



Aalto University
School of Arts, Design
and Architecture

Sustainable design S6

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Monday 15.5.2023

Agenda

13.15–13.45

Sustainability assessment in design – discussion & recap

Readings for the session

13.45–14.45

Assessment and redesign exercise, part 1 – going through topics

14.45–15.00

Break

15.00–15.30

Strategies for life cycle extension and end-of-life management:

EcoDesign strategy checklist

15.30–15.45

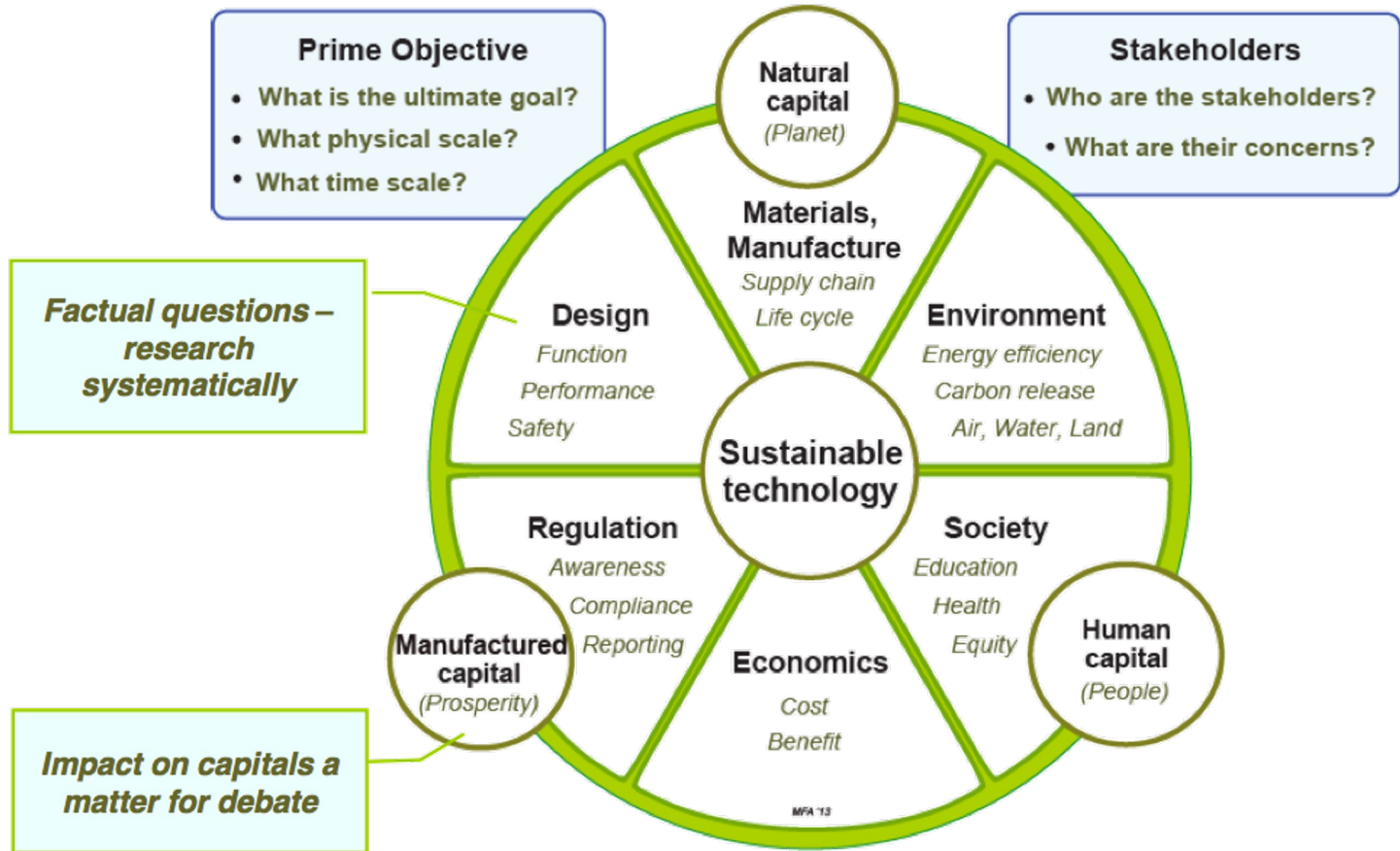
Assessment and redesign exercise, part 2 – prep for session 7

