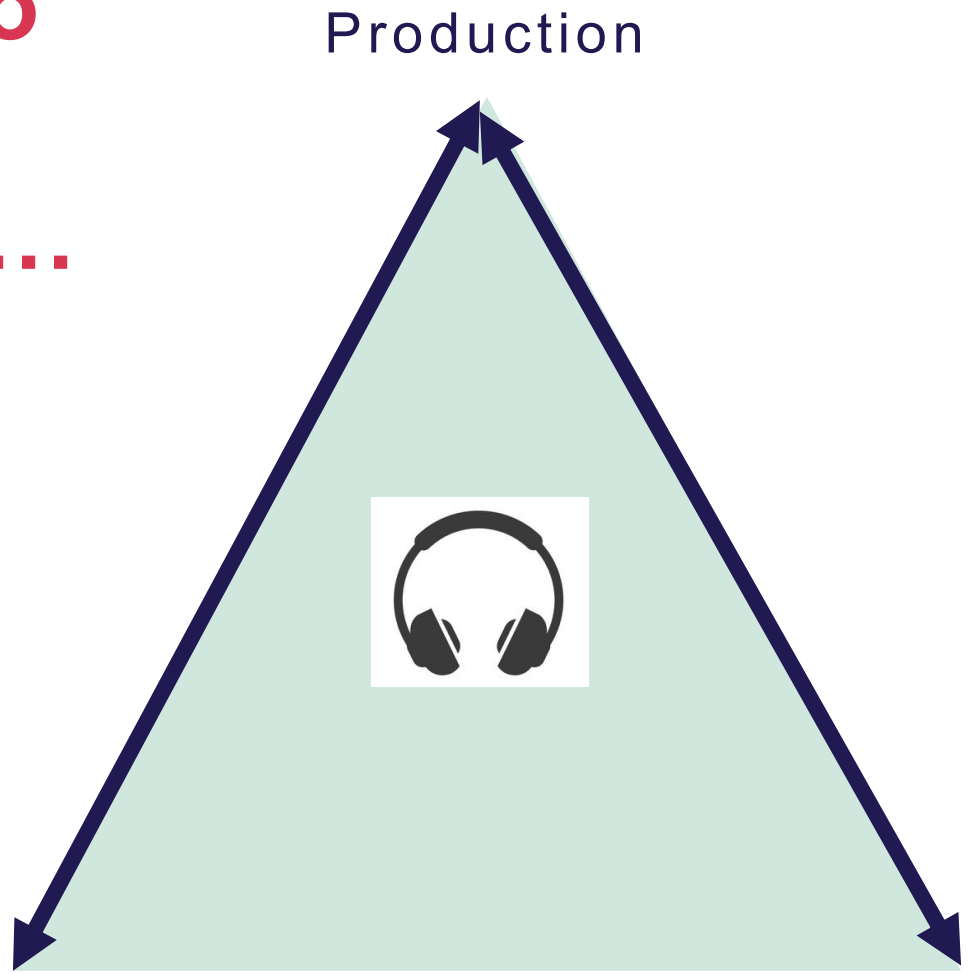


End of Life

- Uncertain and out of producer control
- High spatial and temporal variability (Waste management in China in 10y?)
- **Important for resource recovery**
- A technical as well as management issue (”recyclable” means nothing unless waste is first sorted…)



I want to change material...



