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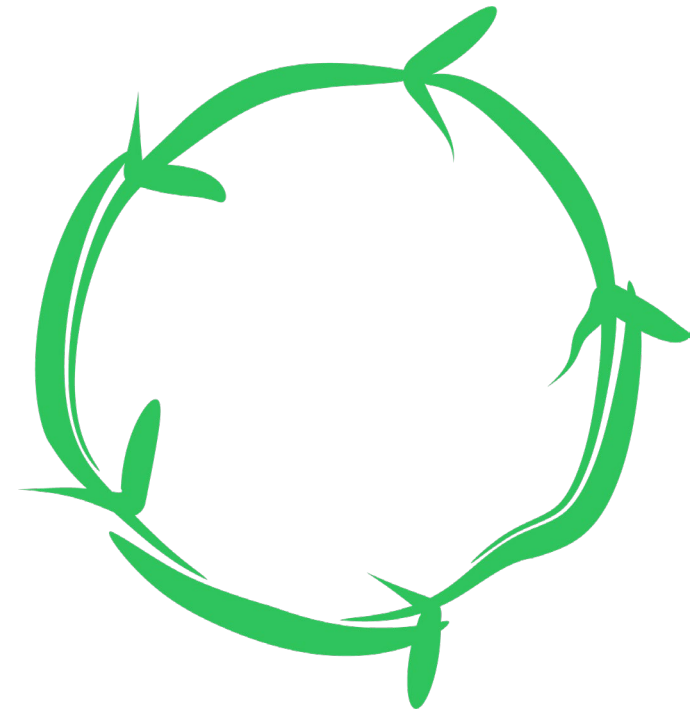
# Circular economy & evaluation of packaging sustainability

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# In this lesson you will learn about

- Principles of circular economy
- Sustainable development and the role of packaging in it
- Role of packaging logistics role in circular economy and sustainability



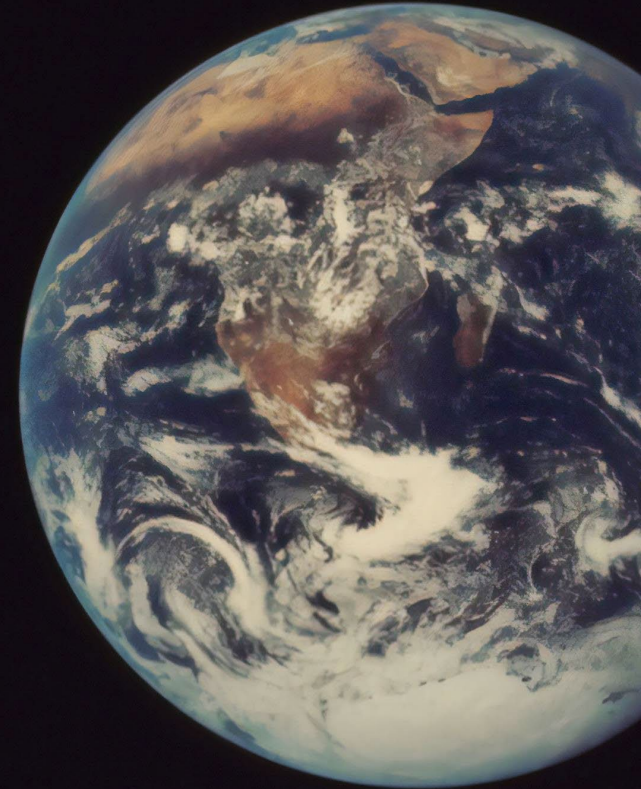
# Why do we focus on circular economy?

## Problems:

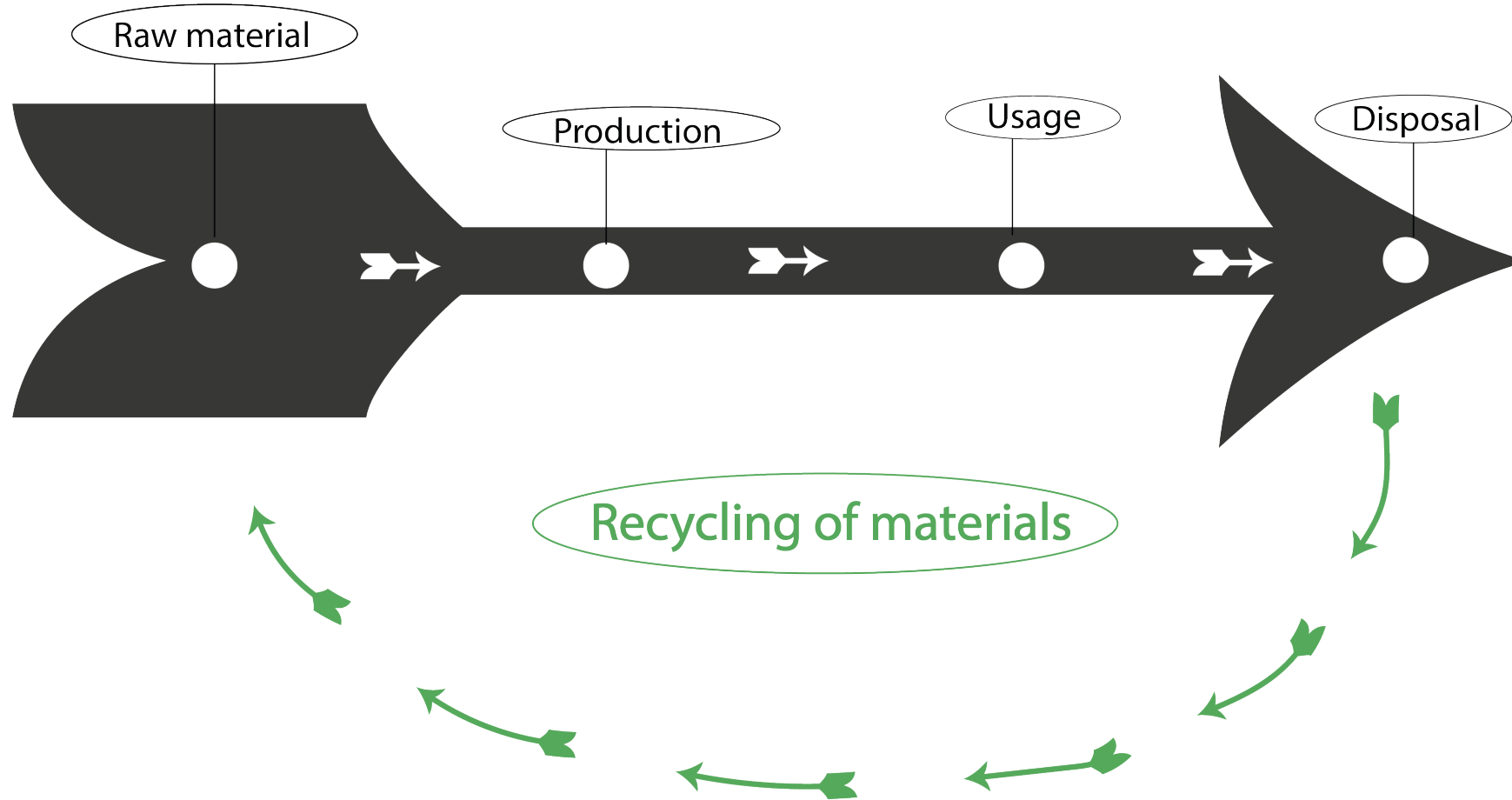
- Global warming
- Lack of raw materials
- Lack of clean water and food
- Need to get rid of oil-dependency
- Population growth

