

# Sustainable design

## *S10 Barriers and policies*

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# Readings for the session

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

Chapter 23: Business activity evaluation

Also discussed:

Chapter 24: The influence of policy

Chapter 25: The actions of individuals

# Where do you think change comes from? Driving forces of sustainability?

In Session 1, we looked at drivers of sustainability:

- Innovative business
- Consumers and value change
- Science and technology
- Regulation

# Business activity evaluation: Barriers to change

Material efficiency does  
not always pay

Standardization vs  
optimization

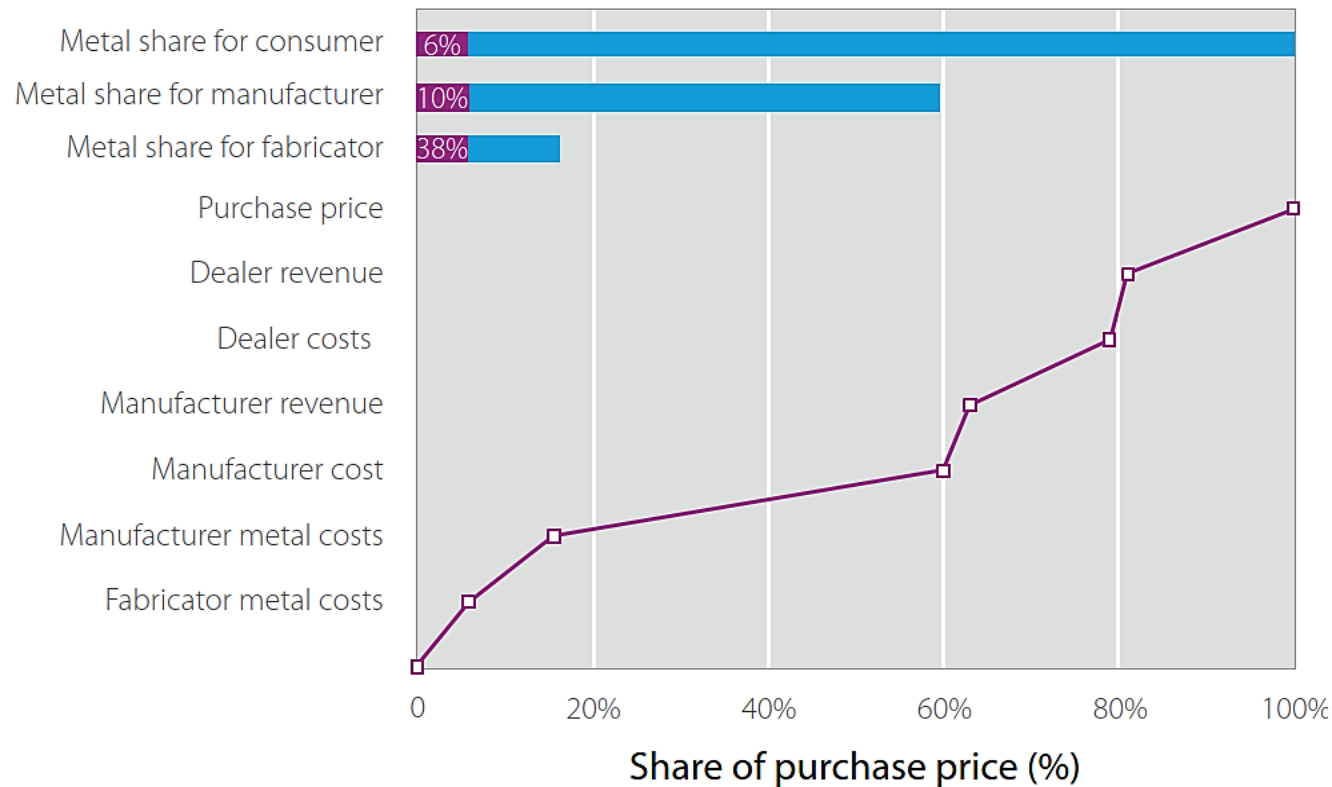
Evolution of the industry  
is path dependent

Risk aversion and  
imperfect information

Product sales vs service  
revenue

Consumer attitude to  
access vs value

# Barrier 1: Material efficiency does not always pay!



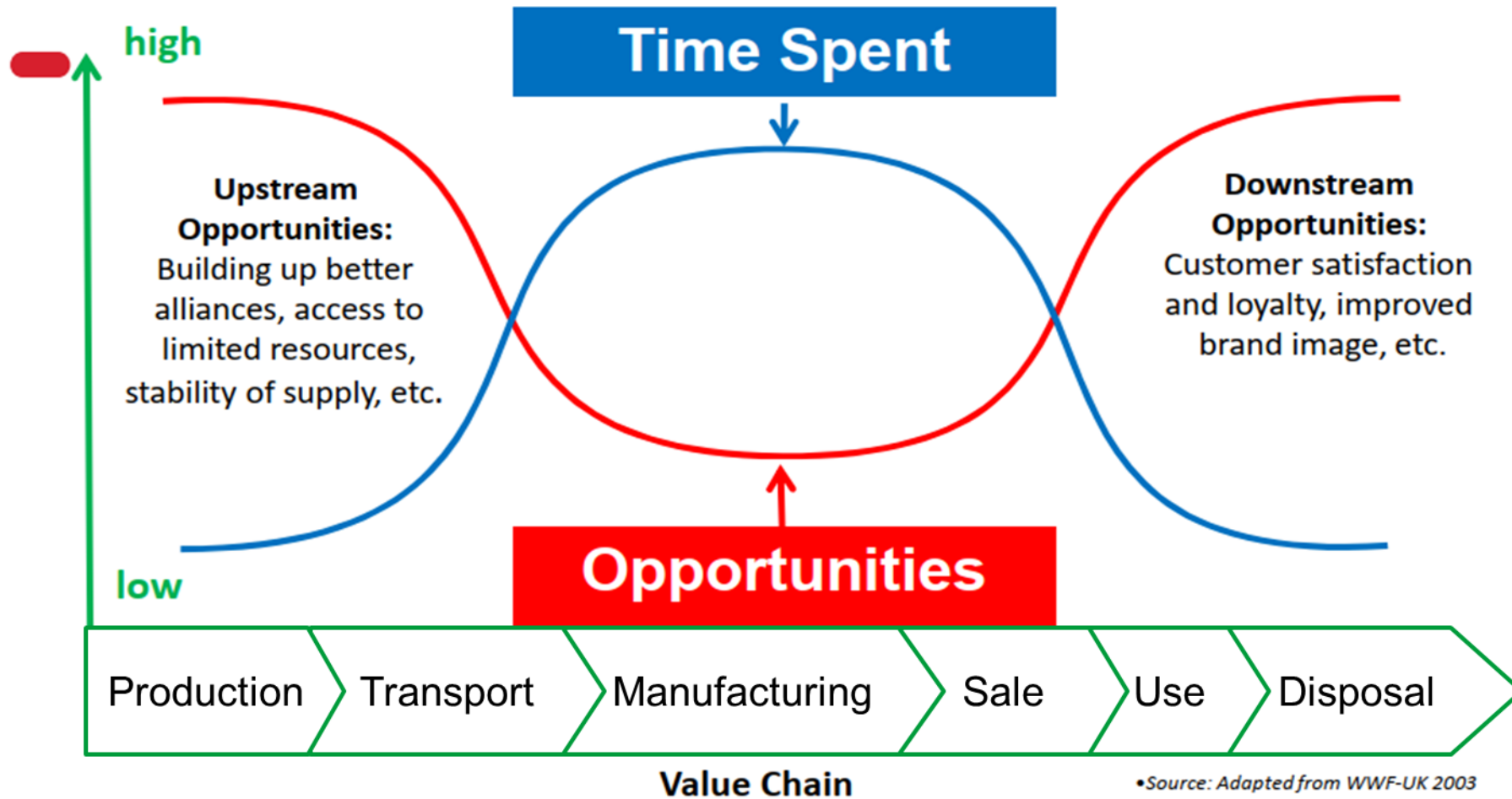
## Problem:

1. Material cost is only a fraction of the purchase price
2. For fabricator & manufacturer, labor costs outweigh material efficiency benefits

## Solution:

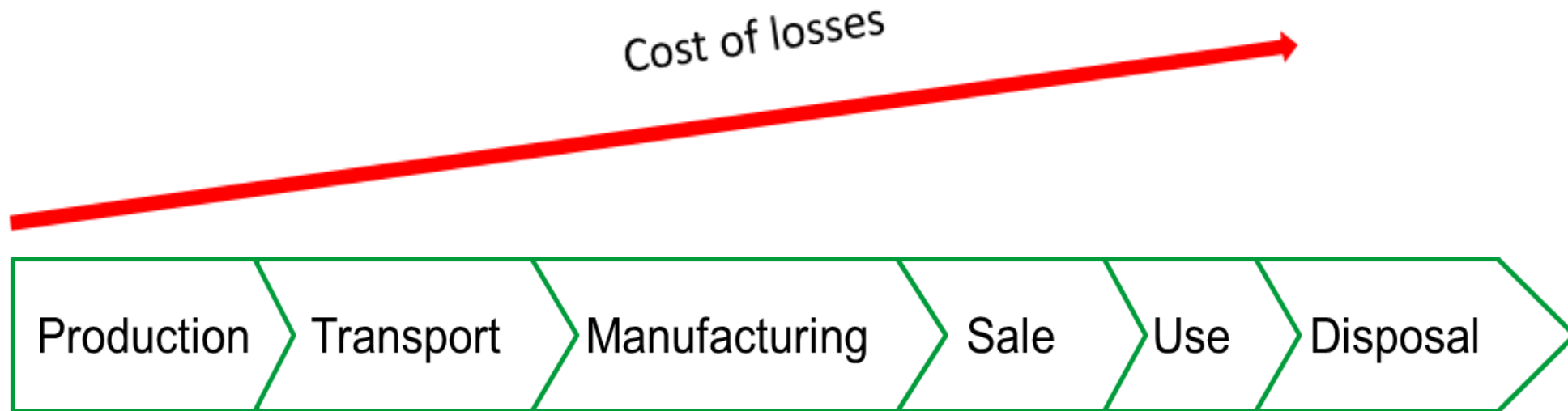
1. Regulatory pressure to improve efficiency through emission saving benefits

# Opportunities vs. time



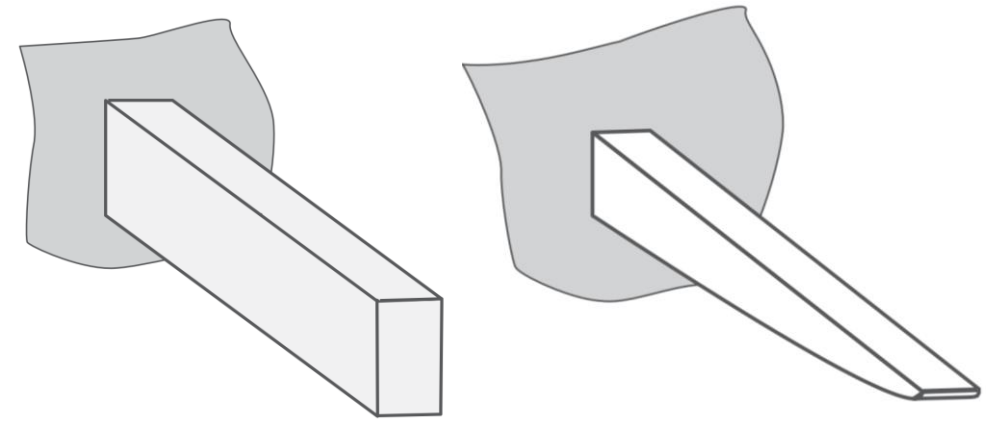
# Tracking the cost of resources

- The cost of losses increases along the value chain
- Eliminate the causes at the earlier stages
- Easier to recover production scrap than a damaged final product



# Barrier 2: Standardization vs optimization

- Standardization = Economies of scale
  - *High-volume products*
  - *Ease of production, handling storage and transport.*
  - *Downstream production is easy*
- Optimization = Make and use only what you need
- Problem: “Does using less metal now to make an optimized component, compromise our ability to adapt or use the component in future for a changed or different use?”
- Solution: Design for modularity with a combination of standardized and optimized components



Standard vs optimized beam (Source: Ch 12)



# Role of Design



## STEP 01

### Design for assembly & disassembly

Parts consolidation, modularization, combination, appropriate fastening methods

### Design for reuse, remanufacture & recycling

Optimized dismantling of products, ease of extending life

### Manufacturing method selection

Environmentally friendly production with reduced material waste, promote reuse



## STEP 02

### Design for service & maintenance

Easier servicing of parts, environmentally friendly tools, methods & consumables during servicing



## STEP 03

### Material identification & selection

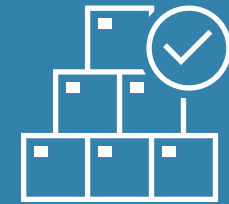
Visibly identify materials, e.g., recycled polypropylene, easily recyclable materials, eco-friendly materials



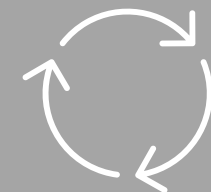
## STEP 04

### Design for longevity

Develop products that last longer, more efficient use of products



## STEP 05



## STEP 06

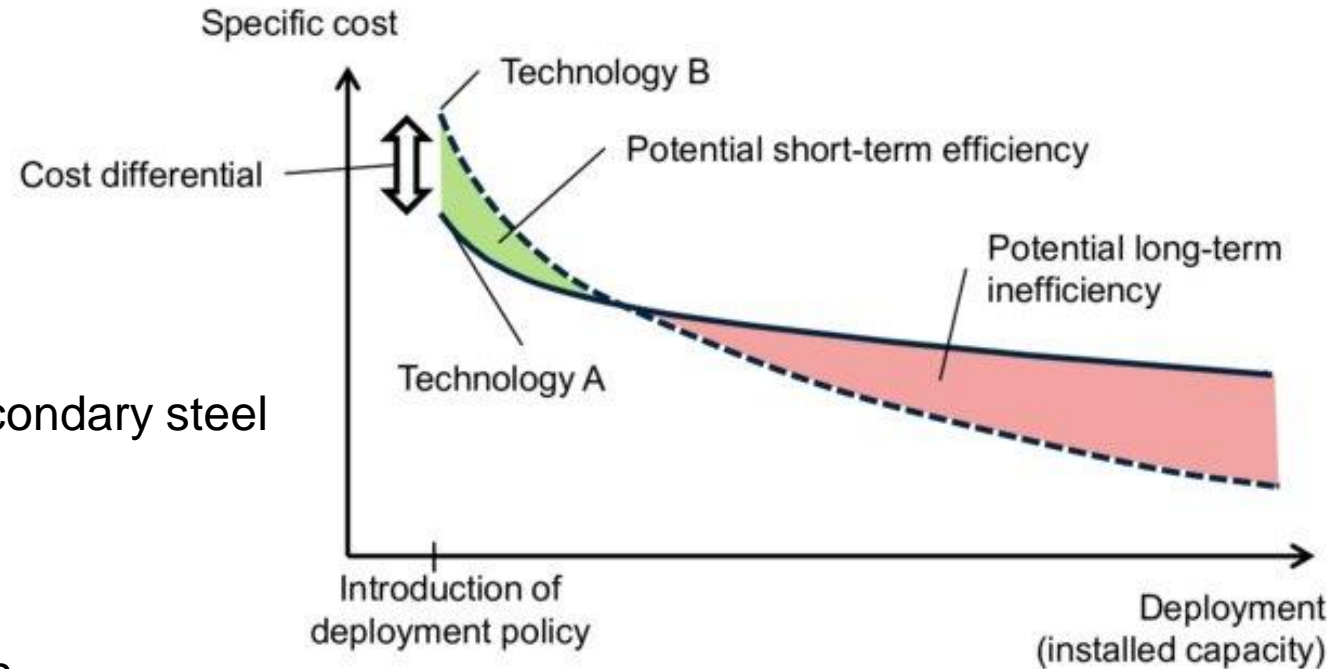
# Barrier 3: Evolution of the industry is path dependent

