Aalto University
School of Arts, Design
and Architecture

Sustainable design S6

Tatu Marttila
6.5.2020

Agenda

9.15–9.50

Sustainability assessment in design – Discussion & recap

Readings for the session

9.50–10.30

Assessment and redesign exercise, part 1: Going through topics

10.30–10.45

Break

10.45–11.30

Strategies for life cycle extension and end-of-life management: *Ecodesign strategy checklist*

11.30–11.45

Assessment and redesign exercise, part 2 (prep for session 7)

Sustainability assessment in design – a recap

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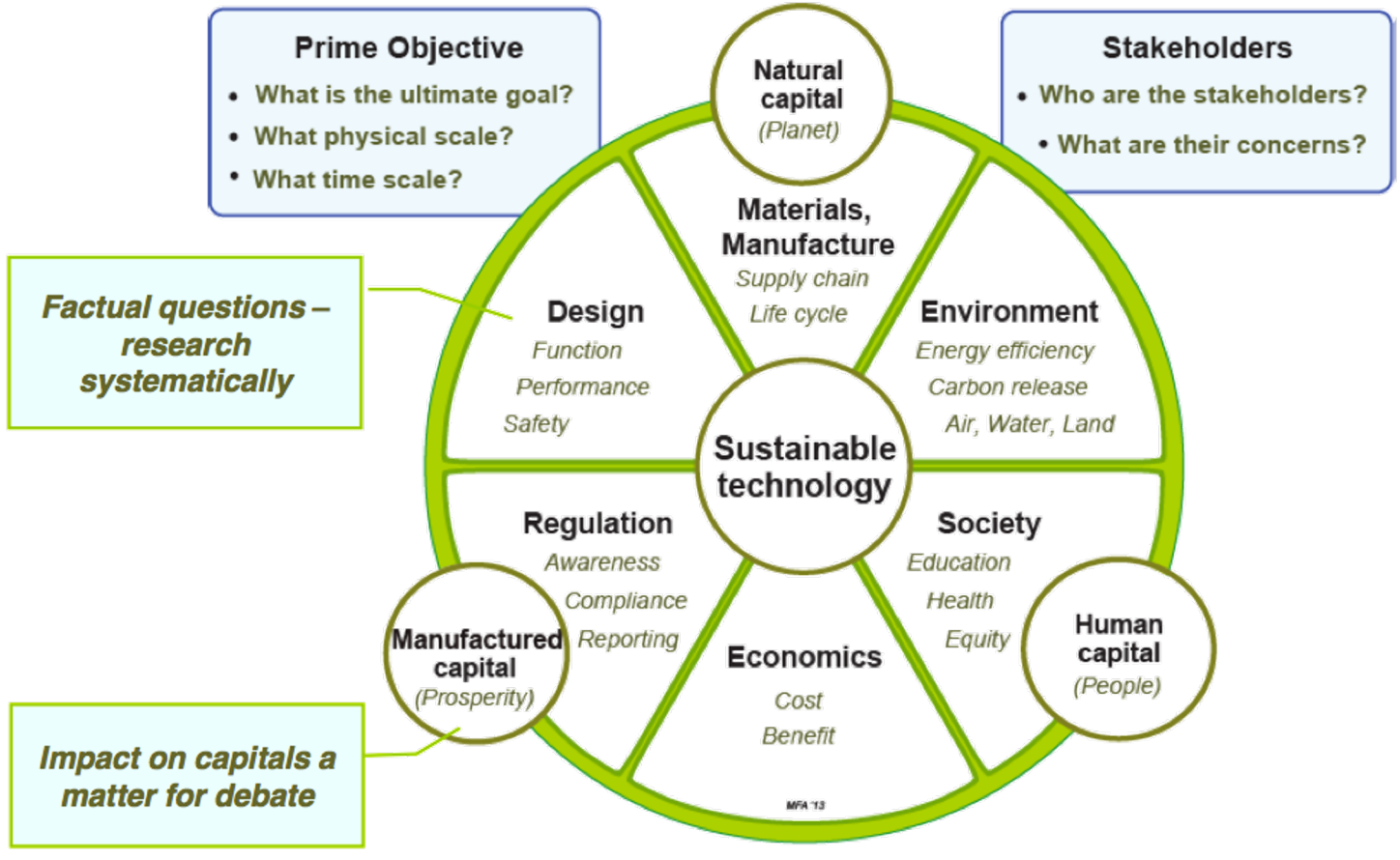
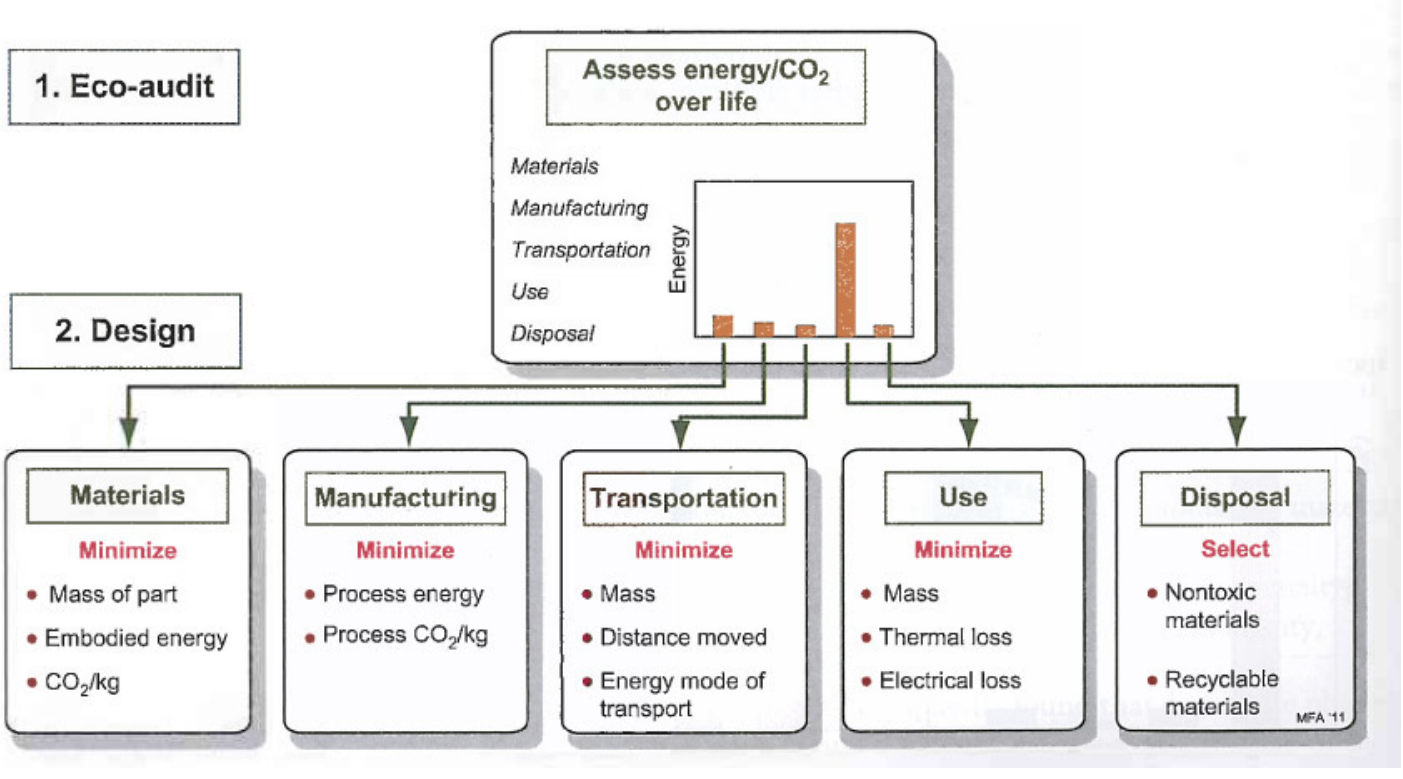
Sustainability assessment:



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

Product level life-cycle assessment:



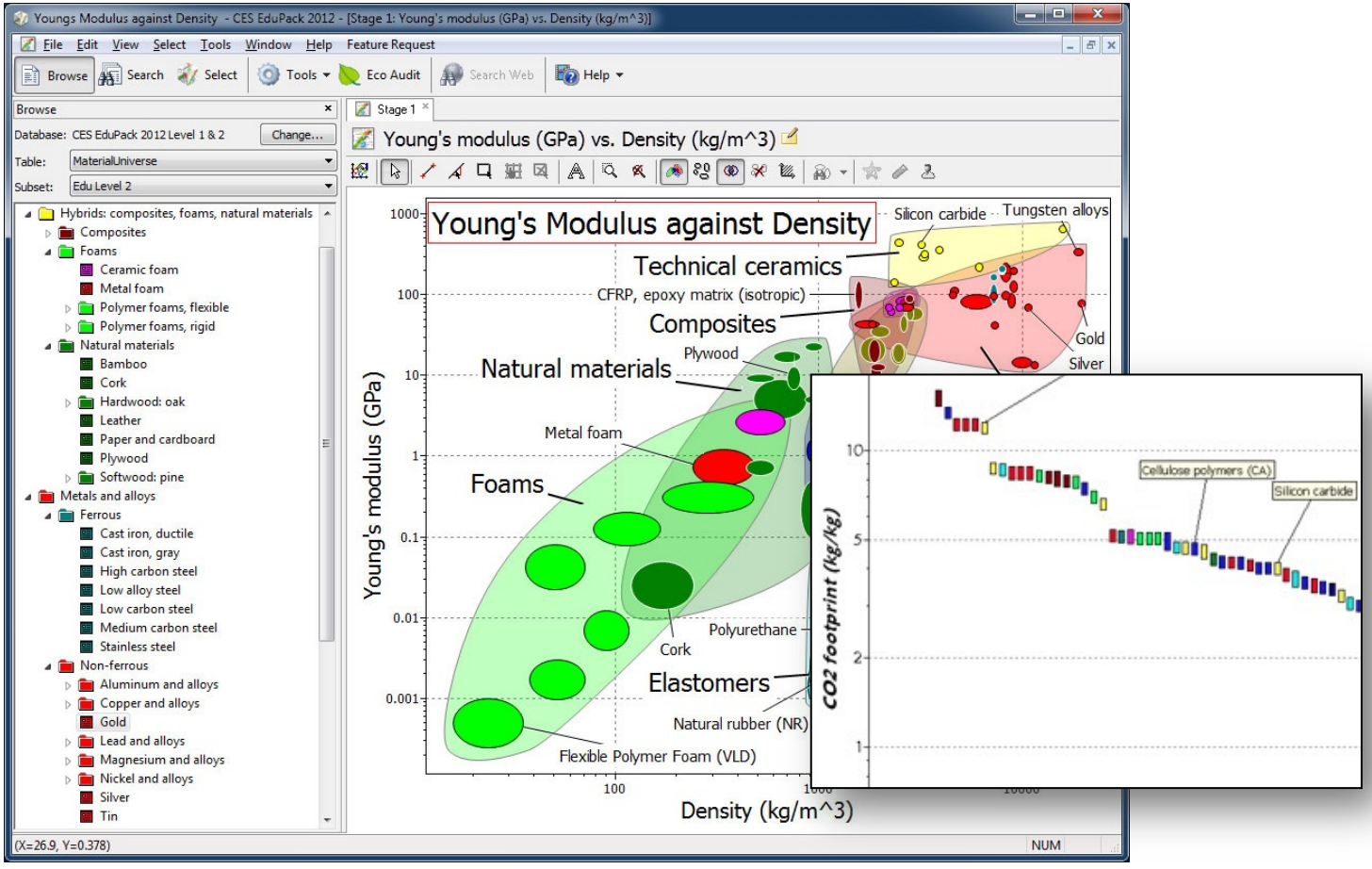
Source: Ashby, M. (2012) Materials and the Environment: Eco-Informed Material Choice