## Solution:

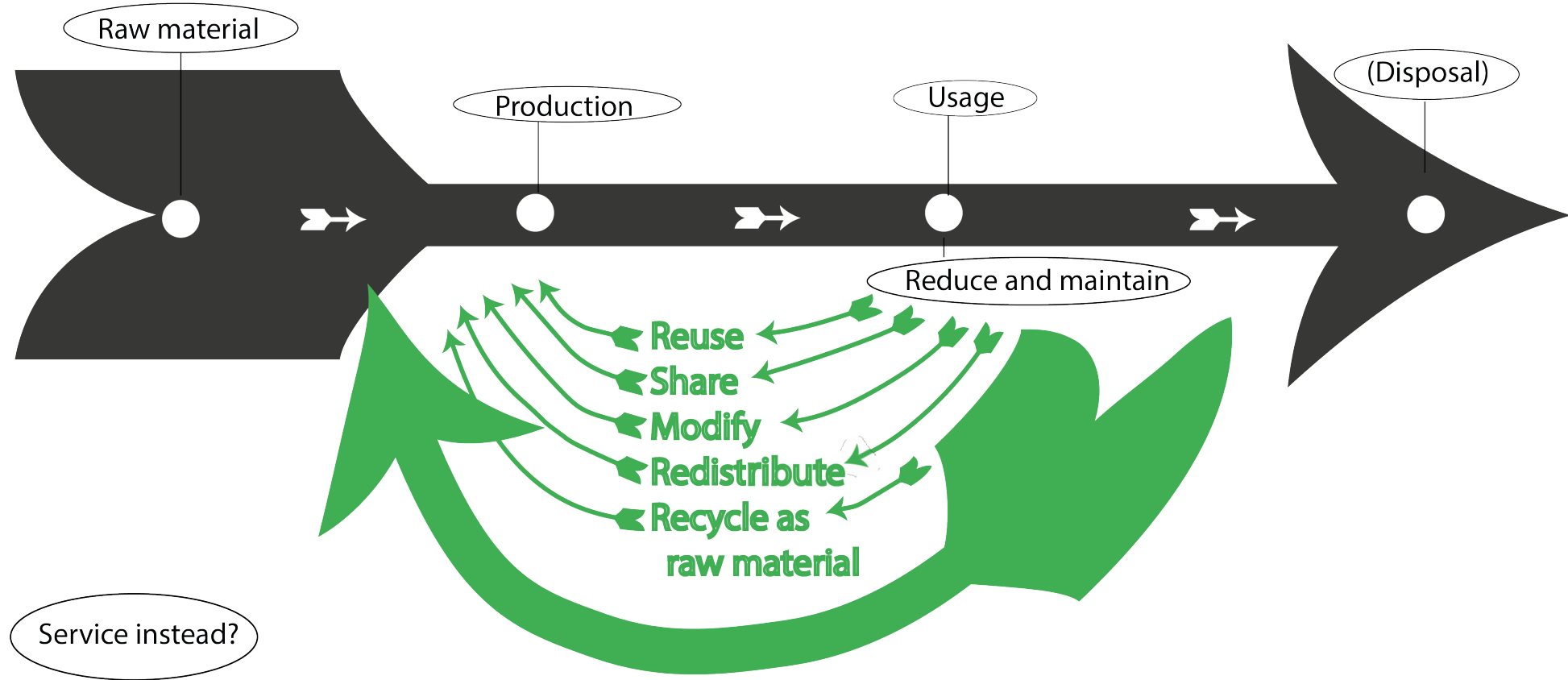
- Welfare by generating new services, products and energy from side streams and waste
- Moving back to a lifestyle-where nature's limits are recognized and respected



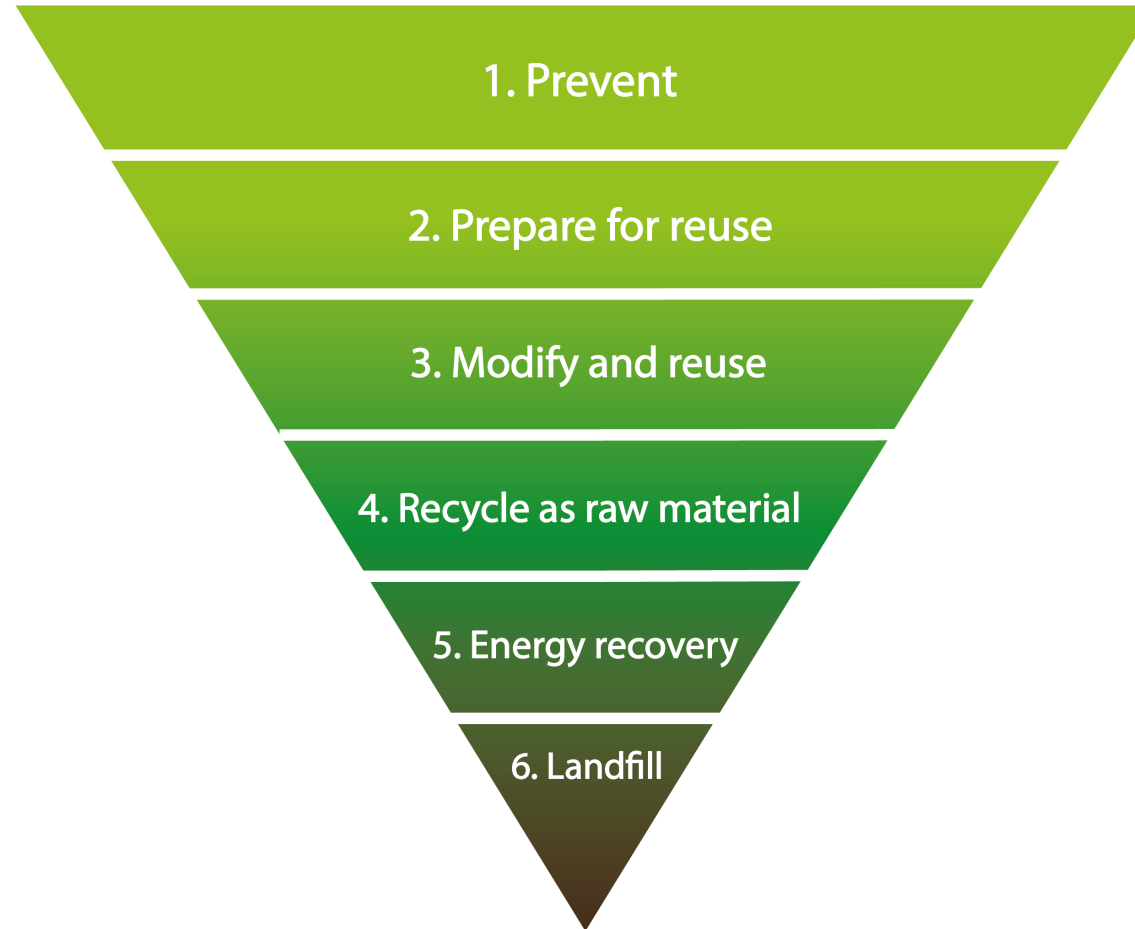
# Earlier: Linear thinking



# Now: Cyclic thinking



# Waste act: Waste hierarchy



# Prevent



# Prevent

- Preventing waste should be the 1<sup>st</sup> step in designing new products and services
- Also the 1<sup>st</sup> step while thinking of buying something
- Questions to be asked:
  - Is the product or having it necessary?
  - Can we replace the product with a service?
  - Is maintenance possible?
  - How can we prevent waste?