Problem: No one likes 'Disruptive technology'

- Disruption leads to job loss, IPR issues
- Look at standardization vs optimization
- Small-scale change vs large scale disruption
- Ex: Reluctance of primary steel producers to secondary steel production despite available technology

Solution:

- Regulatory interventions to enforce new practices
- Life cycle thinking & impact assessments



Risk of technology lock in  
(Source: [Schmidt et al. 2016](#))

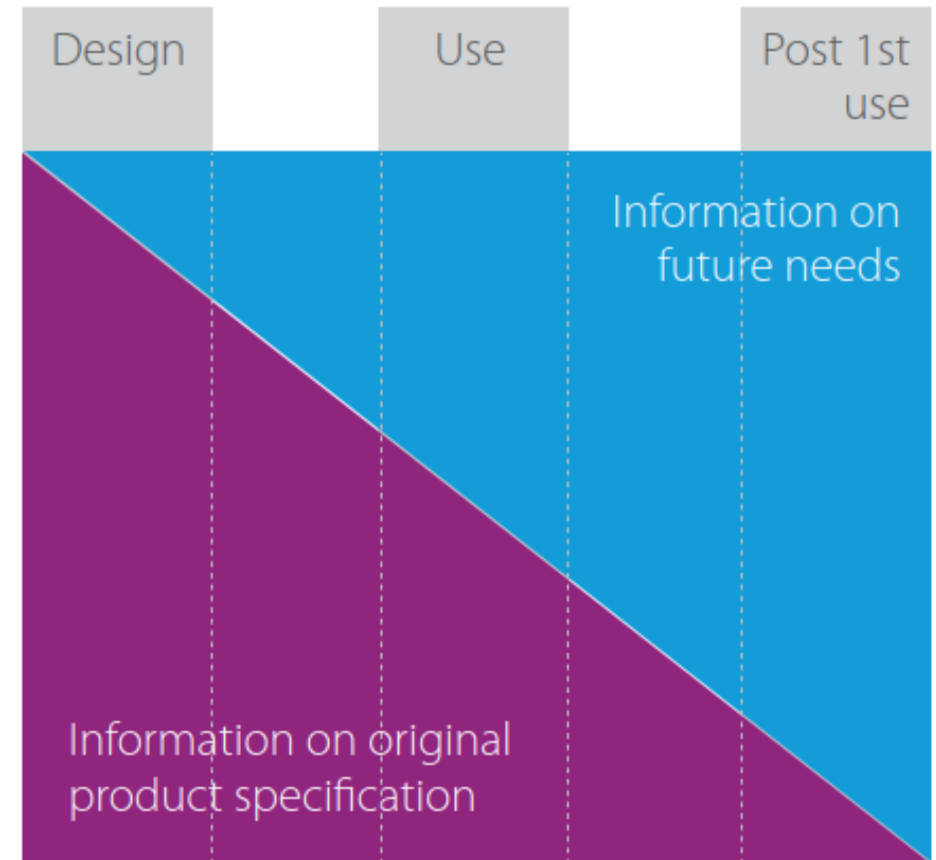
# Barrier 4: Risk aversion and imperfect information

## Problem:

1. Overdesign due to safety concerns and fear of penalties
2. Lack of information on future use and product composition for optimal design

## Solution:

- Better communication between makers and commissioners and insurers



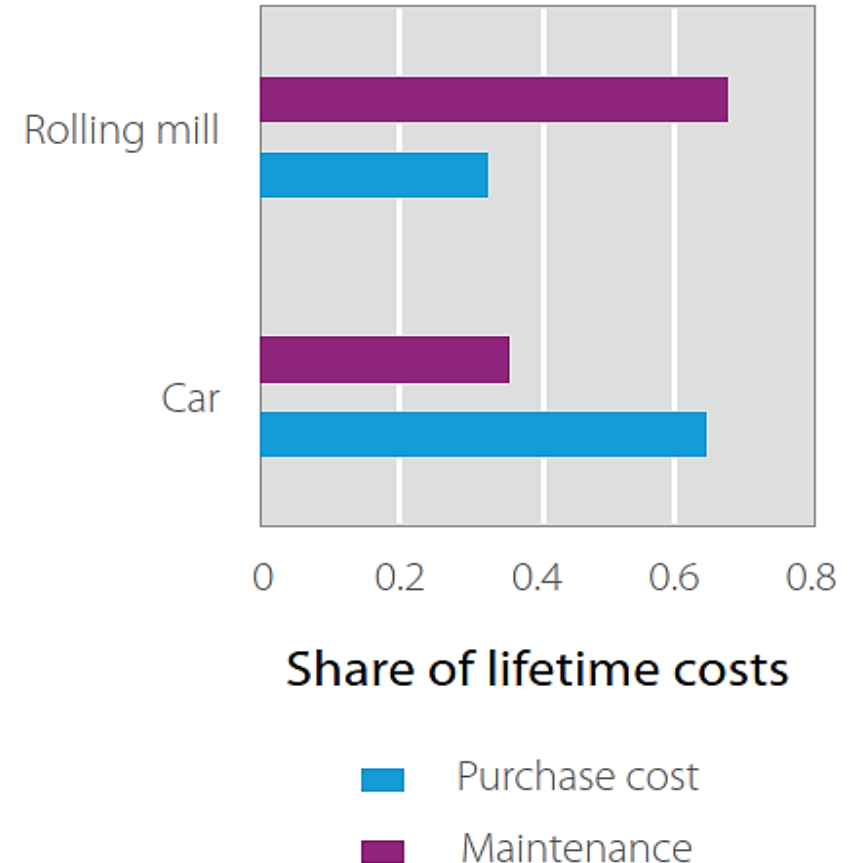
# Barrier 5: Focus on product sales and not service revenue

## Problem:

- Business models are focused on sales not service so increased material use rather than longer product life

## Solution:

- Explore better service providing models and build customer relationship



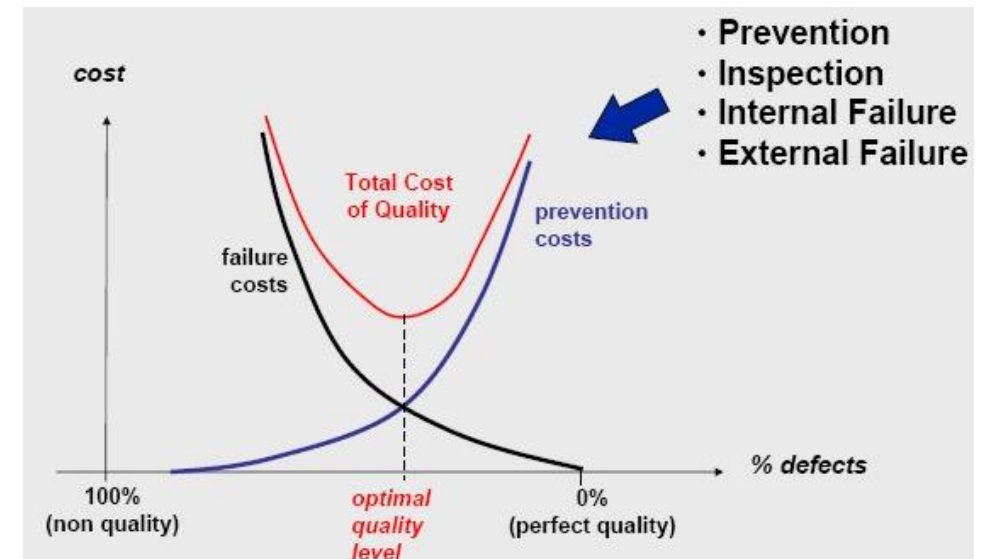
# Barrier 6: Consumer attitude to access vs value