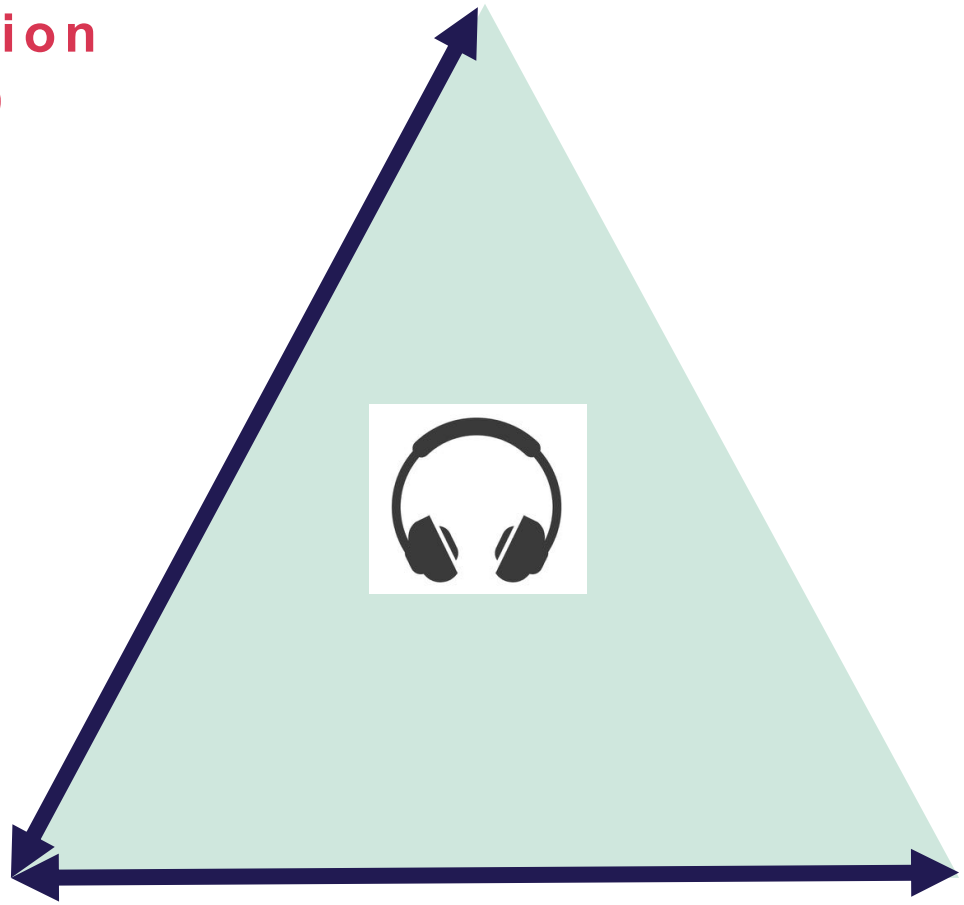
Burden-shifting

Can it be recovered? (Impact of waste man. change)

Will it last less? (Impact of lifetime change)

Burden-shifting

Will I need more materials? (Impact of production change)