# Reuse – packaging in logistics and retail



# Reuse - CirclePack

- Reusable take away packaging with a deposit system
- Cups, cutlery and different types of plates and bowls
- Customer pays a deposit for the packaging when buying a take away meal
- Available in the biggest towns in Finland



# CirclePack experiences

- Simple system
- Customer chooses a reusable package as take away package
- Customer returns the package and gets the deposit money back – or changes it to a clean one
- Packaging should be circulating – the deposit money guides



# Use for different purposes or modify



Mustard packages put into new use as a drinking glass

Picture: Turun Sanomat



Coffee packages crafted into a handmade bag

Picture: anndesign.fi

Modified beverage can openers as a bag



**Modify**



# Recycle as raw material

- Recycling saves raw materials and energy
- Recycling targets must be met
- Table: CO<sub>2</sub> emissions of a shopping bag made of recycled plastics compared to bags made of other materials
- How many times do you need to use other bags to achieve the same CO<sub>2</sub> level as with a one-time use of a shopping bag made of recycled plastics?

Usage times for similar CO <sub>2</sub> -level	Material of the bag
1	Recycled plastics
4	Virgin plastics
4	Paper
6	Biodegradable plastic
251	Cotton

# Consumer's choice



<https://en.plastex.fi/products/eko-product-family.html>

- Good recycling efficiency also requires markets for recycled plastics
- We as customers need to choose products made from recycled materials, to make recycling economically feasible
- Recycled plastics have a lower environmental impact compared to virgin materials



<https://reset-plastic.com/en>

# Energy recovery / Composting / Digestion

If packaging can't be recycled as material, energy should be recovered to use.

- Contaminated and dirty materials
- Materials with low volume
- Organic materials can also be composted or digested
  - Paper and paper board, compostable plastics
  - Minor role among packaging materials



# Energy recovery / Composting / Digestion

## PROS

- + Energy can be taken into use in heating
- + Plastics has high energy content
- + Hygienic way to solve waste masses
- + Compost can be used for plants
- + Biogas production

## CONS

- Increases greenhouse gases
- Material is lost
- Packages do not usually pass to the biowaste processes

# Landfill

- Should not be considered as an option
- Landfill ban of organic waste in many European countries
- Actually, landfills are future resources of raw materials

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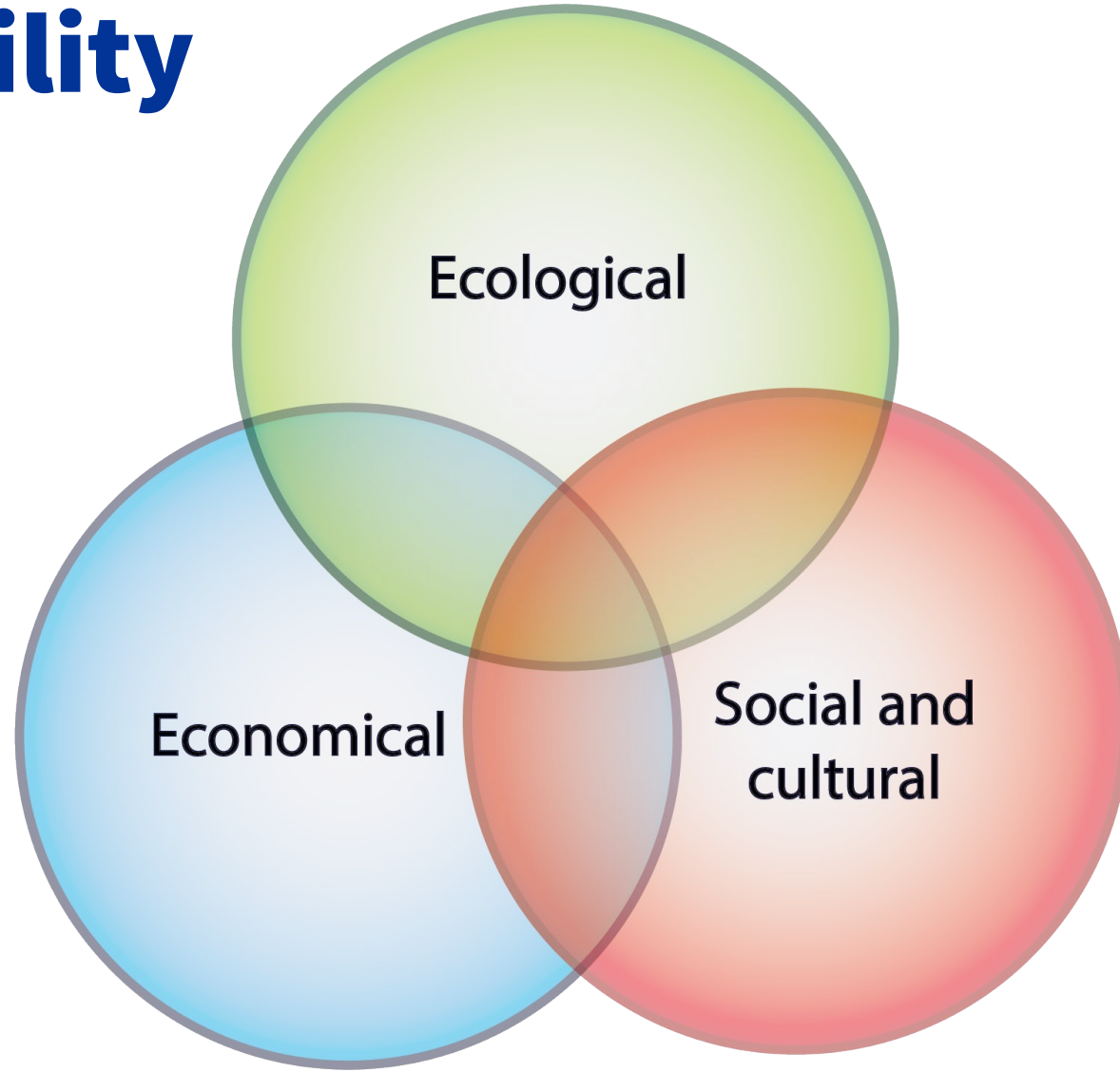


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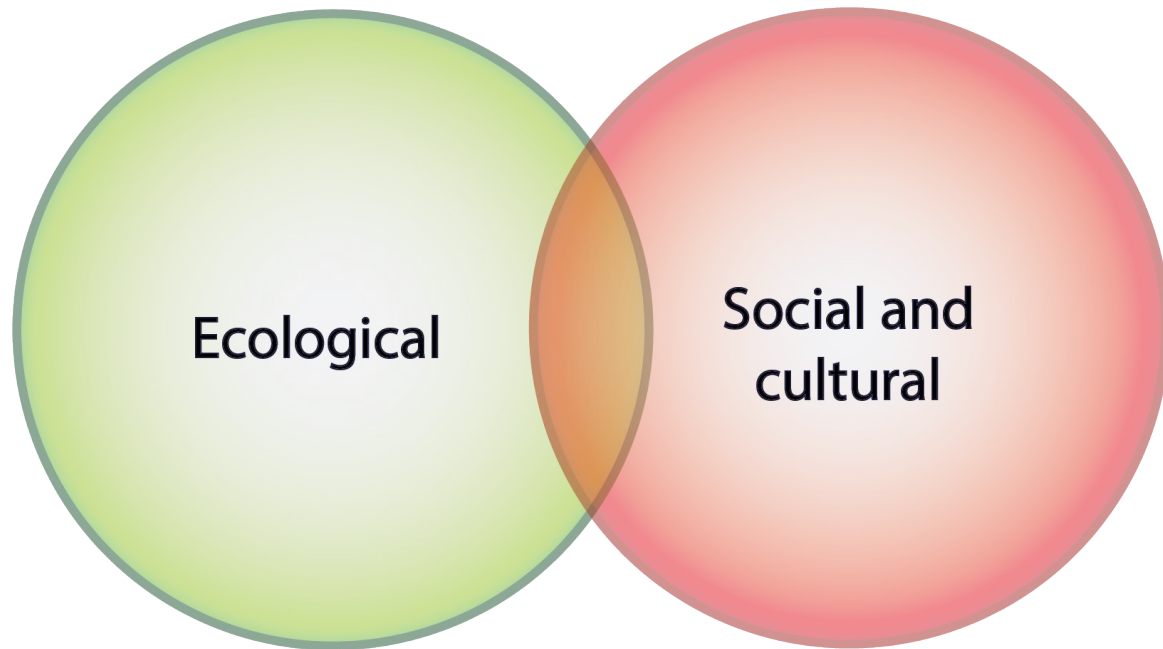
# Sustainability of food packaging