Sustainability assessment in design – a recap



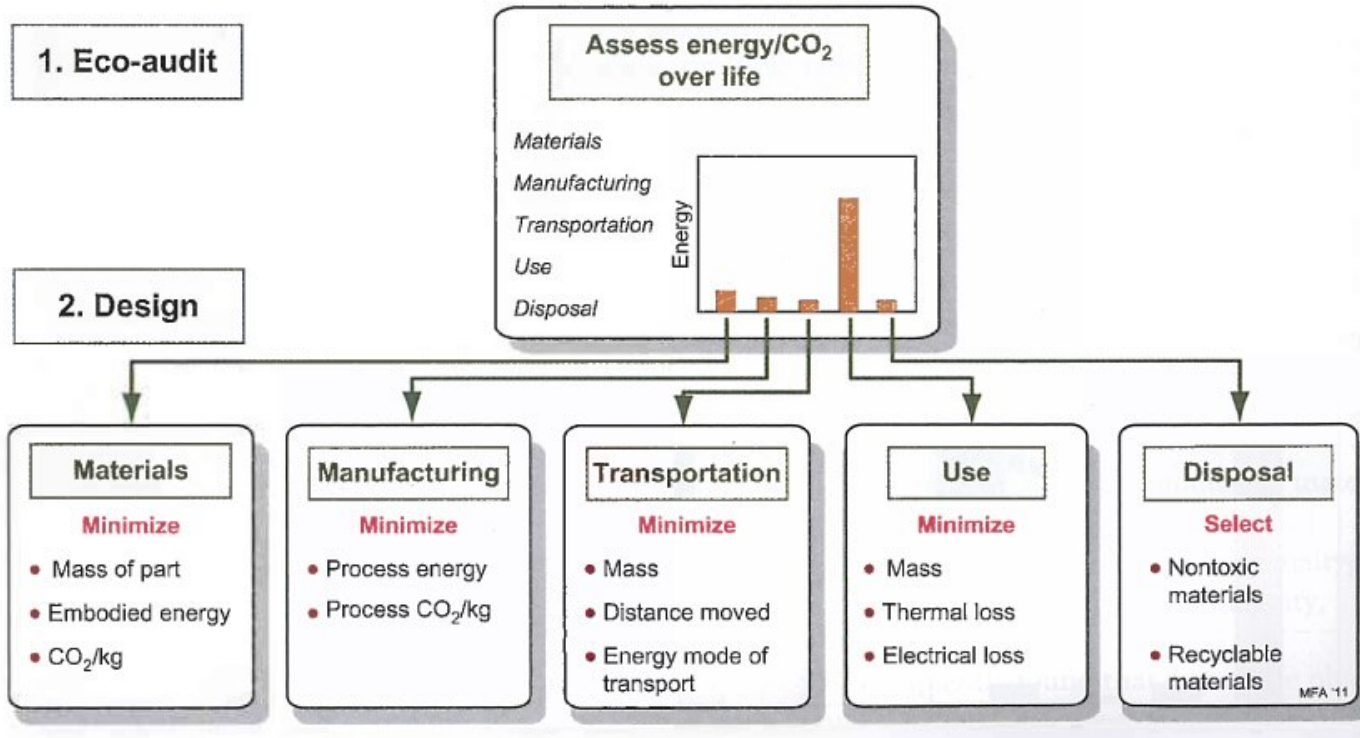
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Sustainability assessment:



Source: Ashby et al. (2013) Materials & SD

Product level life-cycle assessment:



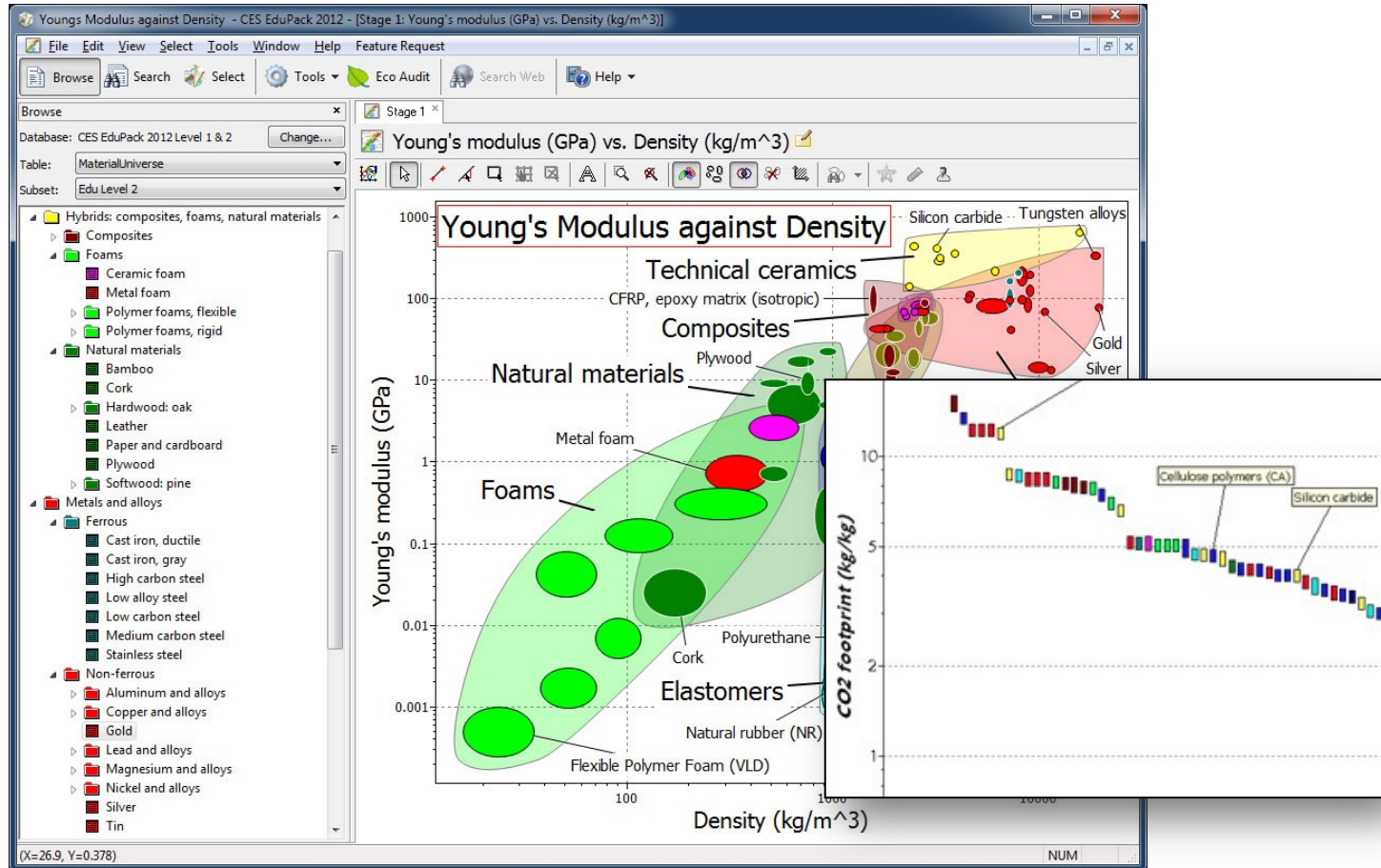
Source: Ashby, M. (2012) *Materials and the Environment: Eco-Informed Material Choice*