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:

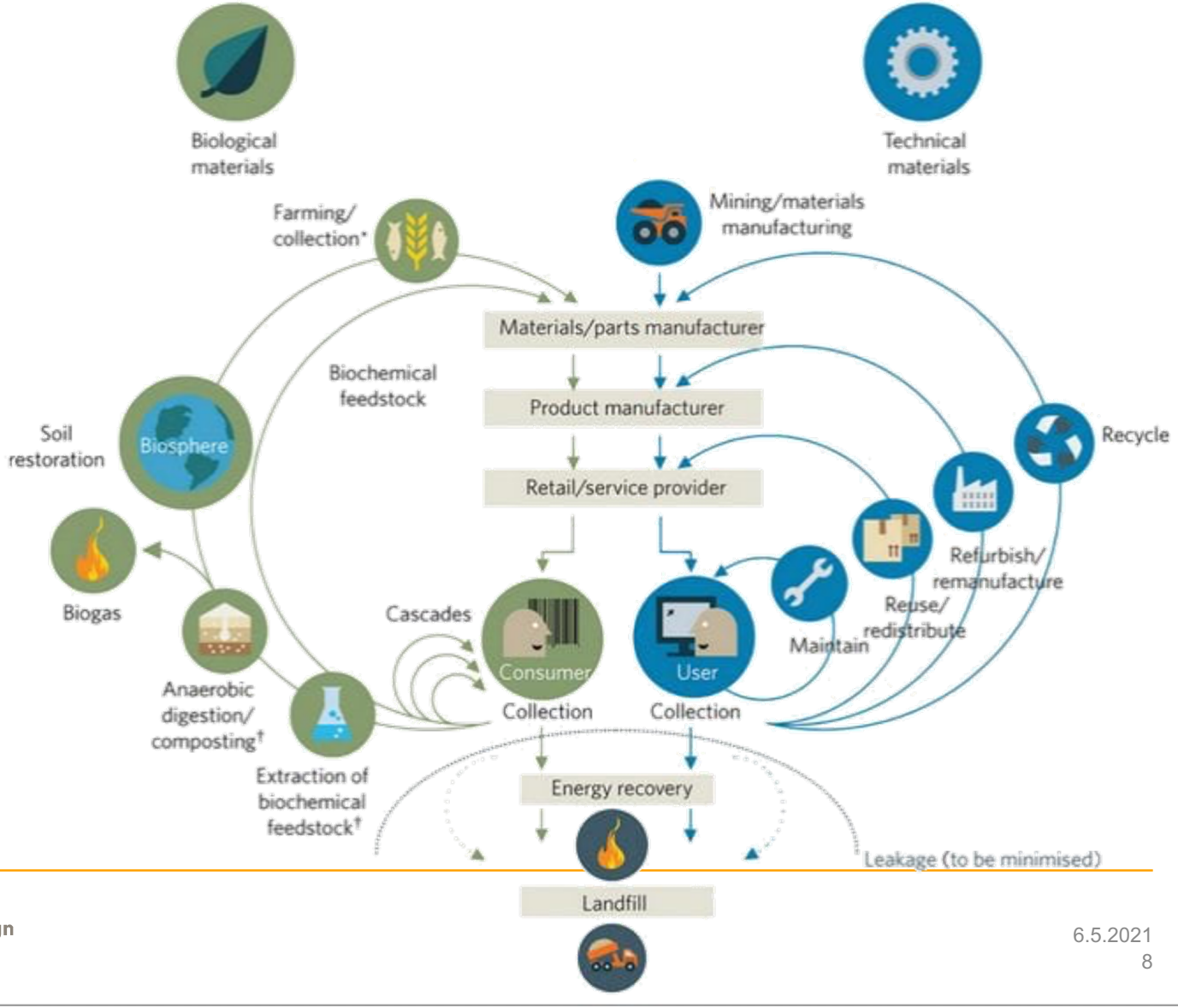
Life phase	Materials	Energy	Toxicity
Raw materials	List of components and materials	Embodied energy	Issues in materials production; eg. CO2
Production processes	List of production processes	Energy consumption in production	Eg. CO2 in manufacturing
Transport/ logistics	Infrastructure in transport & logistics	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