# Sustainability

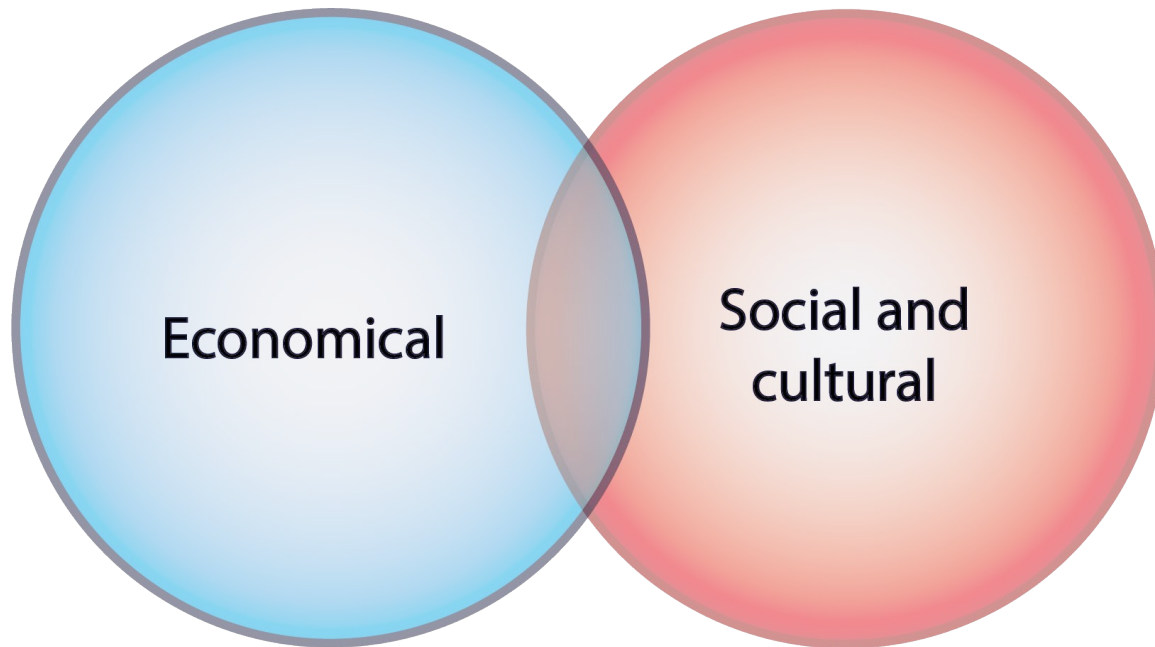


# Ecological and Social & Cultural Sustainability



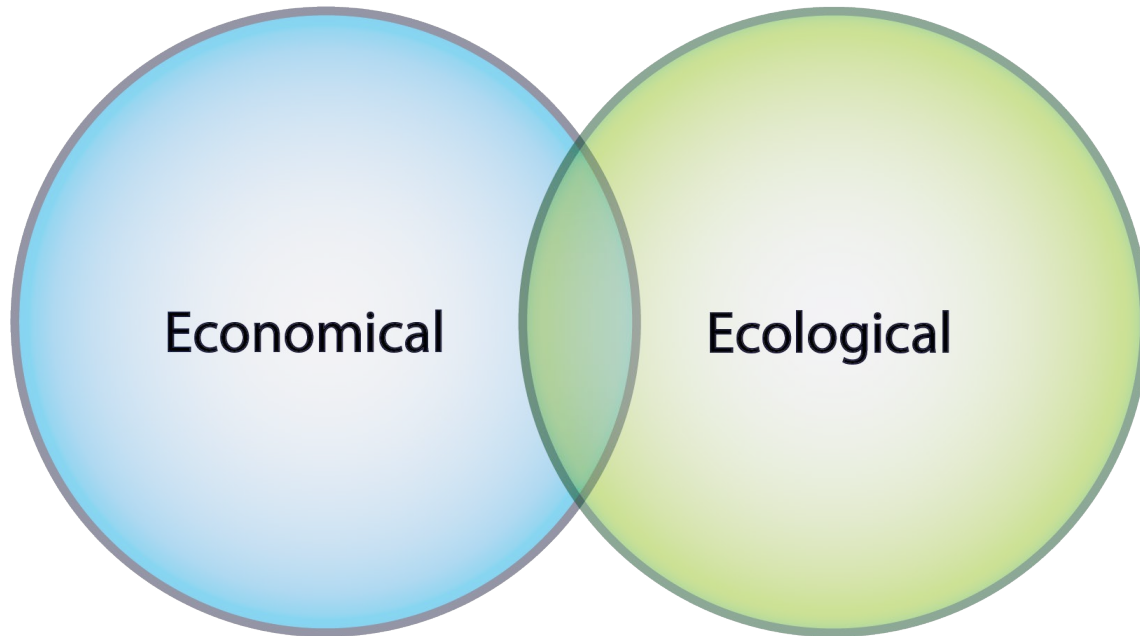
- People are living in balance with nature and as part of nature
- This lifestyle ended when people started to cultivate land and agriculture developed
- Example: Small tribe living isolated in a rainforest
- No money for investments and increasing welfare