Qualitative SLCA approach – MET matrix:

MET (materials, energy, toxicity) matrix/table is an SLCA tool/method to manage research in eco-auditing and LCA processes:

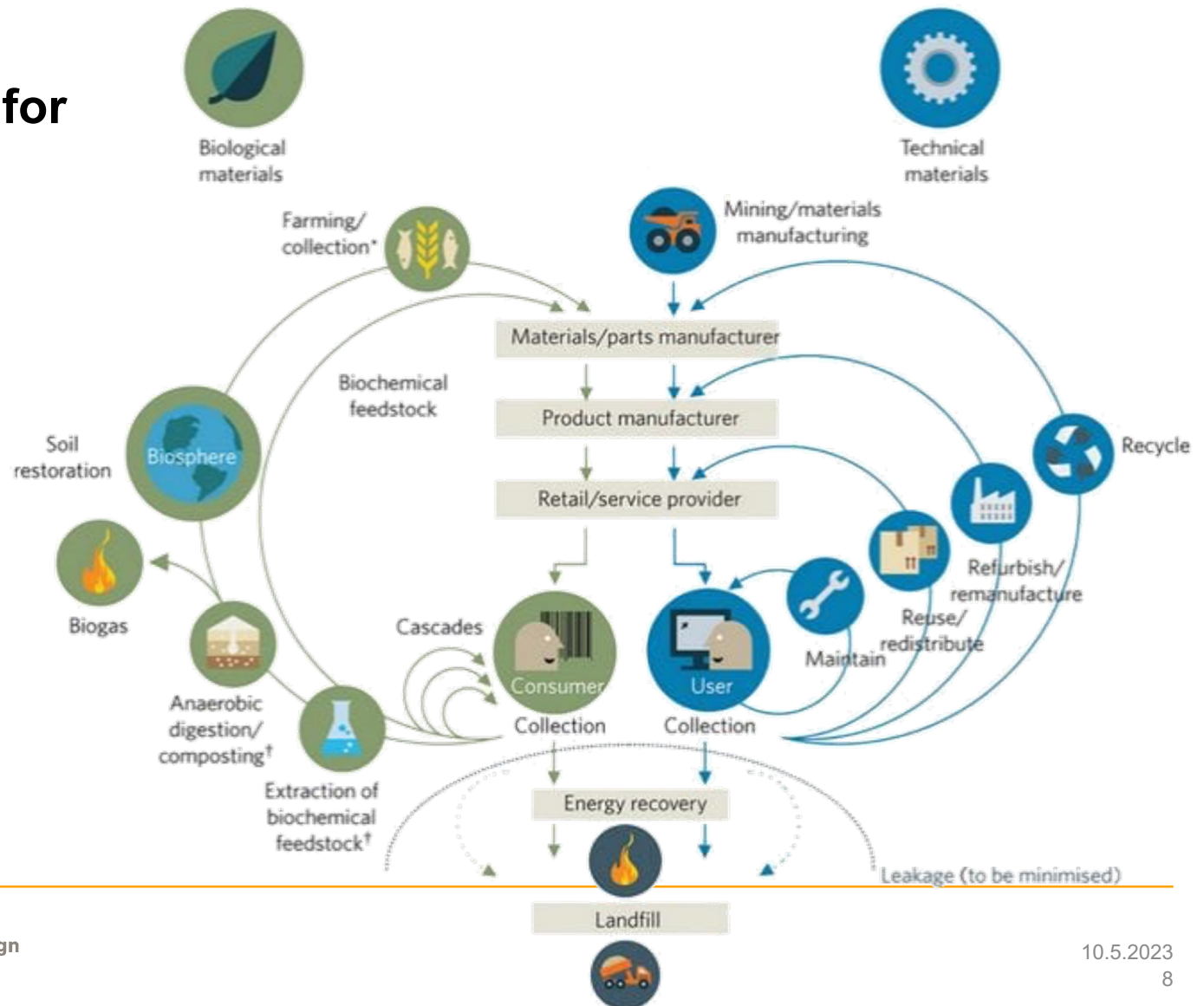
Life phase	Materials	Energy	Toxicity
Raw materials	List of components and materials	Embodied energy	Issues in materials production; eg. CO2
Production processes	List of production processes	Energy consumption in production	Eg. CO2 in manufacturing
Transport/ logistics	Infrastructure in transport & logistics	Energy consumption in logistics	Means of transport? CO2 per kg?
Use phase	Materials needed during use (eg. Coffee filters)	Energy consumption during use	Waste of consumables
End-of-Life (EoL)	EoL choices for components/materials	Impacts of EoL choices	Impacts of EoL choices