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:

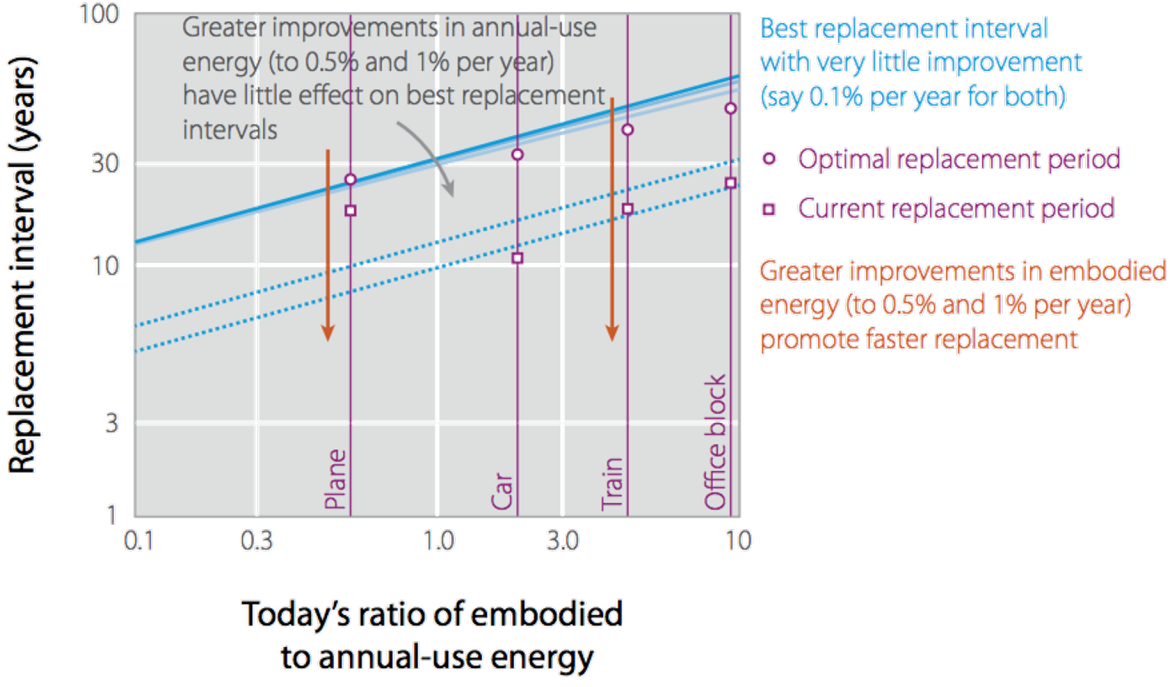


Figure 16.2—**Predicted product replacement intervals to minimise use and embodied energy**

Longer life products

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

	... 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

Table 16.1—**Types of failure**

-> Strategies to avoid product failures?