# Social & Cultural and Economical Sustainability



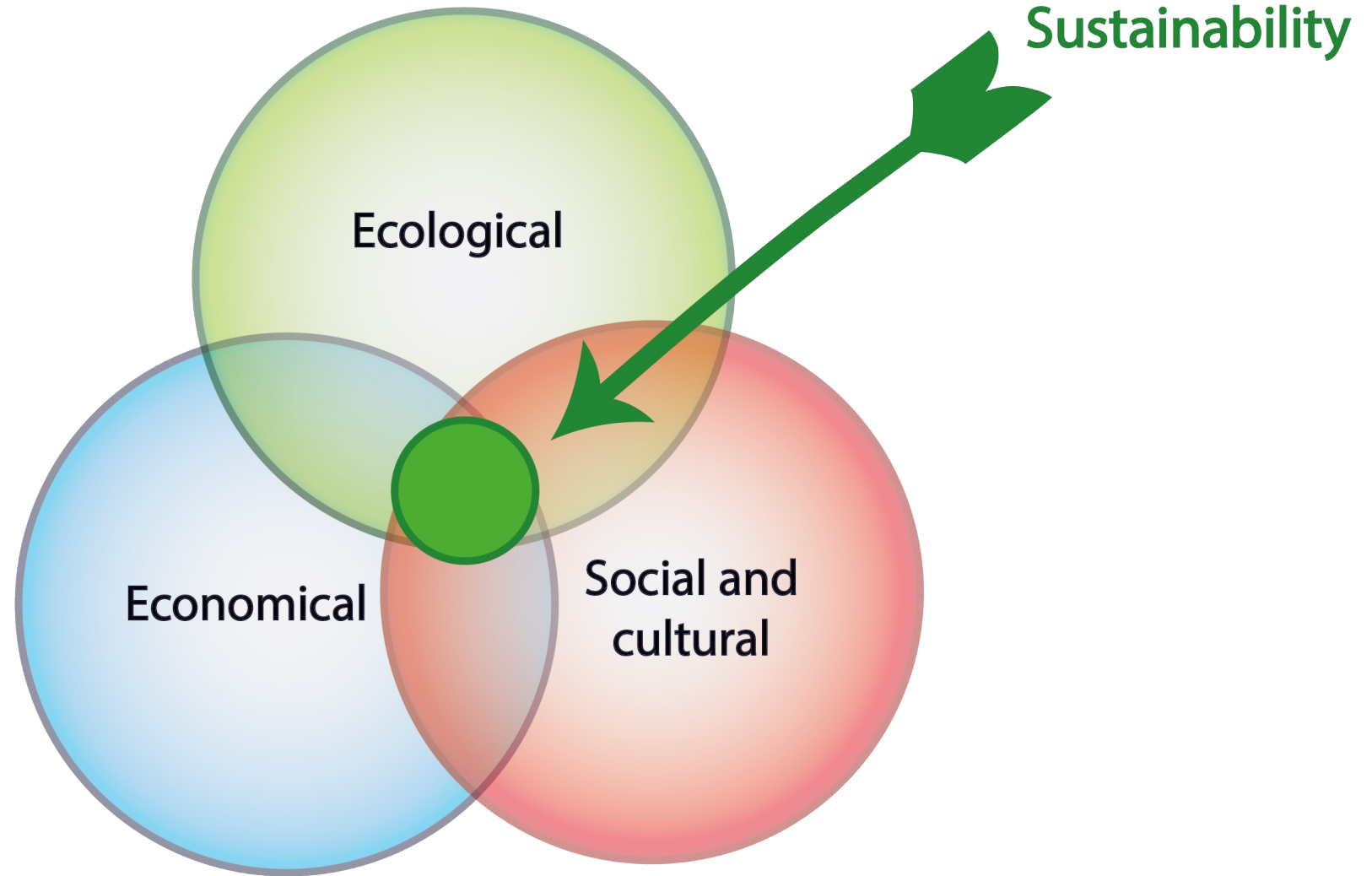
- People are using nature's resources to increase their welfare
- Industry, nature's raw materials and agriculture create work and social support to everyone
- Example: Forest industry in the 1950s in Finland. Finnish forests and lakes were only resources for paper industry. Mill owners organized kindergartens, healthcare and leisure time for their workers. Water, soil and air were badly polluted.

# Ecological & Economical Sustainability



- Economics are based on balanced use of nature's resources, but people's needs are not taken into account
- Example: Many measuring instruments are not taking welfare of human being into account
- For instance, Finnish forests are grown and harvested according to the needs of industry. The social and cultural aspects of forests are forgotten. Forests are no more suitable for hiking or picking berries and mushrooms.

# Sustainability



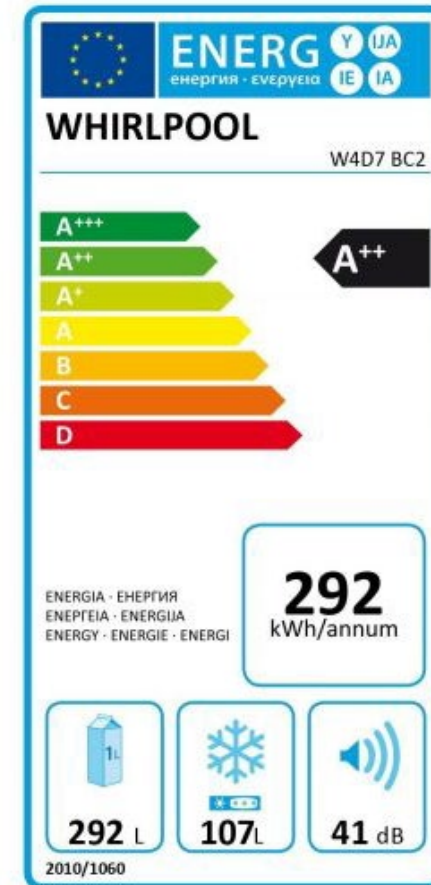


# SUSTAINABLE DEVELOPMENT GOALS

<p><b>1</b> NO POVERTY</p>	<p><b>2</b> ZERO HUNGER</p>	<p><b>3</b> GOOD HEALTH AND WELL-BEING</p>	<p><b>4</b> QUALITY EDUCATION</p>	<p><b>5</b> GENDER EQUALITY</p>	<p><b>6</b> CLEAN WATER AND SANITATION</p>
<p><b>7</b> AFFORDABLE AND CLEAN ENERGY</p>	<p><b>8</b> DECENT WORK AND ECONOMIC GROWTH</p>	<p><b>9</b> INDUSTRY, INNOVATION AND INFRASTRUCTURE</p>	<p><b>10</b> REDUCED INEQUALITIES</p>	<p><b>11</b> SUSTAINABLE CITIES AND COMMUNITIES</p>	<p><b>12</b> RESPONSIBLE CONSUMPTION AND PRODUCTION</p>
<p><b>13</b> CLIMATE ACTION</p>	<p><b>14</b> LIFE BELOW WATER</p>	<p><b>15</b> LIFE ON LAND</p>	<p><b>16</b> PEACE, JUSTICE AND STRONG INSTITUTIONS</p>	<p><b>17</b> PARTNERSHIPS FOR THE GOALS</p>	

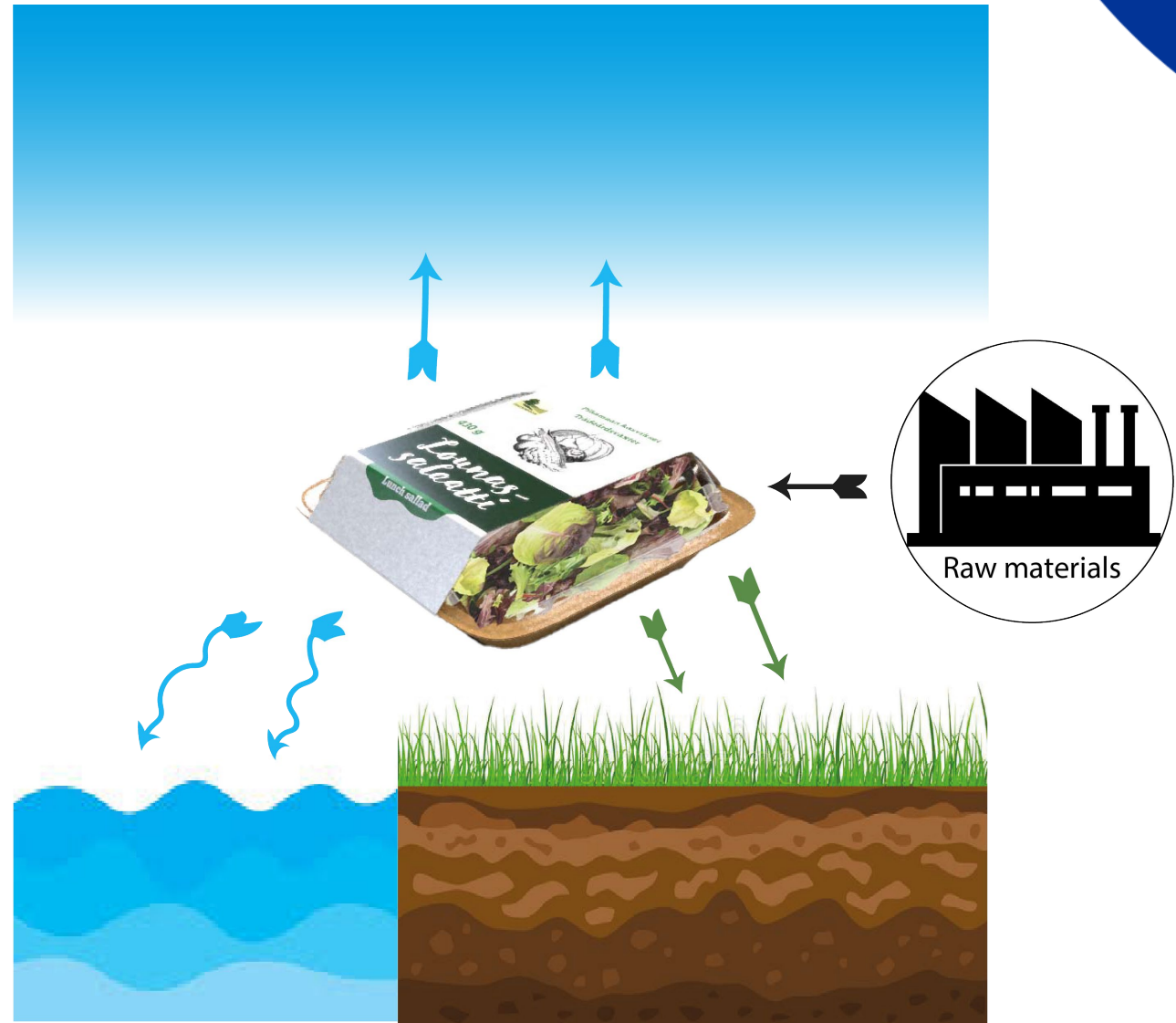
# How can we measure sustainability?