Quantitative data-driven approach:



See session 5 slides for Granta Edupack intro...

Opportunities for design interventions:



Readings for the session



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Readings for this session

Allwood, J., & Cullen, J. (2010). Sustainable Materials – with Both Eyes Open

Chapter 16: Longer life products

Chapter 17: Reducing final demand

Longer life products

Potential to extend lifespan of products:

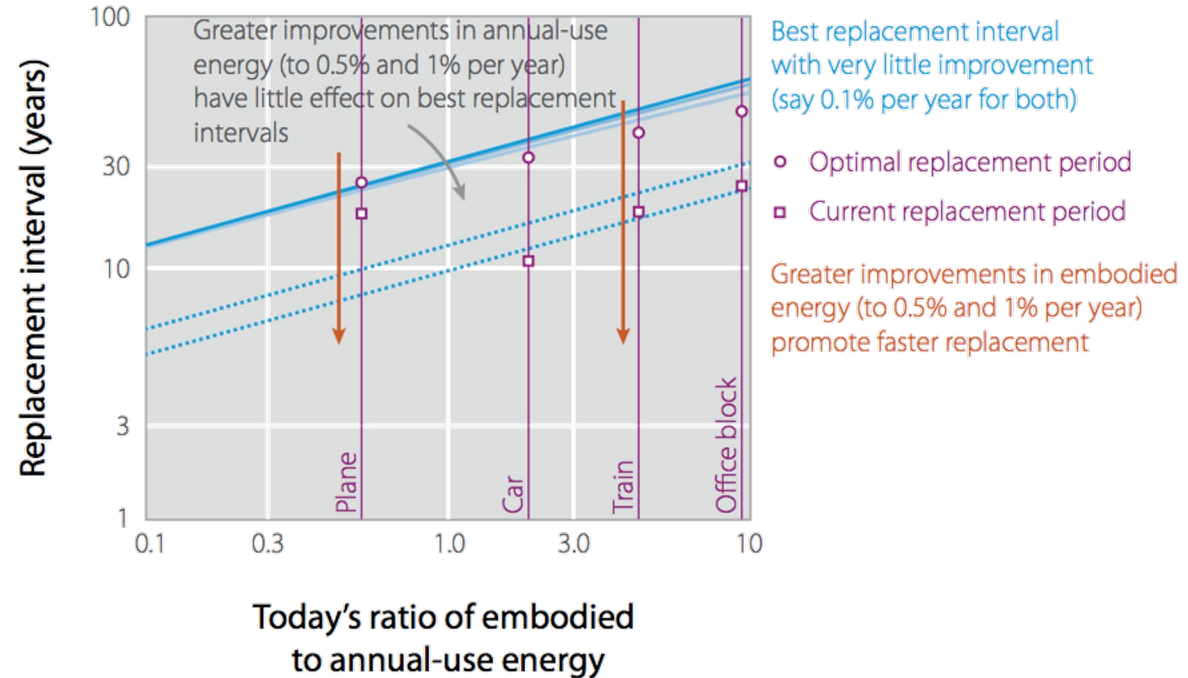


Figure 16.2—Predicted product replacement intervals to minimise use and embodied energy

Longer life products

Why do we replace goods? Why products are discarded – types of failure:

Table 16.1—Types of failure

	... relative to when it was purchased	... relative to what's now available
The product's performance has declined ...	Degraded e.g. rail track	Inferior e.g. washing machines
The product's value has declined ...	Unsuitable e.g. sports car	Unwanted e.g. single hulled oil tankers

-> Strategies to avoid product failures?