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

Longer life products

Strategies to improve product life:

	... 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 delcined ...	Cascade when unsuitable	Design for recycling when unwanted

Table 16.3—**Strategies for 'peeling the onion'**

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

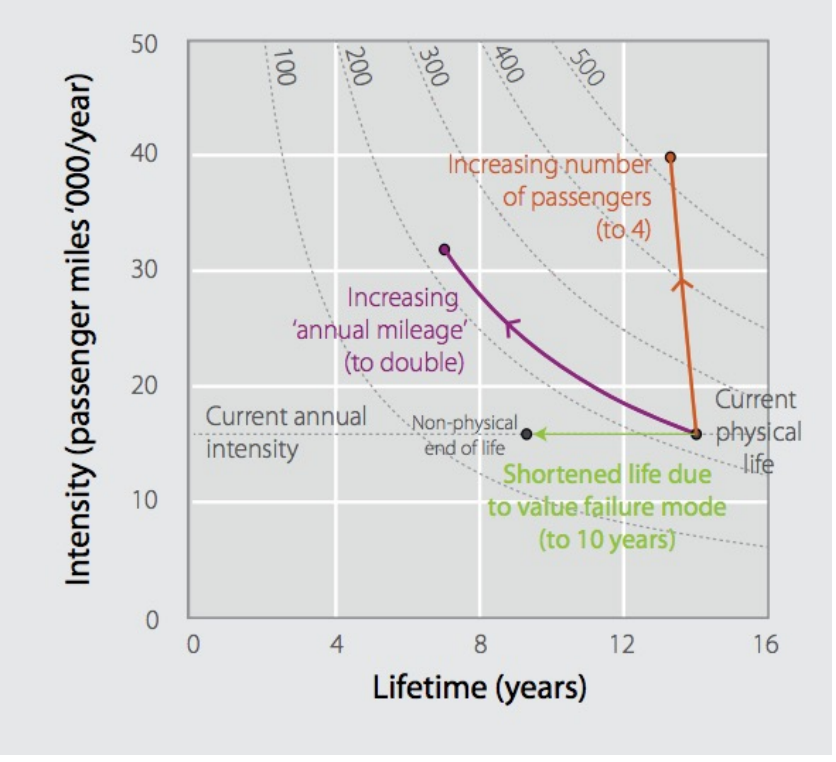
-> Consider: Modularity, repairability, recycling