- Life cycle assessment, LCA
- Greenhouse gas emissions
- Water consumption
- Biodiversity
- Quality and environmental systems/certificates
- Energy and noise classification
- Environmental labels
- Expected lifetime
- GDP, gross domestic product
- ...



# LCA – Life Cycle Assessment

- Measures the impacts of a product or service to nature
- Material flows in numbers
- To air, water and soil



# Life Cycle Assessment Process



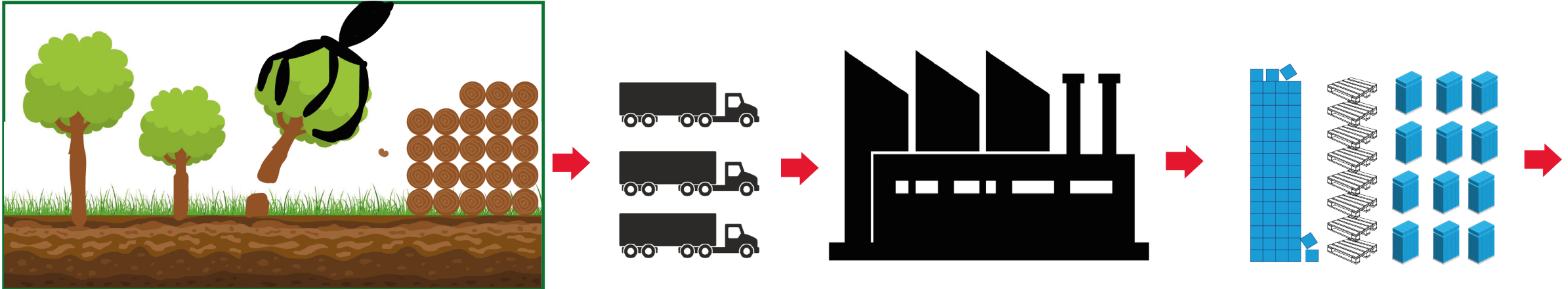
**DEFINING BORDERS OF  
ANALYSIS**

**INVENTORY ANALYSIS**

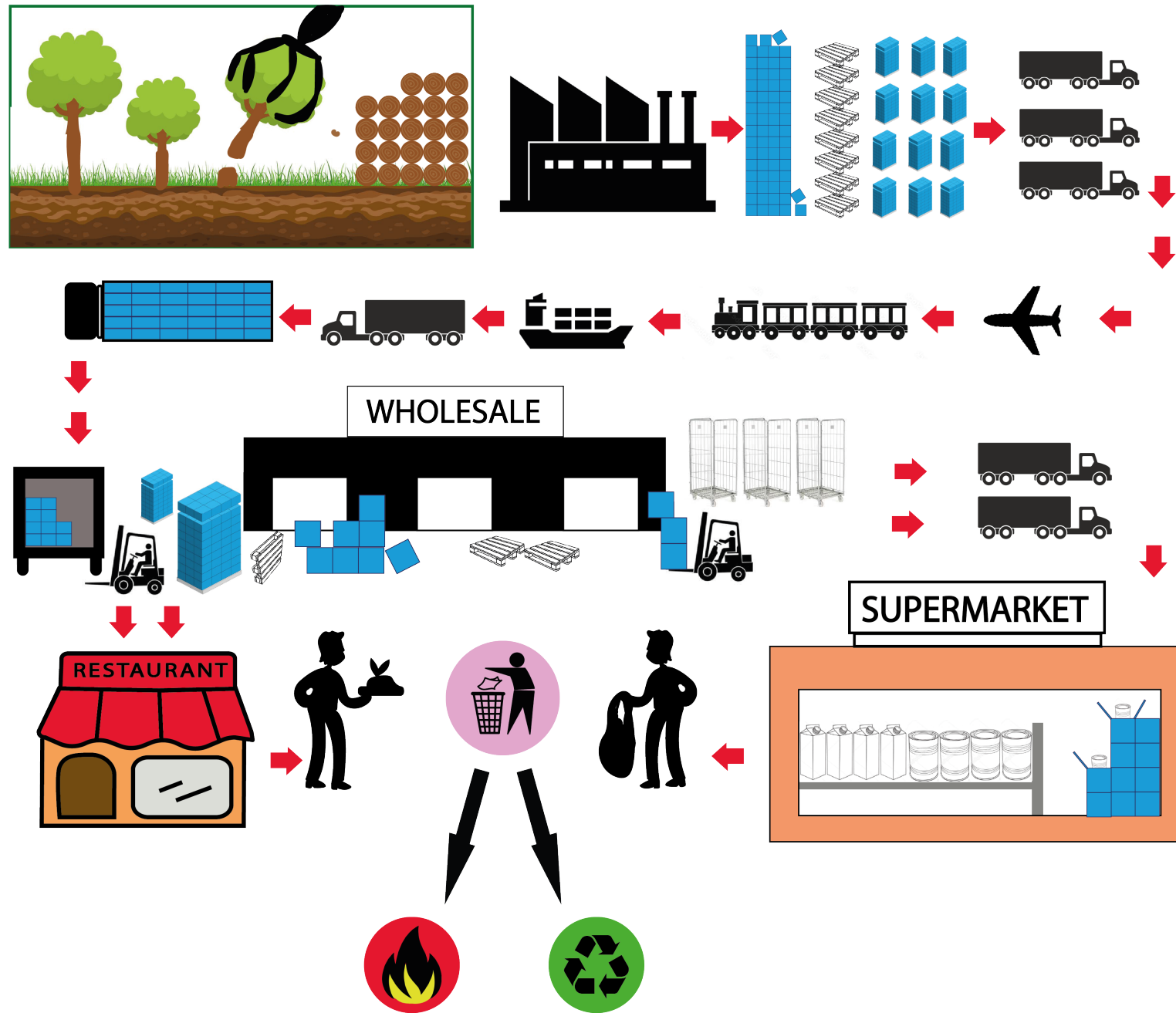
**EVALUATION OF IMPACTS**

# Defining borders

Cradle to gate



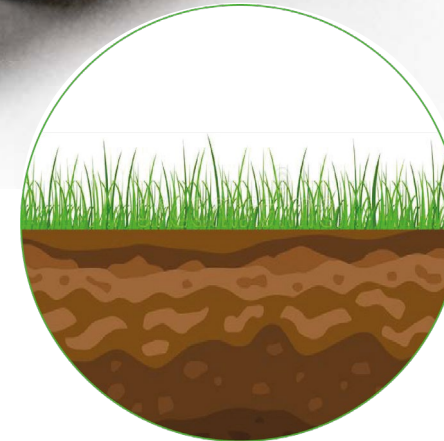
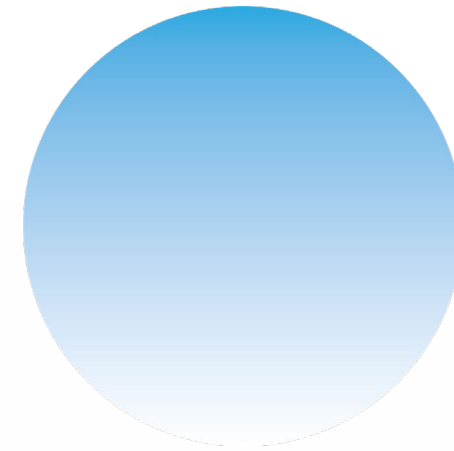
# Cradle to grave