## Problem:

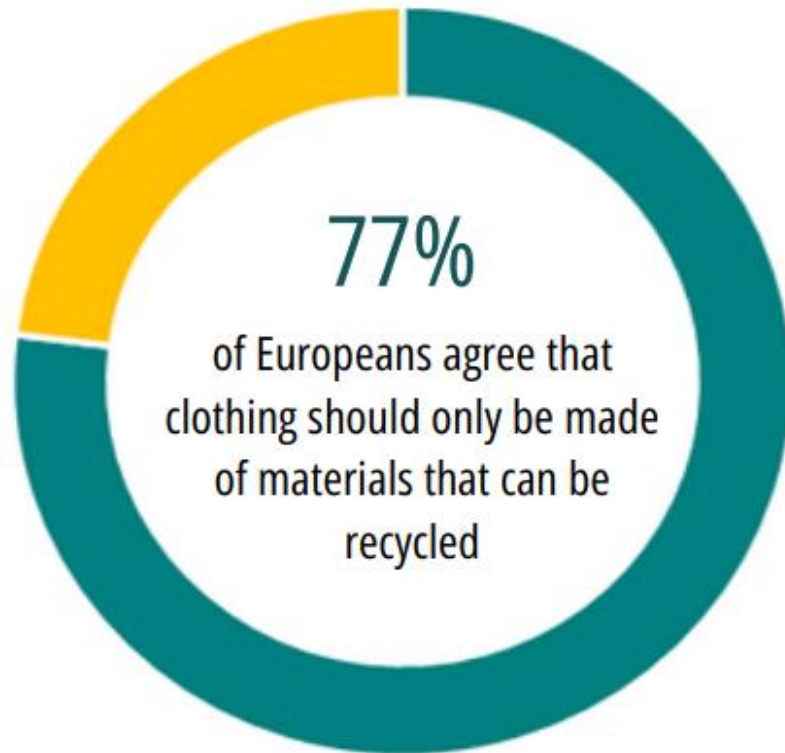
- Consumers demand products with higher safety limits than needed
- Quick payback of short-lived products overtakes the benefits of buying longer lasting products

## Solution:

- Increased transparency in emissions and material impacts, better products at competitive prices



# Consumers as drivers of sustainability



Survey of 27,000 people in the EU Member States in 2022 [\[↗\]](#)

# Finnish consumer attitudes to reuse

Extended producer responsibility

Opinion, whose responsibility is it to organize reuse of the following products and services?

	Retailers	Specialized companies	Third sector	Public sector	Mine	Total %
Food	22	10	12	12	44	100
Housing	21	14	1	11	53	100
Transportation	11	40	1	34	14	100
Consumer electronics	53	29	1	4	12	100
Average	26.75	23.25	3.75	15.25	30.75	

What would be your preferred way to extend the lifespan of the following products and services?

	Service	Third sector	Public sector	Do it myself	Total %
Food	4	15	10	71	100
Housing	53	2	3	42	100
Transportation	57	1	25	17	100
Consumer electronics	75	5	4	16	100
Average	47.25	5.75	10.5	36.5	

What is your preferred way to obtain the following products and services?

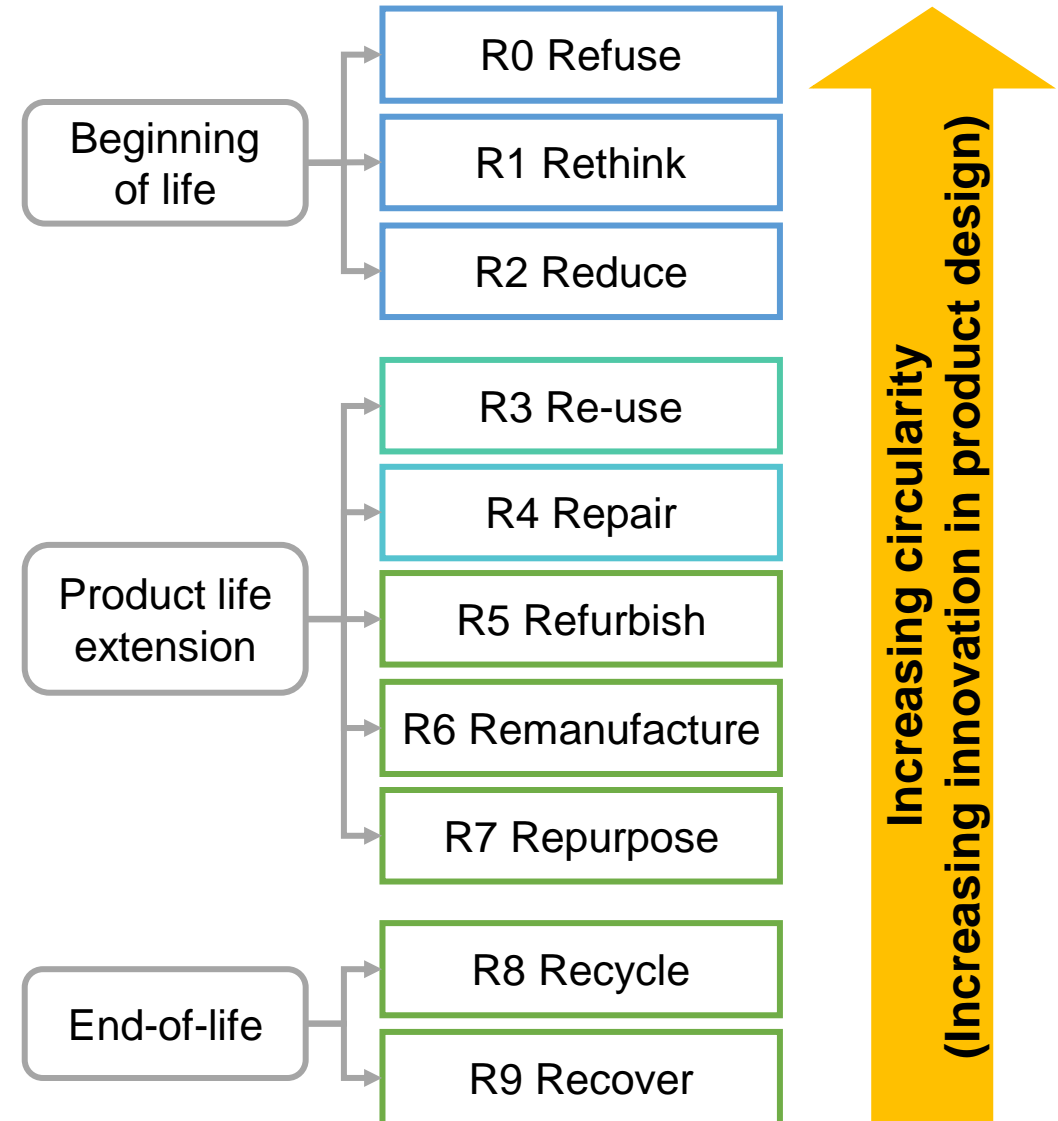
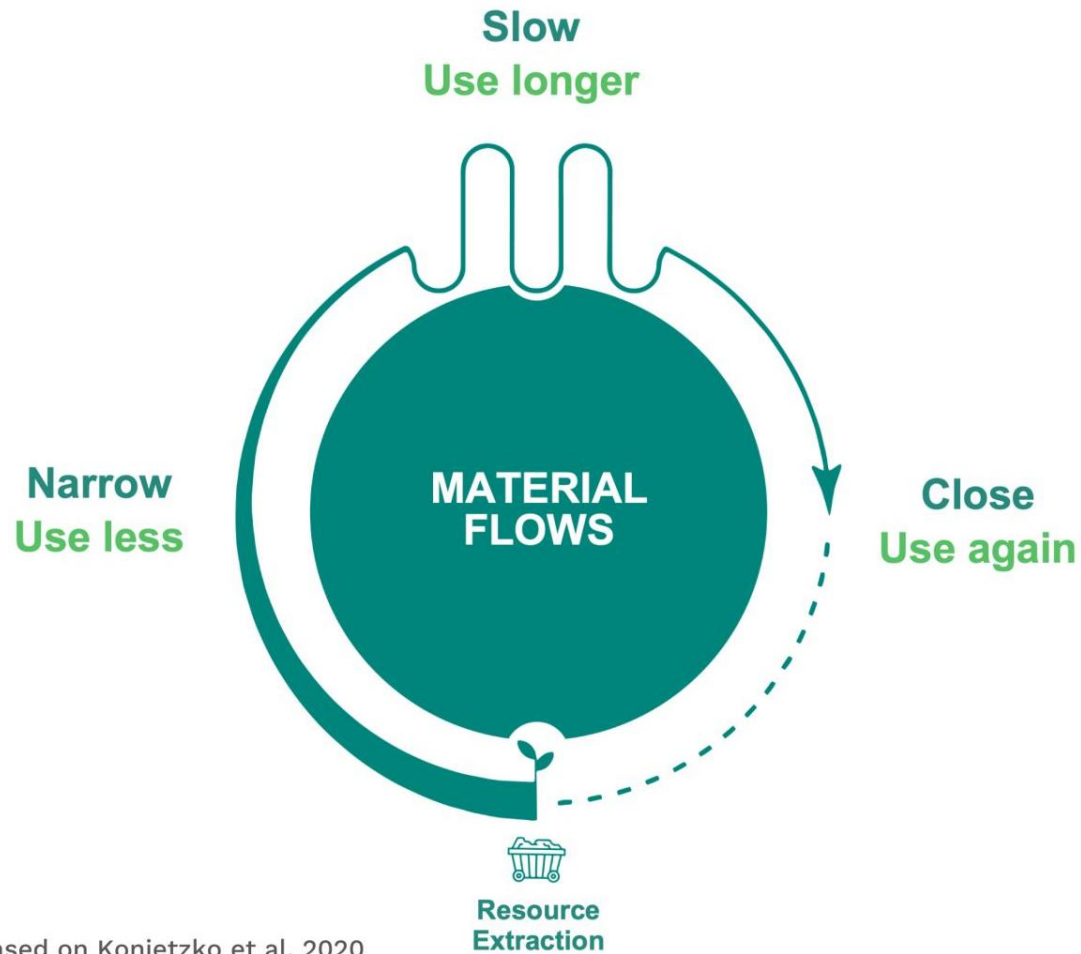
	Service	Buy as used	Joint purchase	Buy as new	Public service	Total %
Food	3	17	4	71	6	100
Housing	33	29	2	34	3	100
Transportation	7	35	5	23	31	100
Consumer electronics	2	10	2	84	2	100
Average	11.25	22.75	3.25	53.0	10.5	