Reducing demand

Providing more services with less materials

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

Example: Vehicles

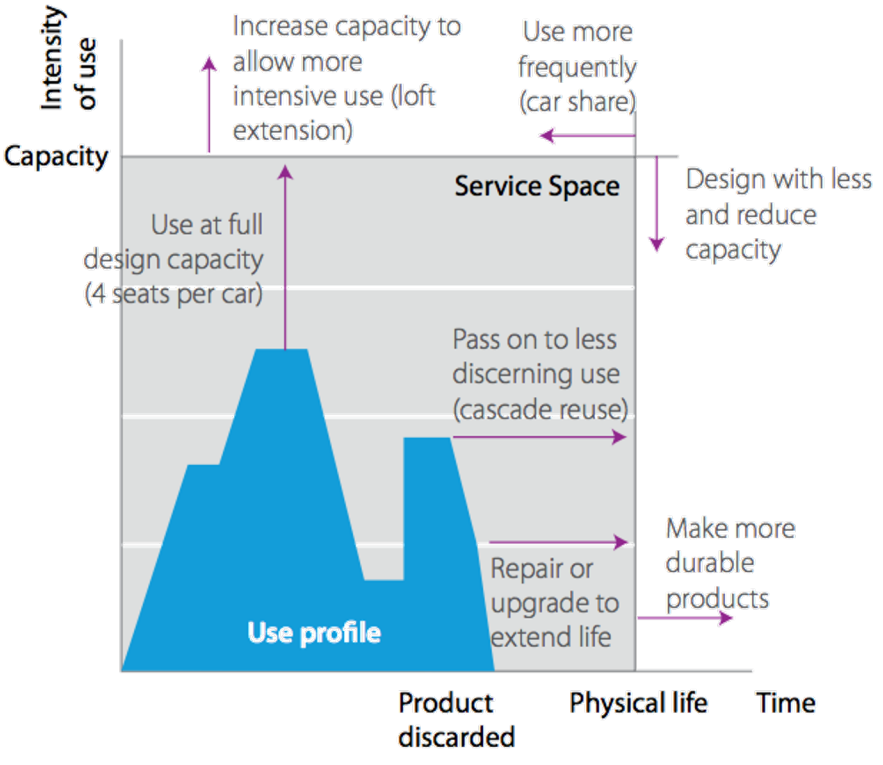


Reducing demand

Design strategies to improve material efficiency: Extending lifelifetime 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?

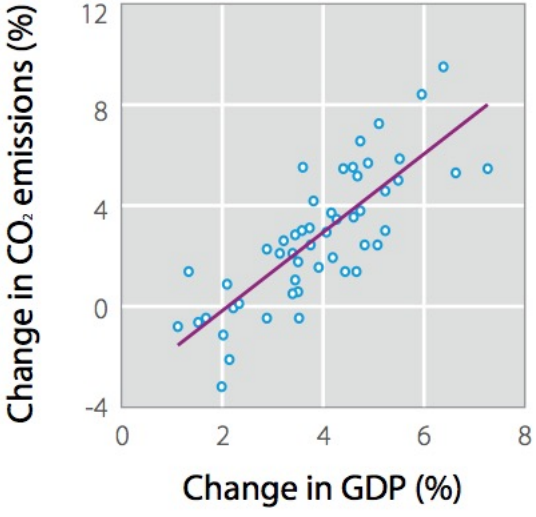


Figure 17.3—**The relationship between emissions and GDP**

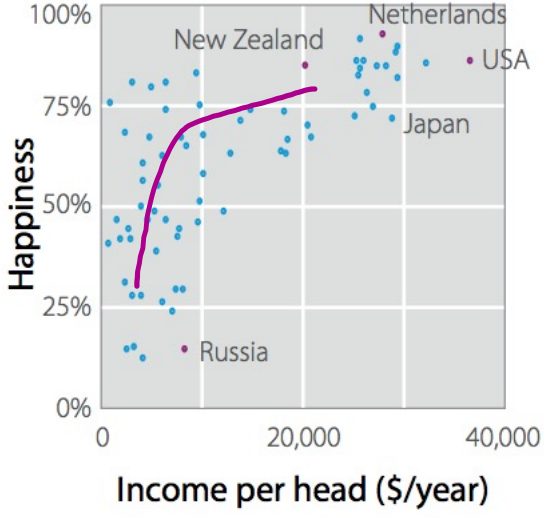


Figure 17.4—**The relationship between GDP and happiness**

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

Assessment and redesign exercise (sessions 5-7)

Assessment and redesign exercise consists of two parts:

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

Exercise is done independently, assessment followed by redesign;

Final results are communicated on next Tuesday with a poster

(with text and images of existing product on left, and redesign on right; landscape layout!)

Reflection in learning diary after session 7 next week!

Assessment and redesign exercise: (part 1)

In the assessment part of the exercise, you perform a simple eco-audit on your selected topic:

- **Research selected product/material; 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..**

Round of topics briefly!

Assessment example: Lidl sneakers

LIVERGY® men's 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*

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?)

