



Aalto University  
School of Arts, Design  
and Architecture

# Sustainable design S6

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# Agenda

9.15–9.45

**Sustainability assessment in design – Discussion & recap**

**Readings for the session**

9.45–10.30

**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***

11.30–11.50

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

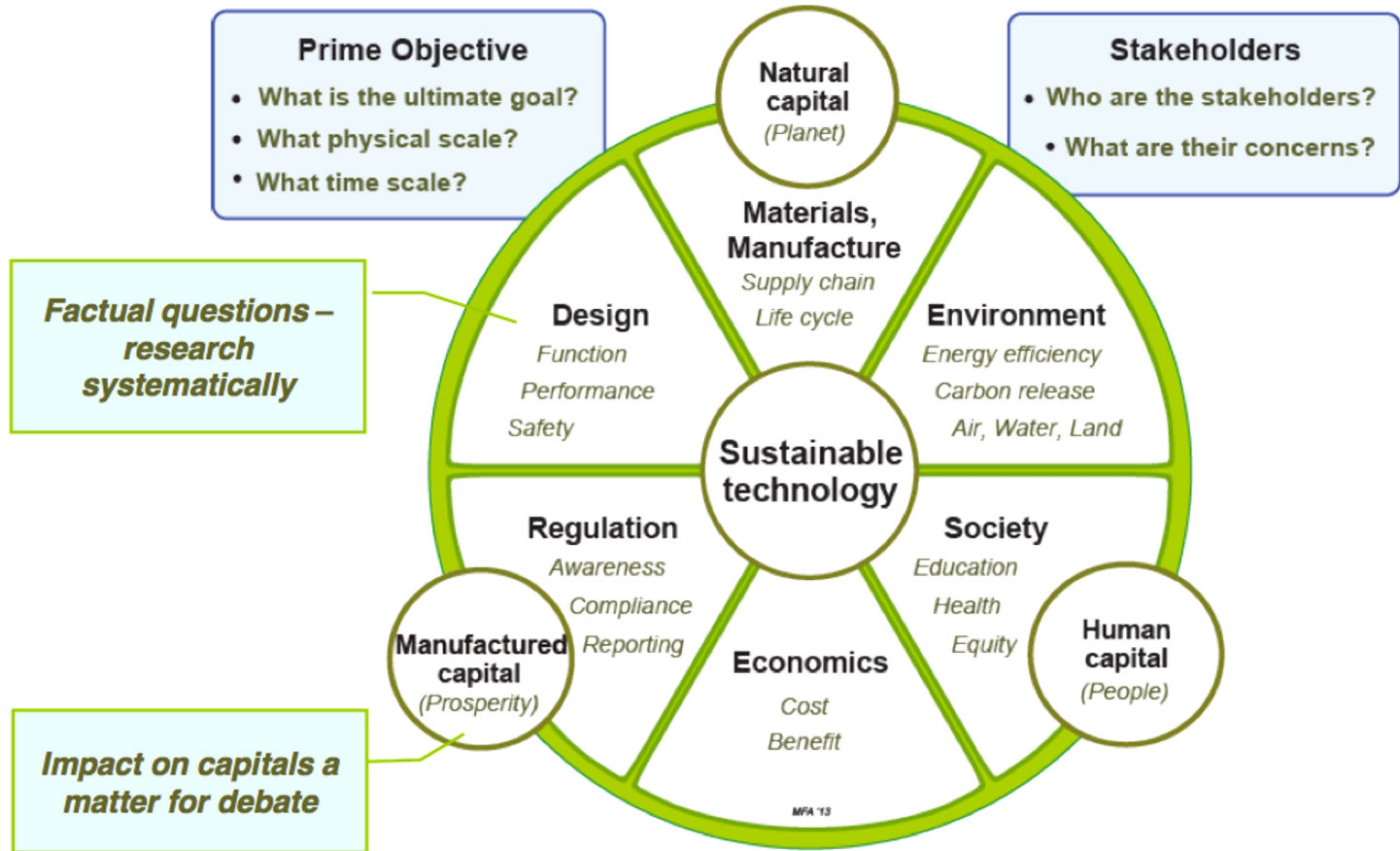
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# Sustainability assessment in design – a recap