Cells with bolded figures were removed from the analyses.

A!



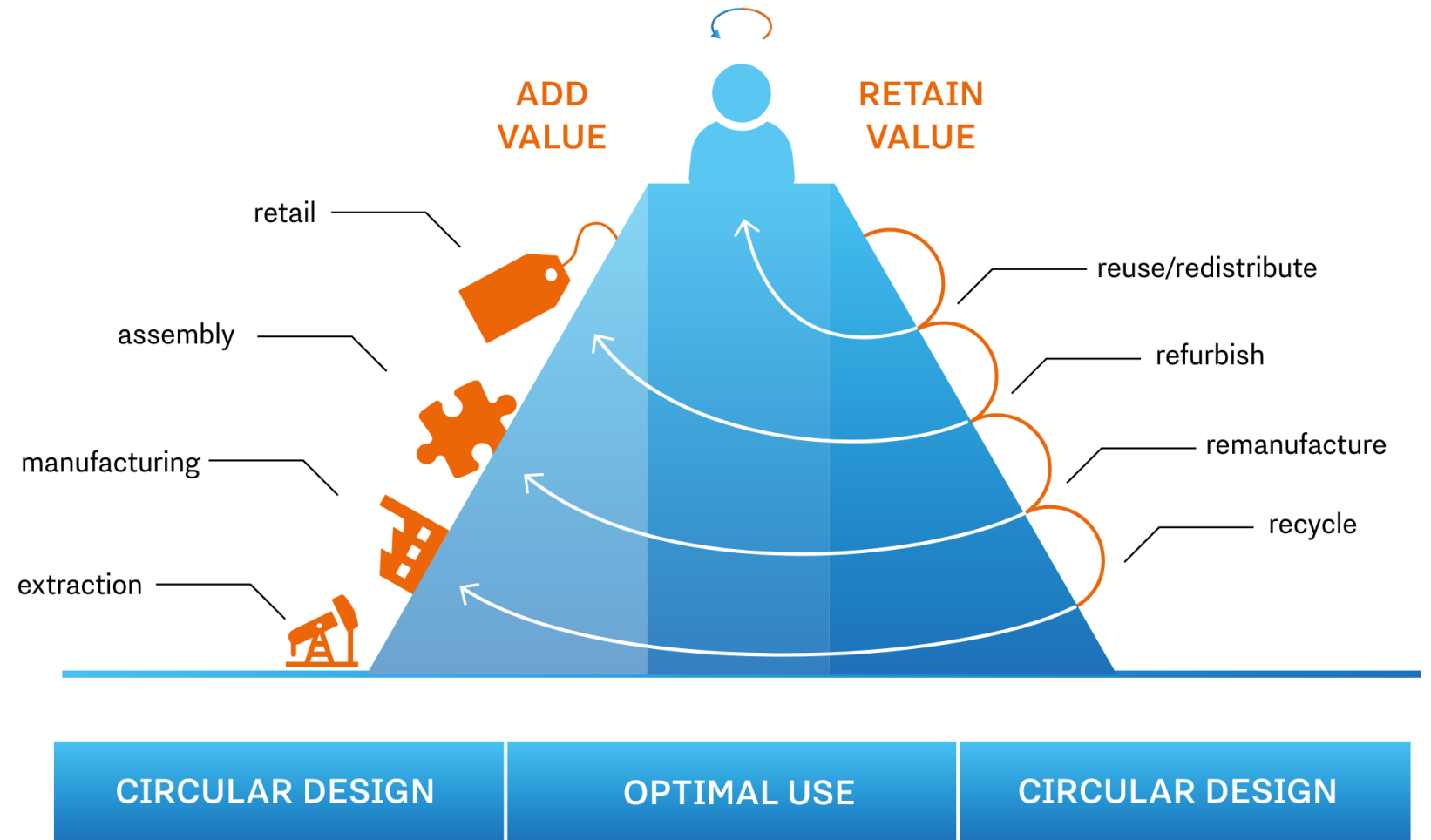
# Role of circular economy in business models