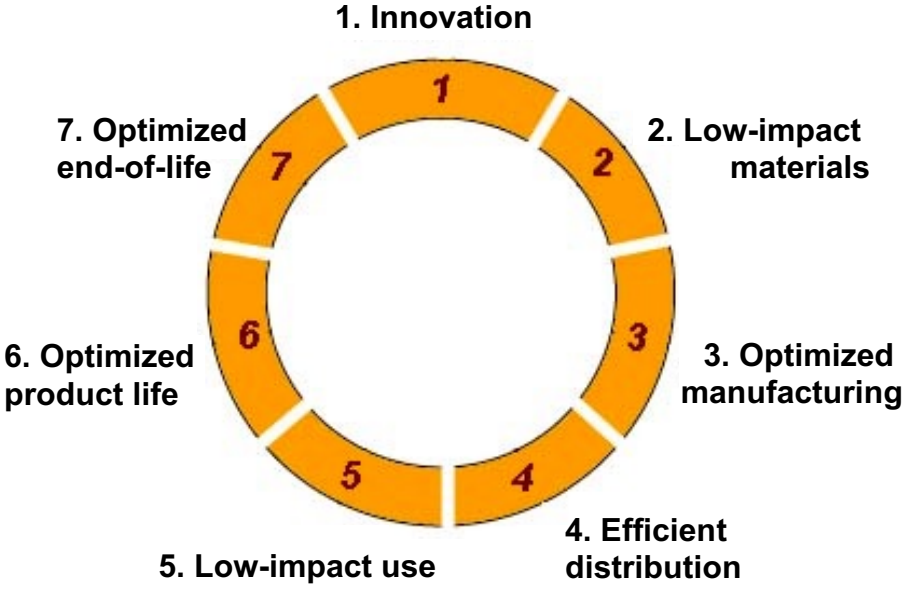
Ecodesign checklist

The **Ecodesign checklist** 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

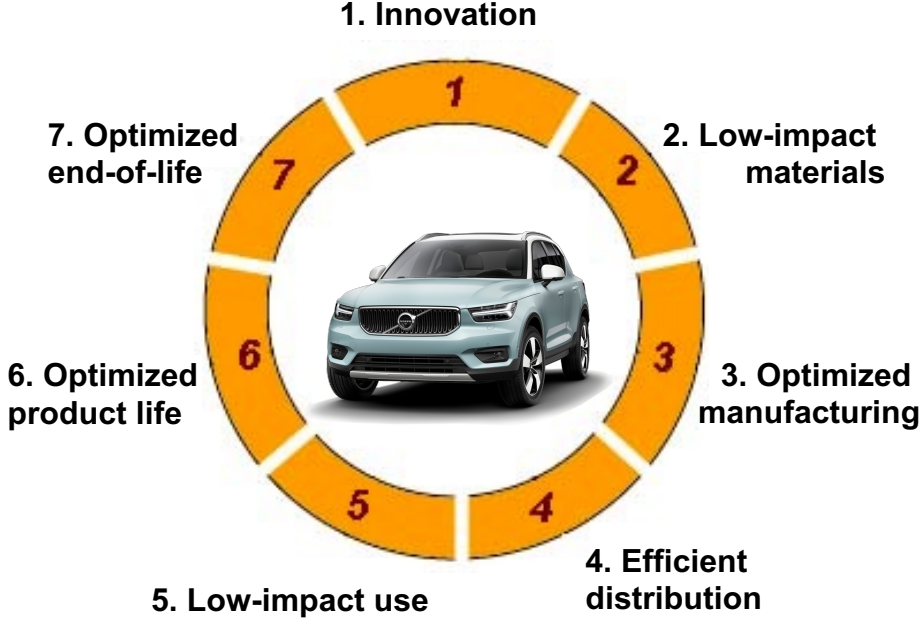
Ecodesign strategies:
6. Optimized product lifetime

- 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



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

- **Consider material alternatives**
- **Consider production and logistics**
- **Consider societal aspects**
- **Consider efficiency in use**
- **Consider services and sharing**
- **Consider 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 and redesign**
- **Communicate sustainability issues and suggested improvements**
- **Present with a 5 min pitch on next Tuesday'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 Ioncell® sneakers
Materials: Ioncell® 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 redesign exercise, ideate improvements!

Produce a poster, upload to MyCourses

Prepare 5 min pitch talk (we split into 3 breakout rooms)

See you on Tuesday 9.15!

Thank you!