# Inventory analysis

## Potential environmental impacts

- Climate change
- Acidification
- Eutrophication of water and/or soil
- Biodiversity
- Energy consumption
- Fine particles in air
- Water consumption
- Toxicity to humans and/or environment
- Effects to ozone layer
- ...
- What impacts are important for the case?



# Evaluation of impacts

- Evaluation, what inventory analysis means in practice
- Good LCA is transparent
- Borders clearly defined
- What is taken into account and what not
- Uncertainties clearly expressed
- Orderer can have a lot of influence on the end result



# What we get as a result

- Potential impacts on soil, water and air in numbers
- A tool for industry for evaluating impacts of different products
- For increasing knowledge and for comparison
- Should not be used for marketing purposes

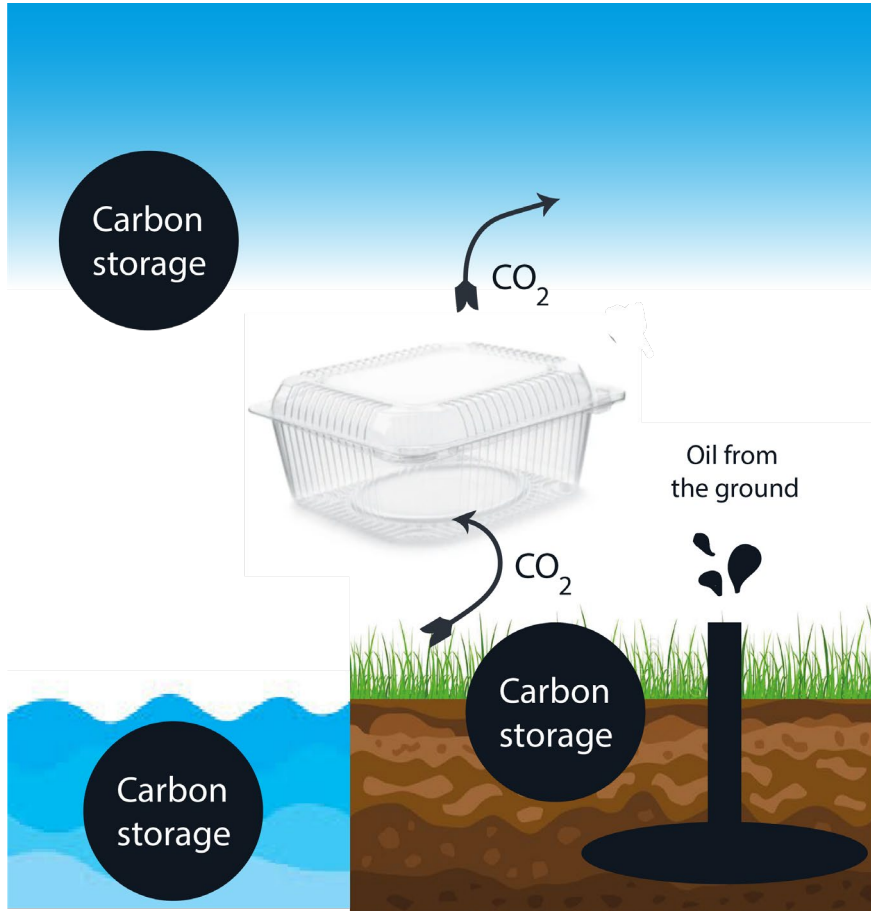


# Other, narrower assessments

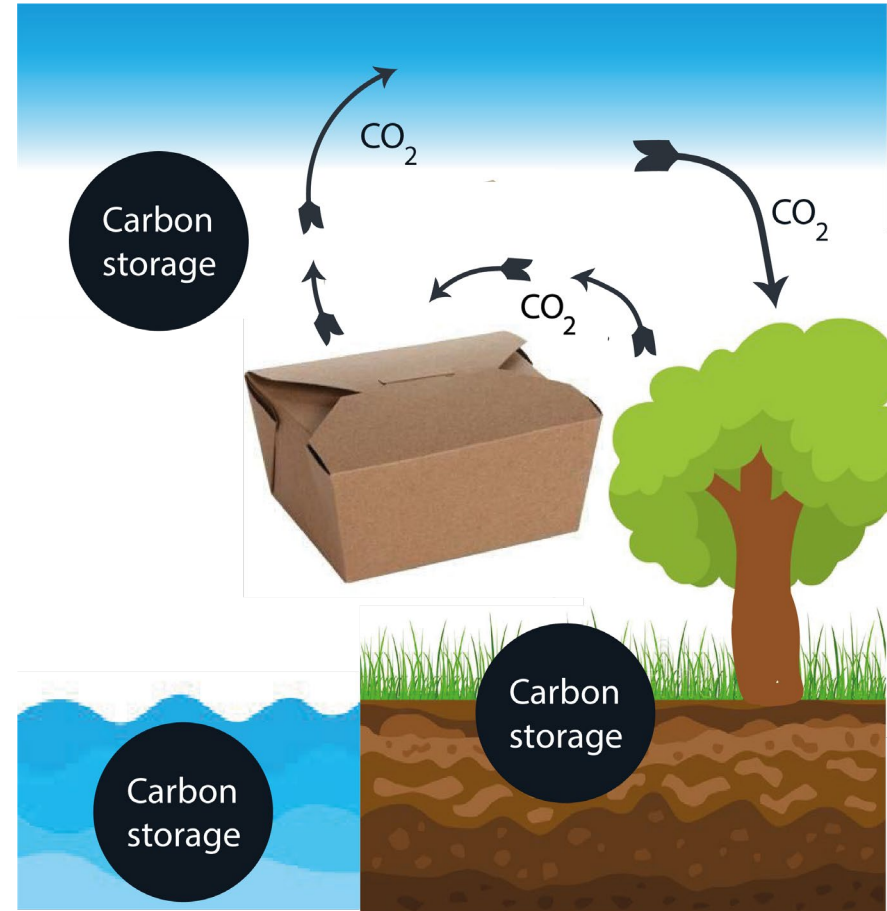
- Water Footprint
- Carbon Footprint
- Carbon Handprint
- Narrower analysis always less informative