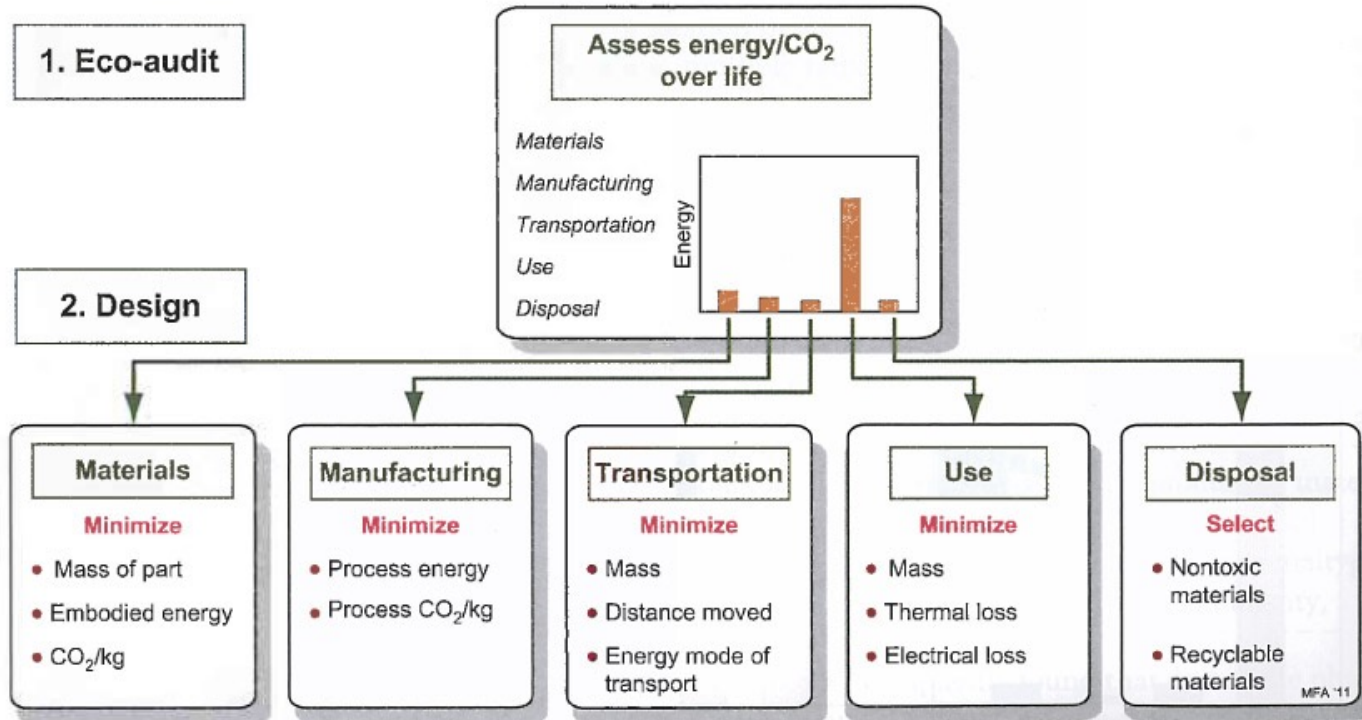
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# Sustainability assessment:



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

# Product level life-cycle assessment:



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

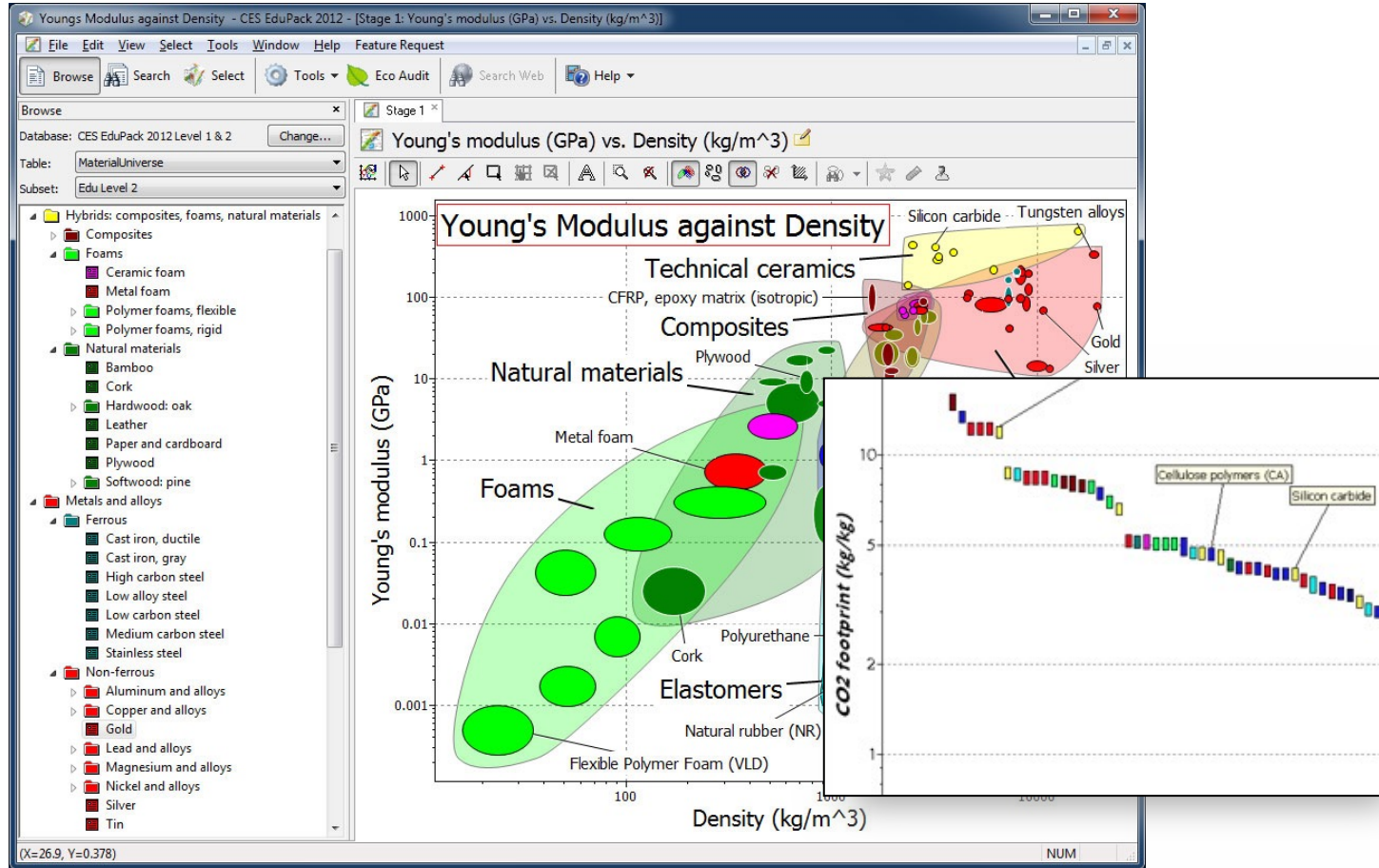
## Qualitative SLCA approach – MET matrix:

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

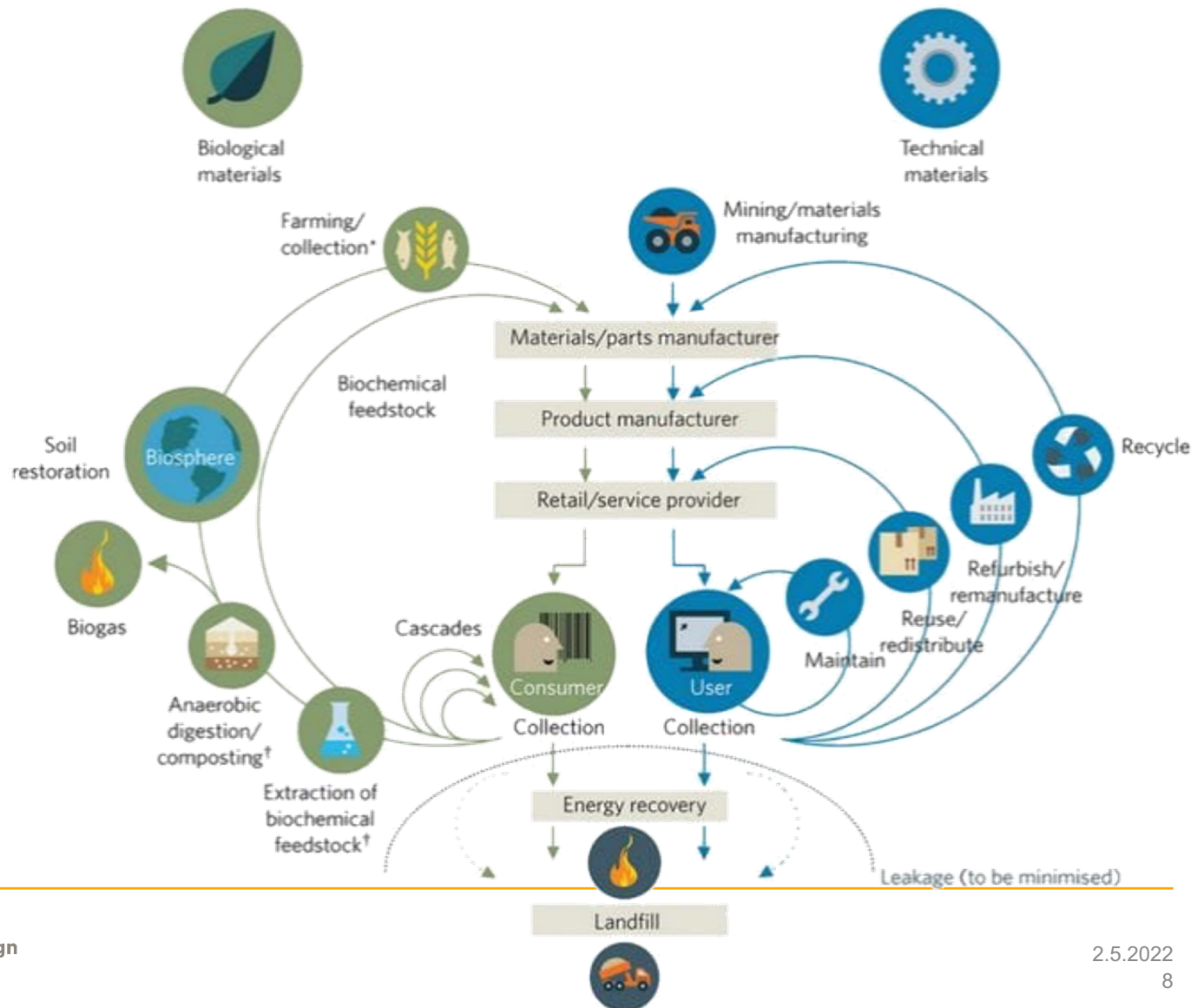
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# Quantitative data-driven approach:



**See session 5 slides for Granta Edupack intro...**

# Opportunities for design interventions:





# Readings for the session



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# Readings for this session

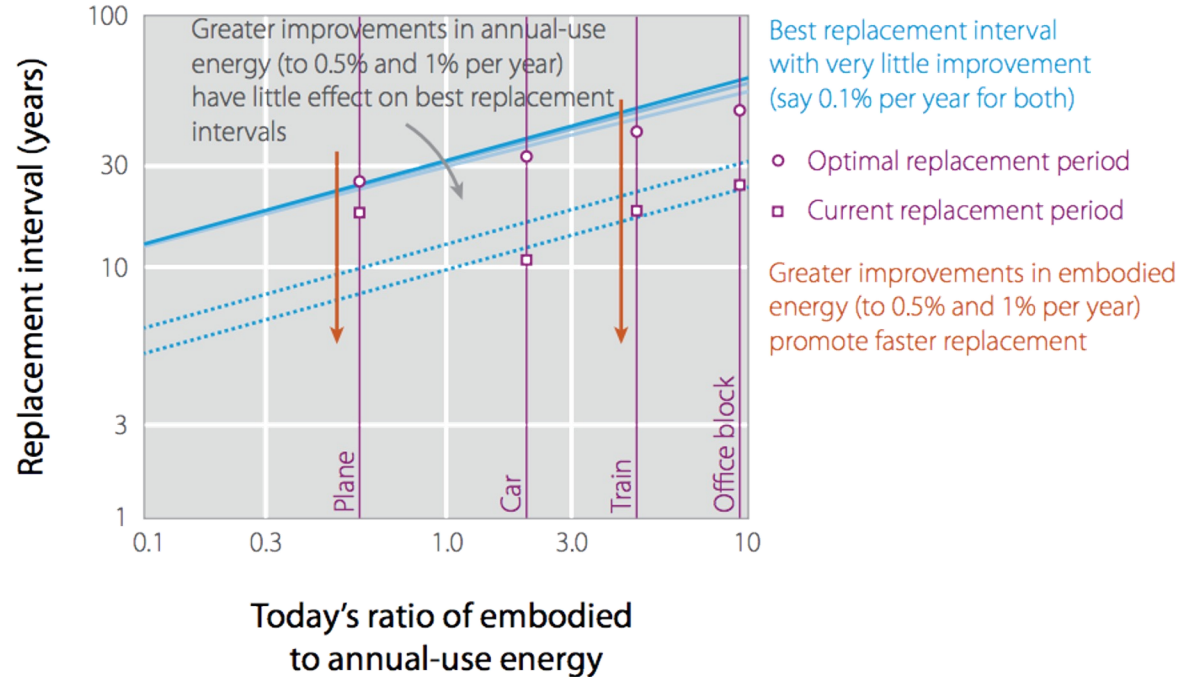
*Allwood, J., & Cullen, J. (2010). Sustainable Materials – with Both Eyes Open*