-> Consider also: Increased efficiency in use vs. longer life spans

Longer life products

Strategies to improve product life:

Table 16.3—Strategies for
'peeling the onion'

	... relative to when it was purchased?	... relative to what's now available?
Has the product's performance declined ...	Durability when degraded	Upgrade when inferior
Has the product's value declined ...	Cascade when unsuitable	Design for recycling when unwanted

-> 'Onion skin model': Material considerations in design

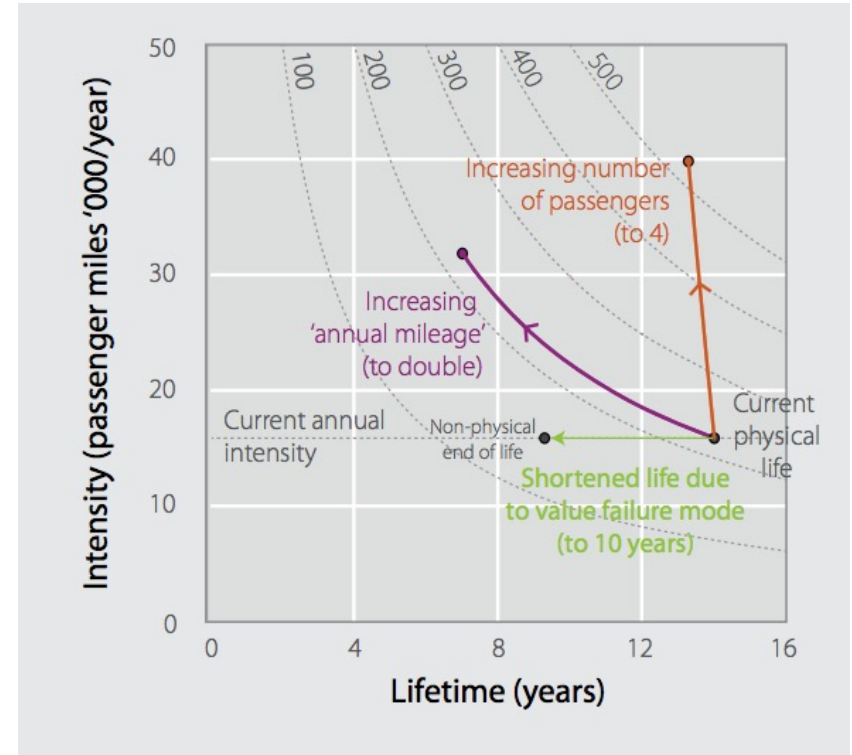
-> Consider: Modularity, repairability, recycling

Reducing demand

Providing more services with less materials

More intense use and reduced impacts per 'service unit' (eg. person / km travelled)

Example: Vehicles

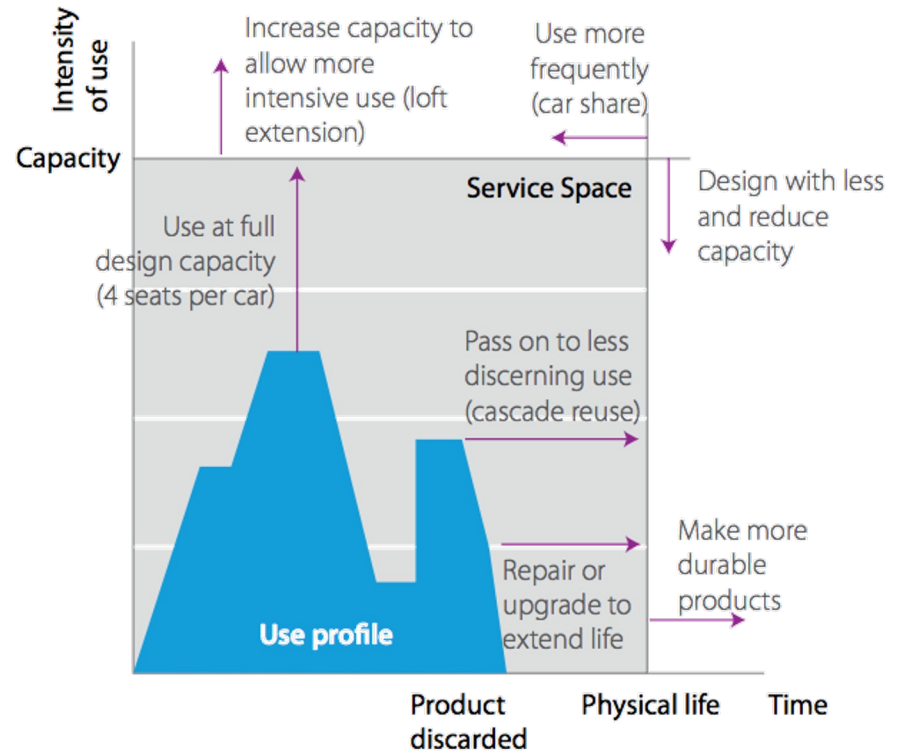


Reducing demand

**Design strategies to improve material efficiency:
Extending lifetime vs.
more intense use**

**Services connecting with
capacity increase and
lifetime management**

Reality? Problems?