Source: Based on Konietzko et al. 2020



# Circular economy in practice



## CIRCULAR DESIGN

Design products and materials with the aim of long term value retention:  
 Product Design,  
 Circular Materials,  
 Classic Long Life,  
 Encourage Sufficiency

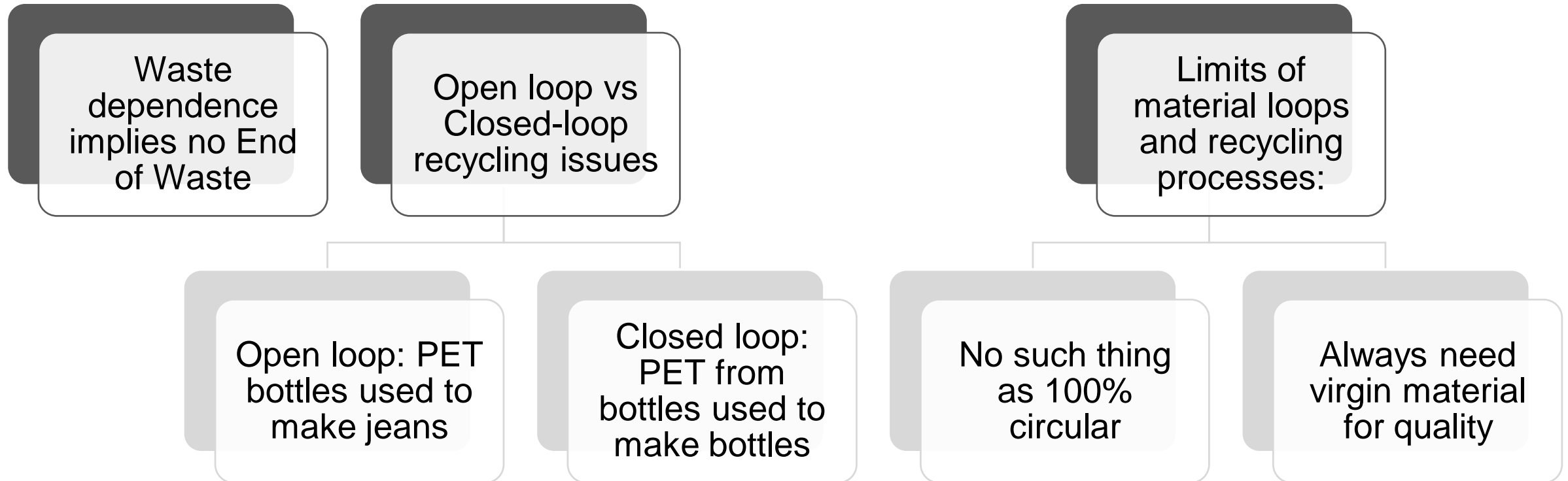
## OPTIMAL USE

Support better usage and product productivity:  
 Product as a Service,  
 Life Extension, sharing  
 Platforms, Sell and buy  
 back, Repair &  
 Maintenance Service

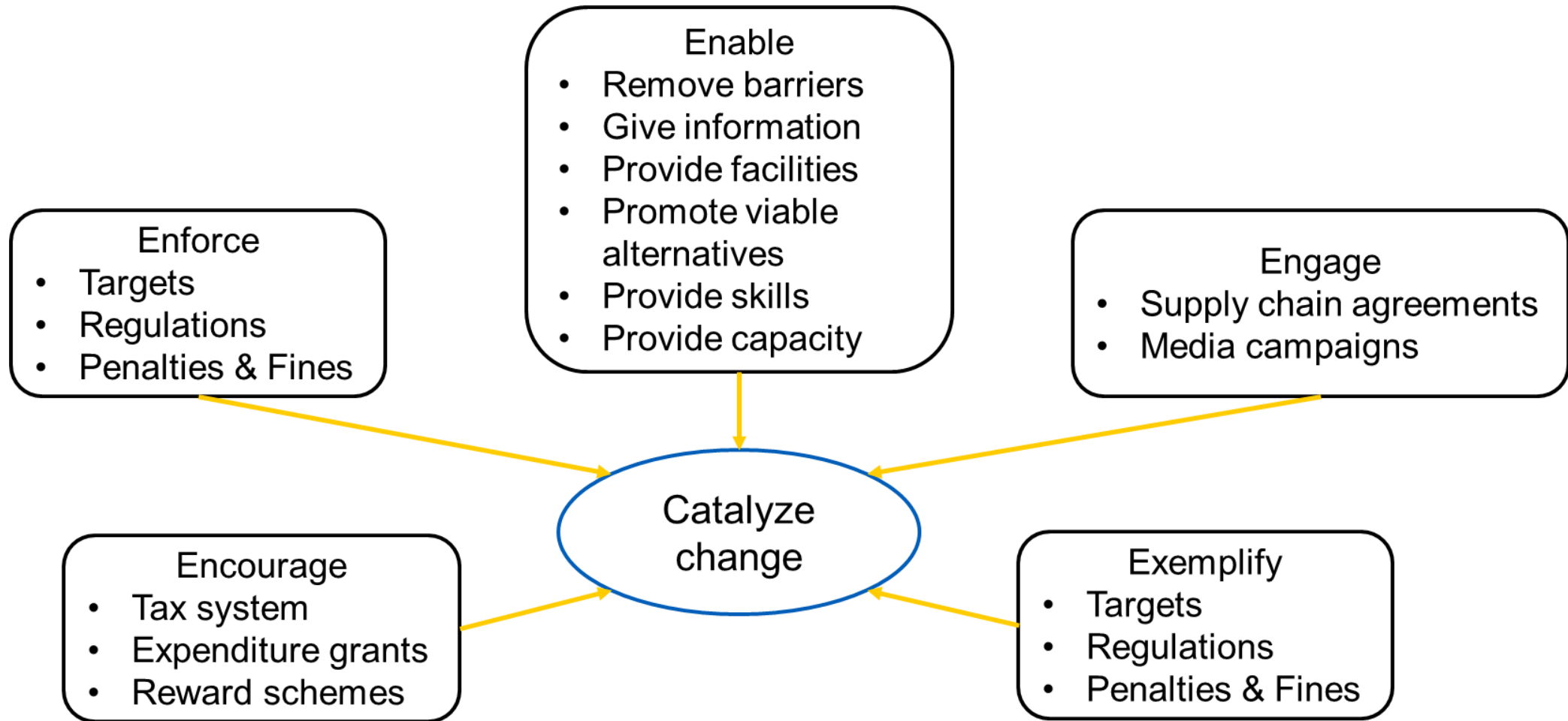
## CIRCULAR DESIGN

Capture value after user life:  
 2nd hand seller,  
 Refurbisher,  
 Recycler,  
 Recaptured material  
 supplier

# Challenges of circular business models



# Making policies work for our goals



# Making policies work for our goals

- **Enforce**

- Emission reduction targets should consider embodied emissions. Ex: 'Zero carbon' houses
- Waste policy should be directed towards minimizing embodied energy losses. Ex: recycle vs reuse
- Health and safety legislation should not prevent material efficiency. Ex: Overall risk analysis
- Product durability standards should be considered. Ex: Eco-design

- **Encourage**

- The tax system should encourage material efficiency. Ex: Tax on disposable products
- Material efficiency should be rewarded in voluntary eco-standards. Ex: Steel quality certificate