**Chapter 16: Longer life products**

**Chapter 17: Reducing final demand**

# Longer life products

## Potential to extend lifespan of products:



# Longer life products

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

Table 16.1—Types of failure

|  | ... relative to<br>when it was purchased | ... relative to<br>what's now available           |
|--|--|---|
| The product's performance has declined ... | <b>Degraded</b><br>e.g. rail track       | <b>Inferior</b><br>e.g. washing machines          |
| The product's value has declined ...       | <b>Unsuitable</b><br>e.g. sports car     | <b>Unwanted</b><br>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 ... | <b>Durability</b><br>when degraded     | <b>Upgrade</b><br>when inferior              |
| Has the product’s value declined ...       | <b>Cascade</b><br>when unsuitable      | <b>Design for recycling</b><br>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

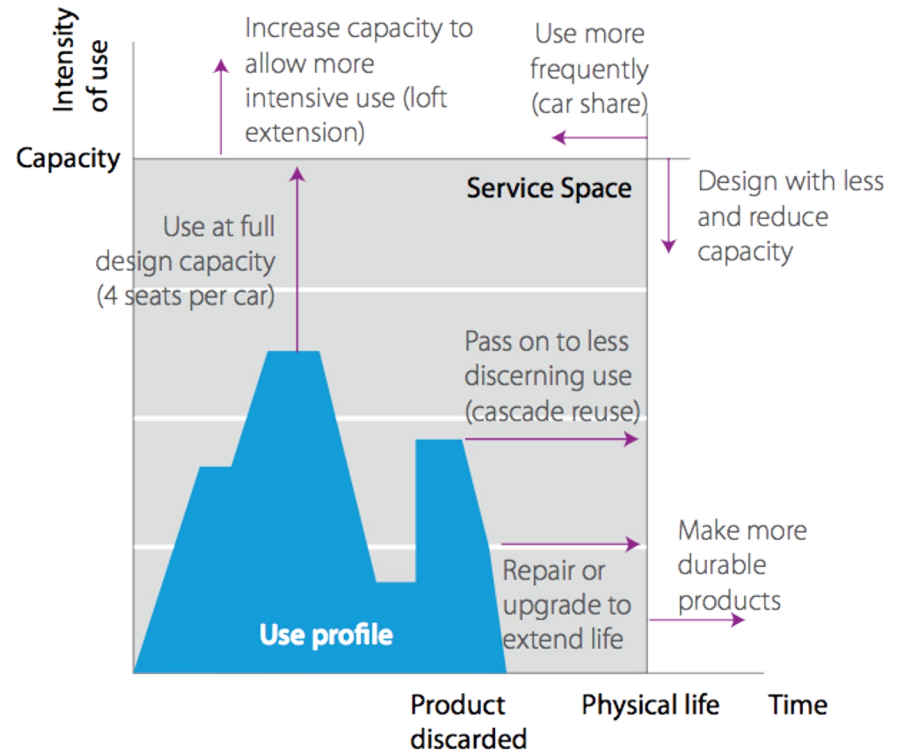


# Reducing demand

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?