Reducing demand: GDP & happiness

Connections with prosperity and emissions

Disconnecting happiness and material demand?

Design for Sufficiency?

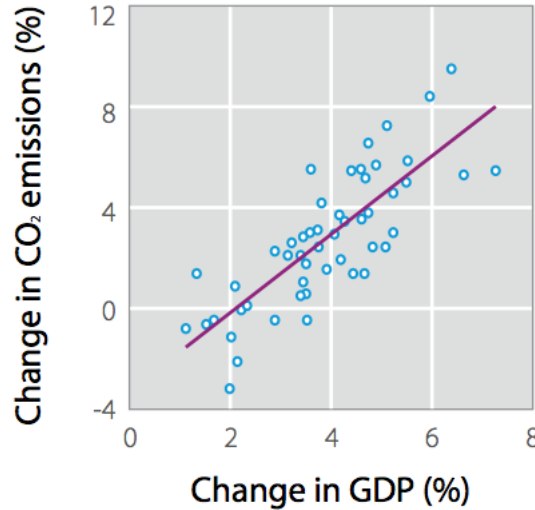


Figure 17.3—The relationship between emissions and GDP

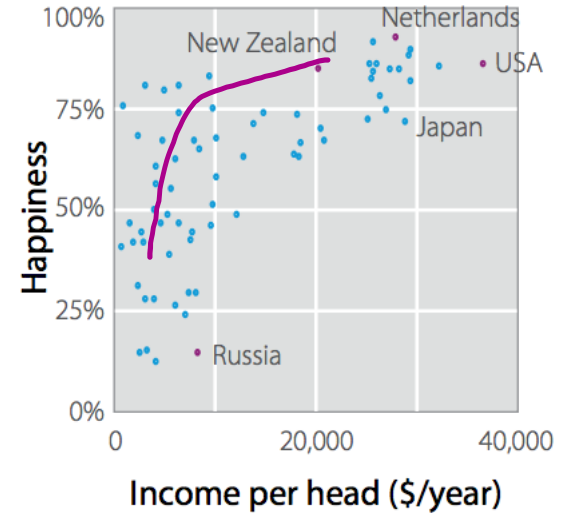


Figure 17.4—The relationship between GDP and happiness

Summary

Ecodesign and sustainability in design is based on:

- **Increasing material/energy efficiency / decreasing negative impacts in production and end-of-life**
- **Increasing efficiency during use phase (per 'service unit')**
- **Decreasing consumption (behavior change; sufficiency)**

-> In policy development level (in UN, EU):

Sustainable Consumption and Production (SCP)

See: <https://www.unenvironment.org/explore-topics/resource-efficiency/what-we-do/sustainable-consumption-and-production-policies>

Assessment and redesign exercise



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Assessment and redesign exercise (sessions 5–7)

Assessment and redesign exercise consists of two parts:

- 1. Assessment of sustainability impacts (of product/material)**
- 2. Redesign improvements**

Exercise is done independently, assessment followed by redesign;

Final results are communicated on this Friday (DL 8 am) with a digital poster

- **Layout option 1:** Use one-page landscape layout with text and images of existing product on left side, and redesign on right side (as in my example later on...)
- **Layout option 2:** Use two pages with landscape format, with existing product on first page, and redesign on the second

Reflection on assessment in learning diary after session 7!

Assessment and redesign exercise – grading

Independent exercises (session 4 & sessions 5-7) form 30% of the overall course grade

The evaluation of redesign assignment considers the following aspects (grade 1-5):

- How well was the impact assessment done? Was the topic selection and boundary-setting for the assessment meaningful? Were the most important aspects regarding materials, life-cycle phases, and stakeholders considered?
- How did the redesign ideas succeed? How feasible they were? How impactful? How innovative or novel?
- How successful was the visual communication in poster and the presentation pitch talk?

Evaluation matrix

<p>Assignment 4: Redesign</p> <p>(MyCourses submission: Digital poster with presentation talk on 19.5.)</p>	<p>The submission includes an assessment that is incomplete and/or has incorrect findings, and the redesign feels incomplete, unjustified, and/or falsely targeted. The communication of content is very poor.</p>	<p>The submission includes an assessment that remains shallow and/or unreasonably limited, and the redesign isn't well connected, remains limited in scope, and isn't that novel. The communication of content feels limited and/or poorly conducted.</p>	<p>The submission includes an assessment that captures main sustainability concerns with support of the database, and the redesign is connected to the sustainability concerns, but limited in scope and/or without being that novel. The communication of content is on an average level.</p>	<p>The submission includes an assessment that is broad, based on the database findings, drawing attention to key sustainability aspects, and the redesign successfully builds on the assessment and introduces feasible changes. The communication of content is well conducted.</p>	<p>The submission includes an assessment that is broad, well-performed and justified with the database and potentially external sources, drawing carefully attention to the key sustainability aspects, and the redesign successfully builds on the assessment and introduces feasible changes that feel novel and innovative. The communication is professional and also visually pleasing.</p>
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Assessment and redesign exercise: (part 1)