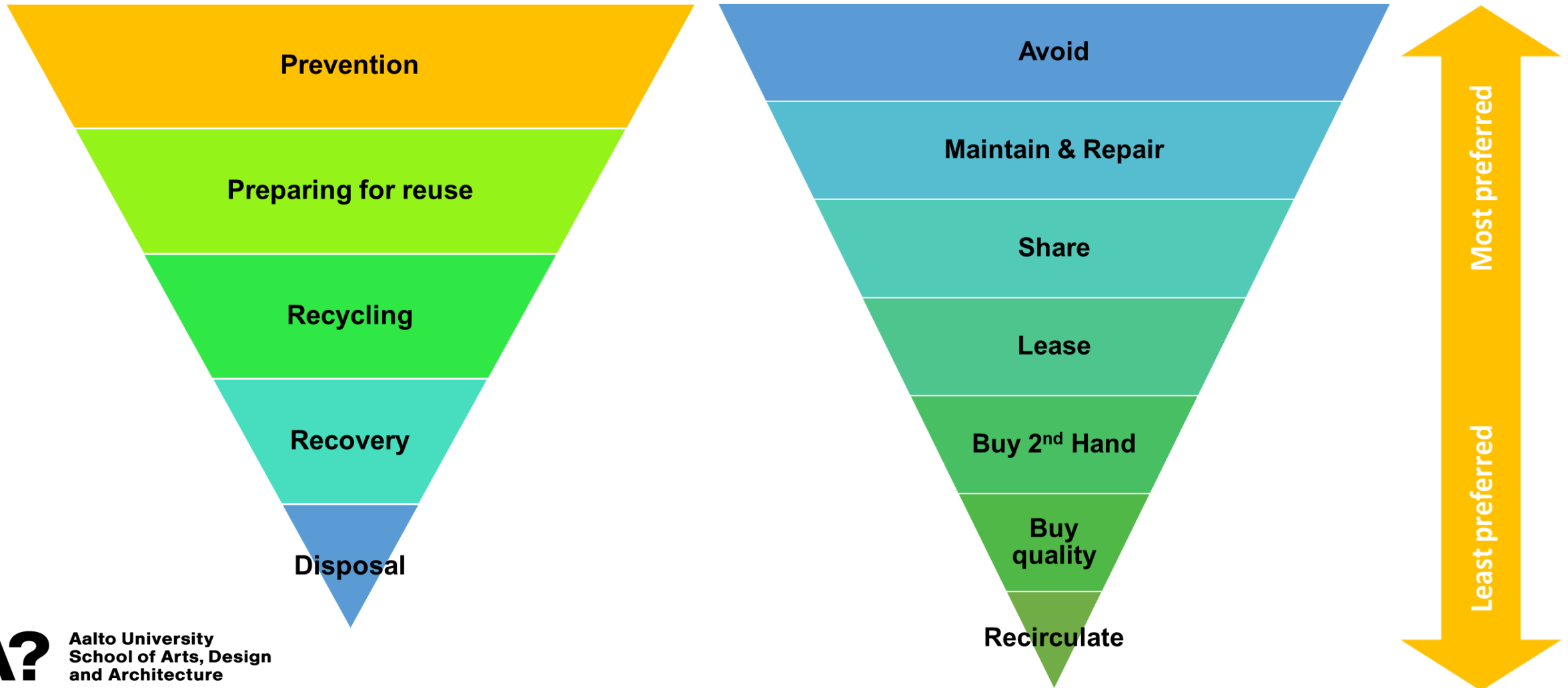
- **Enable**

- Government should promote meaningful data collection on material efficiency. Ex: LCA
- Government should provide greater clarity on requirements or reuse. Ex: Digital product passport

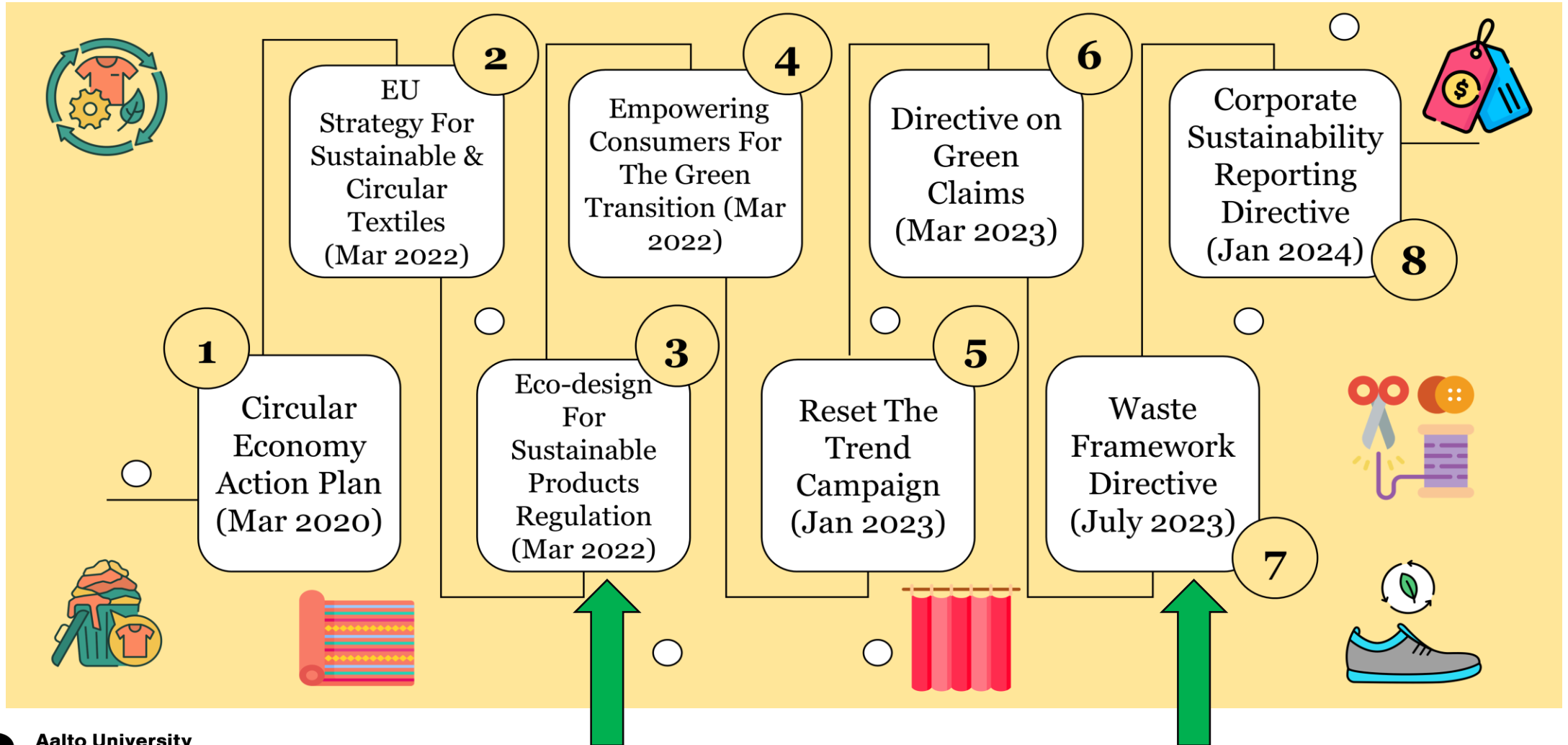
# Making policies work for our goals

- **Exemplify**
  - Government procurement can be used to promote material efficiency through their purchasing choice to demonstrate good practices.
- **Engage**
  - Raise consumer awareness of embodied energy.