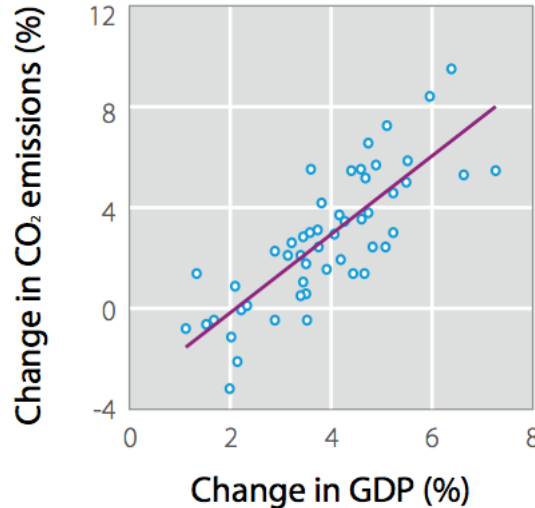


Figure 17.3—The relationship between emissions and GDP

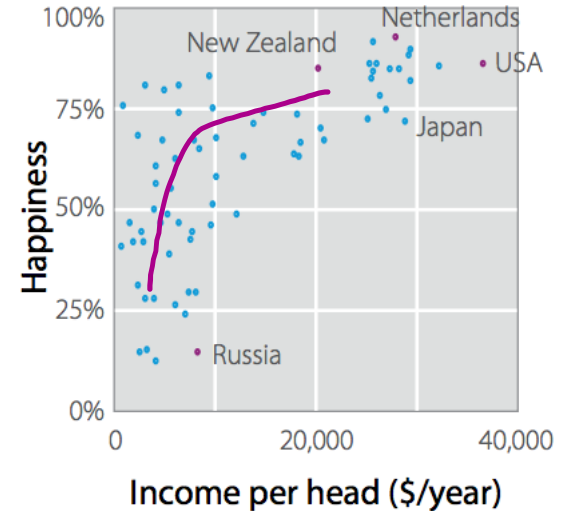


Figure 17.4—The relationship between GDP and happiness



# 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 next Tuesday with a poster**  
*(with text and images of existing product on left, and redesign on right; landscape layout!)*

**Reflection on assessment in learning diary after session 7!**

# Assessment and redesign exercise – grading

**Independent exercises form 30% of the overall course grade:**

- Assignment of meanings and messages (session 4) counts for 10% of the overall grade
- **Redesign assignment (for session 7) counts for 20% of the overall grade**

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

- 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?

# 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

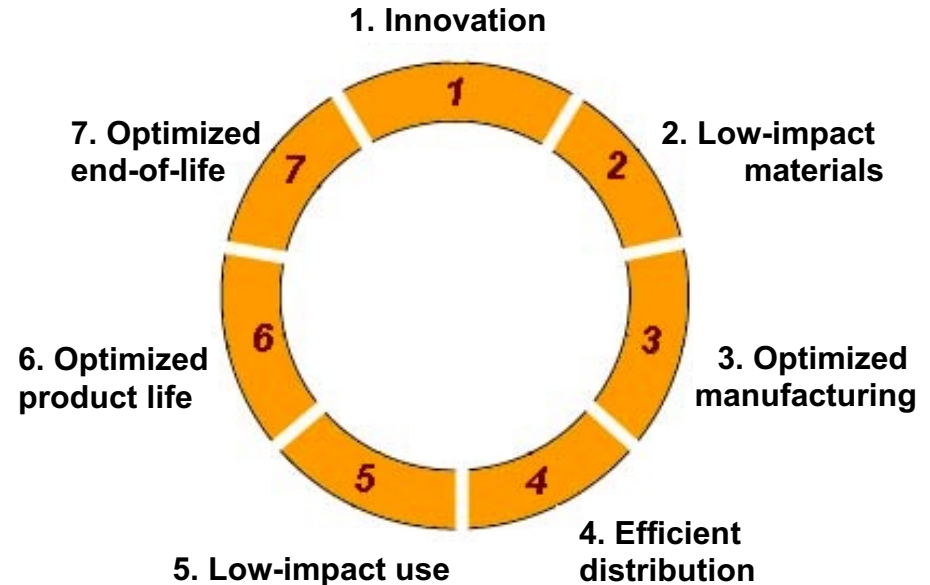
The **Ecodesign checklist** is a life-phase based checklist with questions that provides support for the analysis of a product's impact on the environment. It provides relevant questions that need to be asked when establishing environmental bottlenecks during the product life-cycle.

**See:**

**[http://wikid.io.tudelft.nl/WikID/index.php/EcoDesign\\_checklist](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

6. Optimized product life

3. Optimized manufacturing

4. Efficient distribution

5. Low-impact use

# 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 and redesign**
- **Communicate sustainability issues and suggested improvements**
- **Present with a 3-4 min pitch for 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 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 Tuesday (cut-off 8 am!)**

**Prepare 3-4 min pitch talk (stick to the timeframe!)**

**We will split into 3 classrooms in Otakaari 1: U121a, U250a, U262**  
(Check your group & classroom from MyCourses announcement after class!)

**See you on Tuesday 9.15!**

# Thank you!



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