In the assessment part of the exercise, you perform a simple sustainability impact assessment on your selected topic:

- **Research selected product/material (or even some service?); Consider life phases, and identify main materials, processes, and stakeholders:**
 - *Raw materials production*
 - *Manufacturing processes*
 - *Transport/logistics*
 - *End-of-Life (EoL) options*
 - *and/or use phase itself*
- **Reflect on dominant phases and sustainability issues!**

Selecting topics

Example topics:

- **Product (domestic, leisure)**
- **Electrical device**
- **Clothing/textile**
- **Vehicle/transport system**
- **Material (its usage, production)**
- **Food (product, ingredient)**
- **Etc..**

- *Work with your nearby student(s) and present/discuss your topics to each other (~10 minutes);*
- *What is your topic?*
- *Have you thought of important impacts?*
- *Have you thought already of redesign?*
- ***Let's go through round of topics briefly!***

Strategies to improve product sustainability



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Strategies to improve product sustainability

- **Life-cycle assessment as a cornerstone**
- **Consider production; Remember also societal aspects!**
- **Less harm from materials: Consider alternatives, processes, and end-of-life options**
- **More value from materials: Extending product life and product use (consider service systems)**
- **Consider end-of-life options and processes**
- **Design for R: Reduce, Reuse, Recycle, Recover (and Regenerate etc.)**
- **Communicate with values against throwaway society (eg. 'luxury' vs. cheap products?)**

Ecodesign checklist

The **EcoDesign checklist by TU Delft** is a life-phase based checklist with questions that provides support for the analysis of a product's impact on the environment. It provides relevant questions that need to be asked when establishing environmental bottlenecks during the product life-cycle.

See:

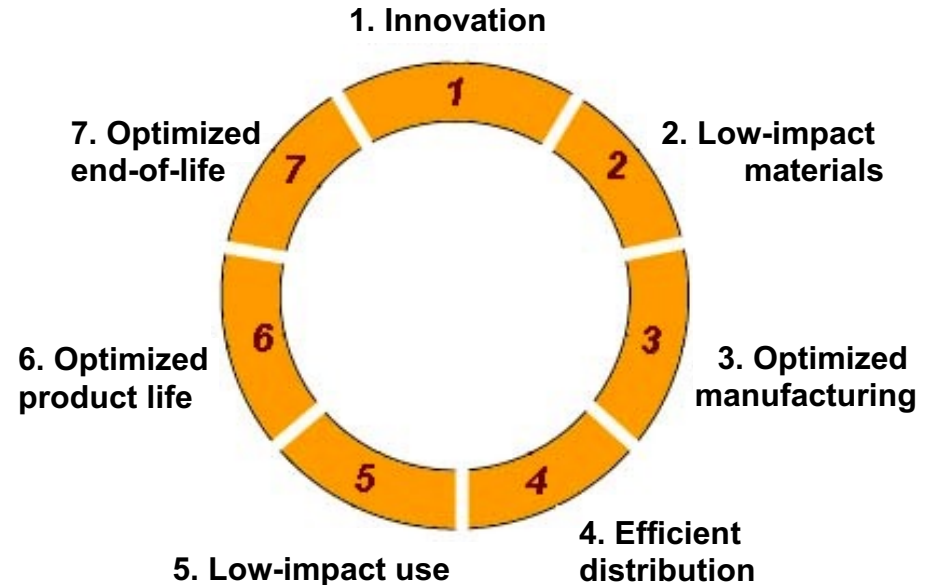
http://wikid.io.tudelft.nl/WikID/index.php/EcoDesign_checklist

EcoDesign checklist: Strategy wheel

1. Define the product idea, product concept or existing product that will be analyzed. Evaluate existing system or your concept.

2. Systematically score the product on each dimension of the strategy wheel, linked to life phases of the product.

3. Consider the optimization options for each of the dimensions, paying special attention to those where the current design scores badly.



EcoDesign strategy wheel by TU Delft

Ecodesign strategies:

1. Innovation

- Rethink how to provide the benefit
 - Serve needs provided by associated products
 - Anticipate technological change and build in flexibility
 - Provide product as service
 - Share among more users
 - Design to mimic nature
-

Ecodesign strategies:

2. Low-impact materials

- Avoid materials that damage human health, ecological health, or deplete resources
 - Use minimal materials
 - Use renewable resources
 - Use waste by-products
 - Use thoroughly tested materials
 - Use recycled or reused materials
-

Ecodesign strategies:

3. Optimized manufacturing

- Design for ease of production quality control
 - Minimize manufacturing waste
 - Minimize energy in production
 - Minimize number of production methods and operations
 - Minimize number of components/materials
-