# Waste hierarchy for industries & consumers

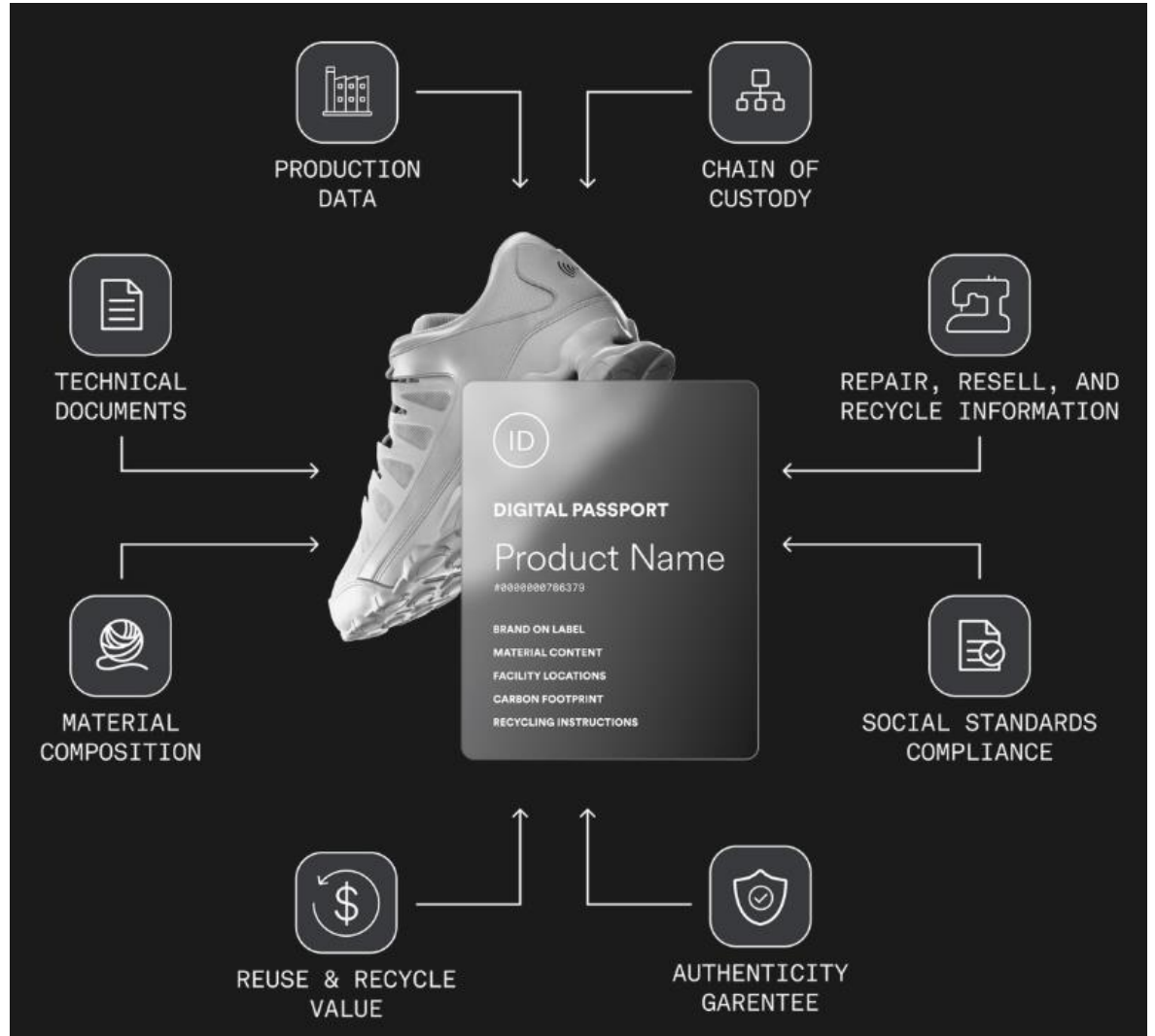


# EU policy timeline for textile industry



# Digital product passport

- **Make all information available to user**
- The EU Strategy for Sustainable and Circular Textiles (March 2022)
- Eco-design for Sustainable Products Regulation to define requirements by 2024.
- DPPs become mandatory by 2030.





# Waste framework directive (EPR)

**Extended Producer Responsibility (EPR)** puts responsibility on producers to bear the cost of waste management. Ex: Batteries, e-waste, packaging, tires

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## • Benefits

- Economic instrument to stimulate better design to reduce costs
- Obliges producers to take responsibility for the end-of-life phase

## Challenges

- Only applicable with specific country. Cross-border secondhand market is not included
- Focusses only on loss of value rather than value retention
- No consultation with economic actors who resell, repair, refurbish, or recycle products
- Does not address 'bad design'

# What can individuals do?

As a consumer  
thinking about  
buying...



- Building & infrastructure: Use an existing building, reduce use-phase energy, re-use construction materials, design for disassembly, keep it modular, prevent excess material use, choose long lasting parts for insides, repair damages in time.
- Industrial equipment: Include maintenance, operating and future replacement costs in mind, choose a modular design (onion skin model)
- Consumer goods: Cars should have lowest fuel use and embodied energy with easy maintenance. Appliances should be bought with long term requirements in mind with guarantees. Packaging should be reusable or easy to recycle
- **Before buying/ discarding consider repair, reuse (resell), disassemble and reuse, recycle**

# What can individuals do?

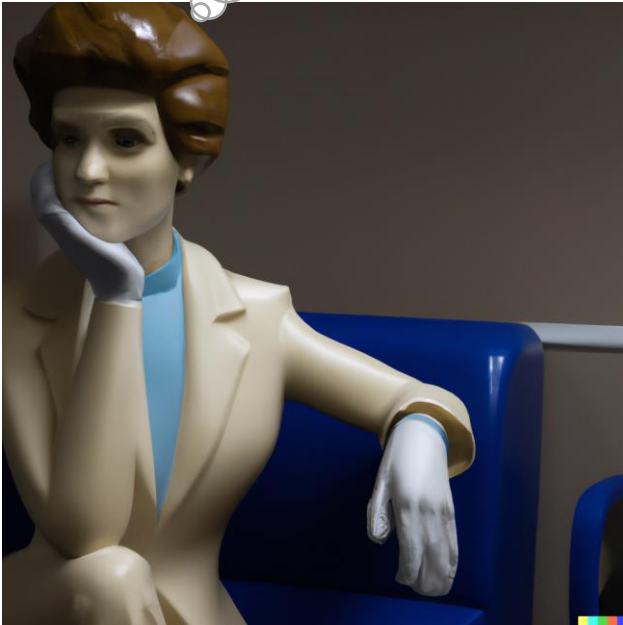
While working in  
manufacturing /  
product design...



- Try to reduce the material costs, embodied emissions, yield losses.
- Optimize quality for suitable lifespan.
- Shorter-lived components should be separable from long-lived structural components.
- Ensure disassembly at the end of life to reuse or recycle components.
- Segregate metal waste for reuse and recycling.
- Document the product's specification and guidelines for maintenance.
- Explore buy-back contracts.

# What can individuals do?

As an employee in  
the...



- Industry: Promote efficient processes, and heat recovery options. Recover and reuse metals, concrete, paper, plastics. Explore novel process development. Offer reuse certification where possible.
- Insurance sector: Offer risk assessments for investing in new processes, reusing products/ appliances
- Marketing & advertising: Build customer trust by transparent reporting
- Retail: Work with suppliers to put durability labels on products. Collection mechanisms for packaging, promoting durable & reusable products.
- Education: Teach about sustainability, evaluate claims, develop new technologies

# Design for sustainability and SDGs



Designing for sustainable agriculture



Designing for health & well-being



Designing for resource efficiency



Designing for inclusivity



Designing for water conservation

# Takeaways

- Business are facing many barriers in promoting more sustainability but there are also many opportunities.
- Consumers can demand sustainability through access to better information
- Circular economy is an emerging business model to address both material use and sustainability
- Governments can both enforce and enable industries to bring a change. EPR and Digital passports.
- But it all starts with better design: Design for redesign, disassembly, multiple users, etc.

# Thank you!

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# Write the drivers and opportunities for your material...

- **Open the link provided:**  
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- **Discuss with your group for 30 minutes**