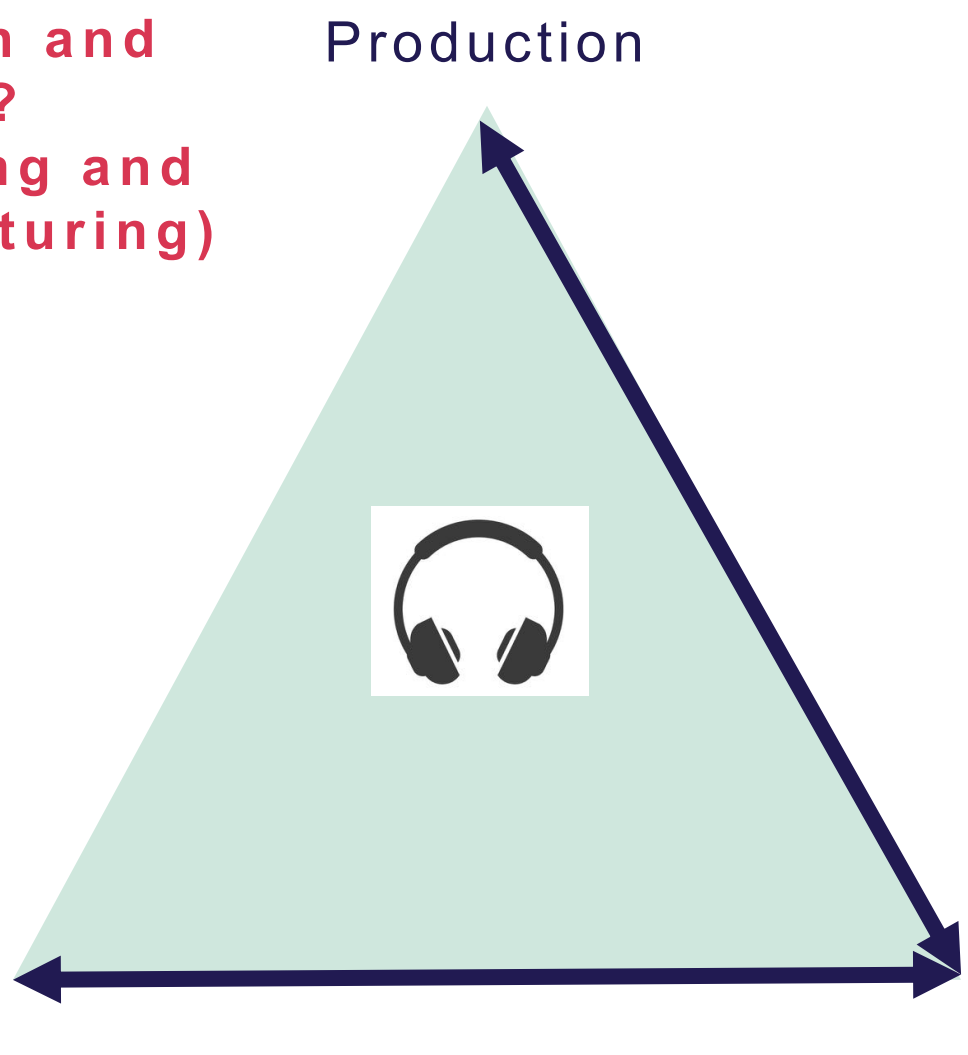


Will I have a sorting system in place in the distant future? (Impact of waste man. change)

I want a more durable product...

Burden-shifting

Change in design and components?
(impact of sourcing and energy in manufacturing)



I want a product that can be disassembled completely

Will the user behaviour change? (impact of lifetime change)

USE AND ABUSE OF LCA MODELS

LCA

Input

Model

Output

Uncertainty, typical questions

- *How sure am I of my LCA results? How wrong can they be?*
- *Is there any data input that might change substantially?*
- *Does the way the model is constructed reflect reality?*
- *Does my study depend on specific conditions?*
- *Did I make any critical assumption or choice in the study?*
- *Am I using old or new data?*
- *How far am I looking into the future?*
- *Is there something I don't know about the subject of my LCA study?*

A paradigm shift

Current paradigm:

Focus on the single LCA numerical result.

Looking for the “right” number.

Narrowing scope.

Uncertainty, what is that?

Decisions first, model later…

A **”sound”** paradigm:

Focus on assumptions and data ranges.

There is a “cloud” of numbers.

Expanding scope.

We don’t know everything

Model first, decisions later…

Limits of quantification

We can make a lot of LCA models…but can we make good ones?

- Less focus on results, more focus on process
- *There is no 'number-answer'* *
- Explorative attitude, embrace the uncertainty space
- Assumption-testing
- Modelling ethics rather than standardisation

*cit. Andrea Saltelli cit. Anthony Fauci

New skillset and new mindset

When you can make many LCA simulations…

…focus on the simulations that matter, design the scenarios to support your decisions *(change the critical assumptions to stress-test decisions…)*

When the reality is difficult to describe univocally…

…focus on scenario design via co-creation with stakehoders *(LCA practitioner does not decide alone…)*

Learn LCA from us

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UDDANNELSE FORSKNING SAMARBEJDE OM AAU NYHEDER

EN

LCA course for professionals

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SÆRSKILT MODUL

LIVSCYKLUSVURDE-RING (LCA) MED FOKUS PÅ KLIMAAFTRYK

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Advanced LCA PhD course

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