Ecodesign strategies:

4. Efficient distribution (logistics)

- Reduce product and packaging waste
 - Use reusable or recyclable packaging
 - Use an efficient transport system
 - Use local production and assembly
-

Ecodesign strategies:

5. Low-impact use

- Minimize emissions/integrate cleaner or renewable energy sources
 - Reduce energy inefficiencies
 - Reduce water use inefficiencies
 - Reduce material use inefficiencies
-

Ecodesign strategies:

6. Optimized product lifetime

- Build in user's desire to care for product long term
 - Design for take-back programmes
 - Build in durability
 - Design for maintenance and easy repair
 - Design for upgrades
 - Design for second life with different function
 - Create timeless design
-

Ecodesign strategies:

7. Optimized end-of-life

- Integrate methods for product collection
 - Provide for ease of disassembly
 - Provide for recycling or downcycling
 - Design reuse, or 'next life of product'
 - Provide for reuse of components
 - Provide ability to biodegrade
 - Provide for safe disposal
-

Strategies to improve product sustainability

1. Innovation

7. Optimized end-of-life

2. Low-impact materials

3. Optimized manufacturing

4. Efficient distribution

5. Low-impact use

6. Optimized product life



1. Innovation

7. Optimized end-of-life

2. Low-impact materials

3. Optimized manufacturing

4. Efficient distribution

5. Low-impact use

6. Optimized product life



Assessment and redesign exercise



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Assessment and redesign exercise (sessions 5–7)

Assessment and redesign exercise consists of two parts:

- 1. Assessment (of product/material)**
- 2. Redesign ideation**

Progress so far – status check:

- Research selected product/material**
- Consider life phases, and identify main materials, processes, and stakeholders**
- Reflect on dominant phases and sustainability issues**

Assessment and redesign exercise:

Redesign phase (part 2)

**Based on your assessment, proceed to suggest improvements.
You can consider for example:**

- **Material alternatives**
- **New ways of production or logistics**
- **Improving societal aspects**
- **Improving efficiency in use**
- **Services and sharing**
- **Communication with design**

Assessment example: Lidl sneakers



LIVERGY® Lidl sneakers

Materials:

- *Upper: Nylon*
 - *Lining and insole: textile*
 - *Outsole: Polyurethane*
- > Fossil-based plastic in various forms*

Sustainability issues:

- *Labor issues in manufacturing location (China)*
- *Material issues (fossil-based)*
- *End-of-Life issues*
- *Focus life phases: Materials & manufacturing, EoL*

Redesign example 1: Lidl X Ioncell® sneakers



Lidl X Ioncell® sneakers

Materials:

- *Upper: Ioncell cellulose fibre*
- *Lining and insole: Ioncell*
- *Outsole: 50% recycled rubber*

Sustainability improvements:

- *Improved material selection*
- *Production partner with fair labor conditions*
- *Future focus in end-of-life improvement, in-store collection*

Ioncell® cellulose fibres, see: <https://ioncell.fi/>

Sneaker design based on Decathlon NH150 eco-sneaker

Redesign example 2: Lidl 2ndLeg sneakers & recycle service



Lidl X 2ndLeg sneakers & recycle service

- *Lidl proceeding to sustainability in clothing*
- *In-store collection system for old sneakers*
- *Back-end recycling and upcycling facilities*
- *2ndLeg sneaker collection in stores*

Sustainability improvements:

- *From producing new cheaply, to recycling and reusing old*
- *Support for local actors in upcycling*
- *Access to waste streams for recycling*
- *Feasibility?*

Assessment and redesign exercise: Poster & pitch (for next session)

Communicate your assessment and redesign:

- **Describe your topic, assessment and redesign**
- **Communicate sustainability issues and suggested improvements**
- **Produce a one-page or two-page PDF poster in landscape format; Upload to MyCourses by Friday 8 am!**
- **Present with a 3 min pitch in this Friday's session!**

Poster example

Product assessment



LIVERGY® Lidl sneakers

Materials: Nylon, Polyurethane

Sustainability issues:

- *Labor issues in manufacturing location (China)*
- *Material issues (fossil-based plastics)*
- *End-of-Life issues*
- *Focus life phases: Materials & manufacturing*

Redesign idea



Lidl X loncell® sneakers

Materials: loncell® cellulose fibre, recycled rubber

Sustainability improvements:

- *Improved material selection*
- *Production partner with fair labor conditions*
- *Future focus in end-of-life improvement, in-store recycling?*

For next session...

Finalize your assessment and ideate redesign improvements!

Produce a poster, upload to MyCourses by Friday morning (cut-off at 8 am!)

Prepare 3 min pitch talk (stick to the timeframe!), 6 min slots inc. feedback

We will split the class into 3 classrooms:

- **Room 1: Jeti - A208d, A Grid**
- **Room 2: Mordor, A Grid**
- **Room 3: F101, Väre**

Check your group & classroom from MyCourses announcement after lecture!

Presentations on Friday beginning from 9.15!

Thank you!



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