# Carbon source – carbon sink

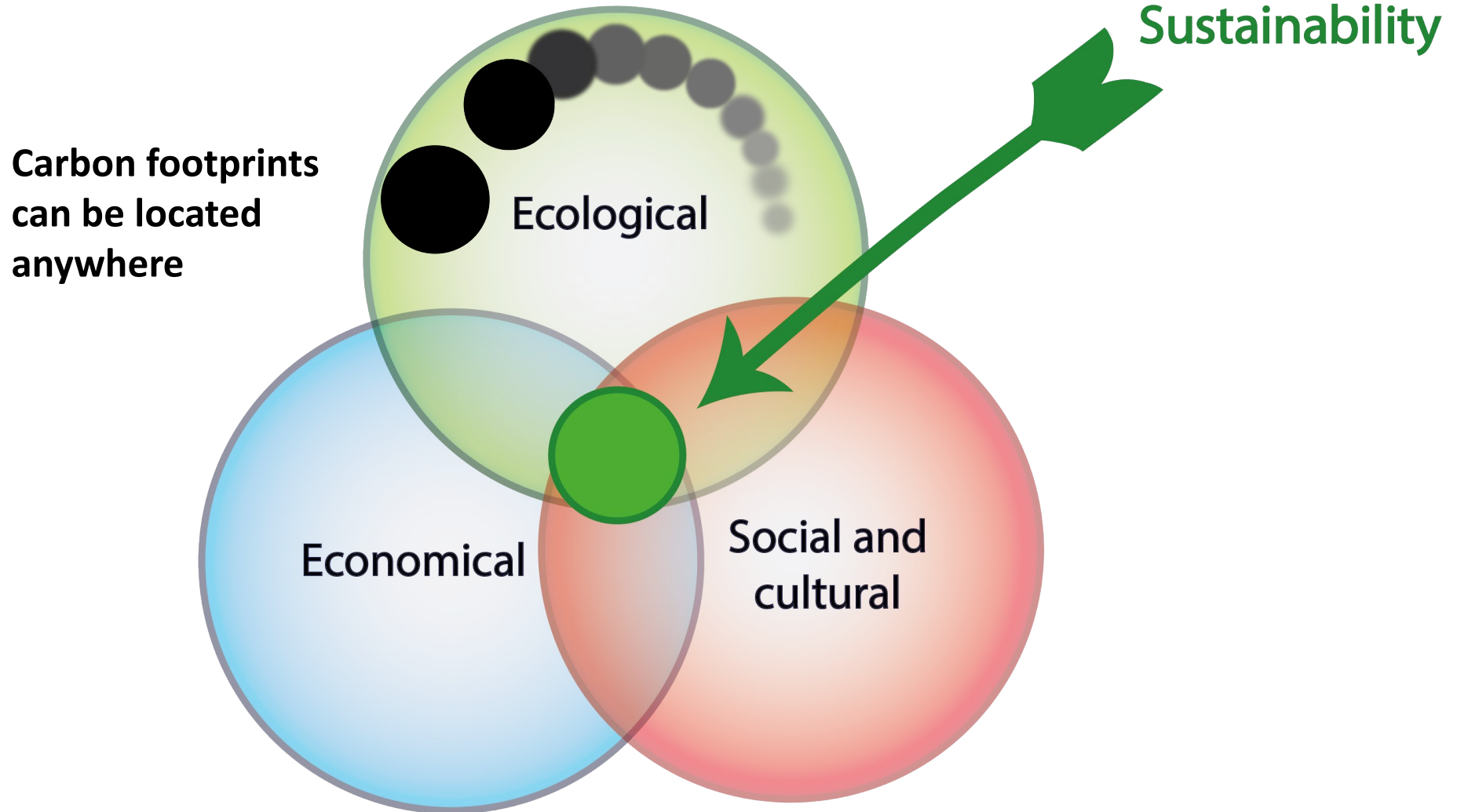


Carbon source



Carbon sink

# LCA versus Carbon Footprint

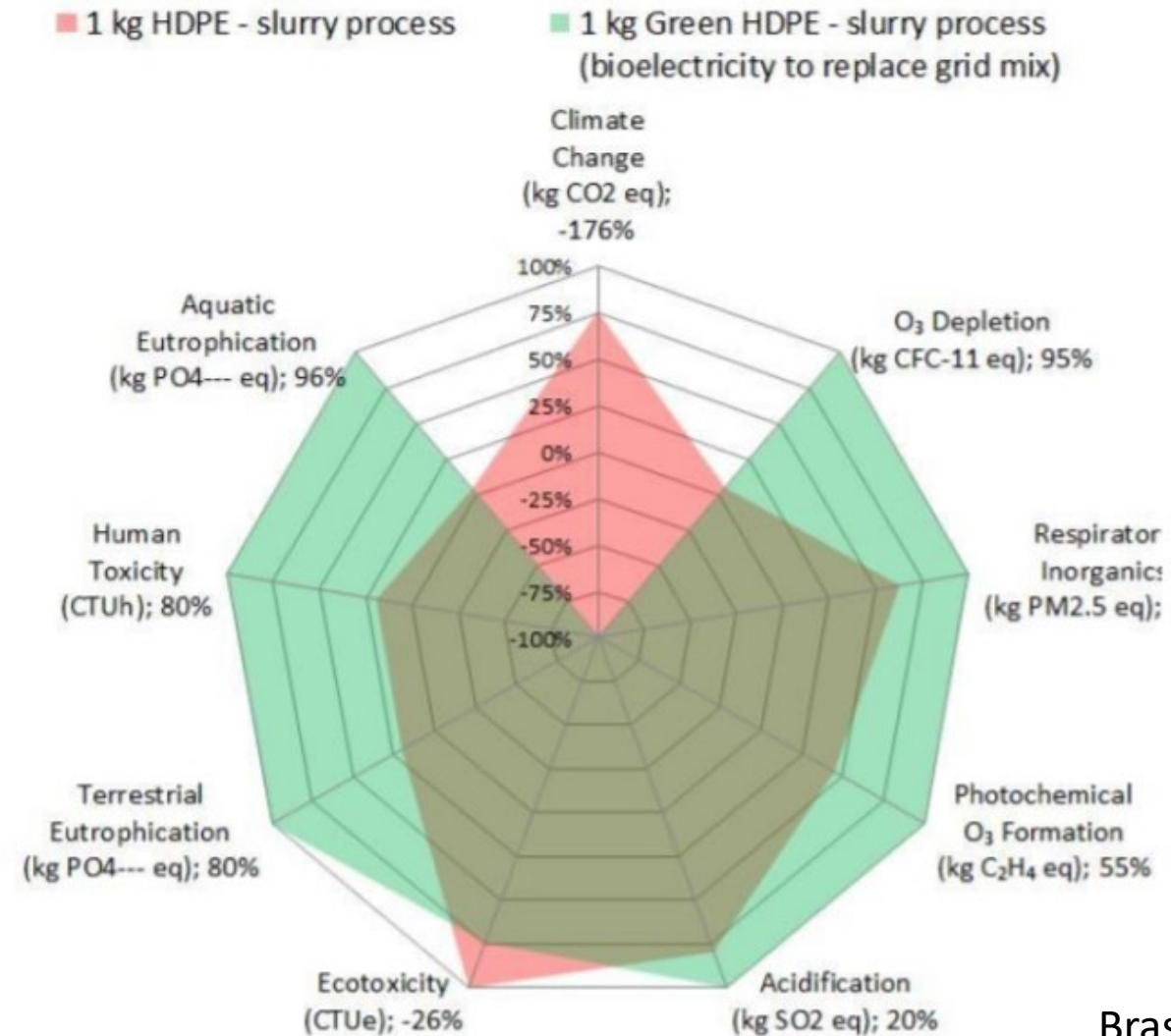


# Example: Carbon footprint of bio-based PE, I'm green™ PE

		kgCO <sub>2</sub> e/kg
Sugarcane Growing	Agricultural Operations	0,91
	Land Use Change Credits	-1,10
	CO <sub>2</sub> Uptake	-3,14
	Total	-3,33
Ethanol Production	Ethanol Production	0,03
	Bagasse Burning	0,16
	Electricity Cogeneration Credits	-1,17
	Total	-0,98
I'm green™ bio-based PE	Ethanol Transport	0,46
	Industrial Operations (Ethylene and PE)	0,76
	Total	1,22
		<b>-3,09</b>

# Example: The LCA comparison

- Analyses are complex
- LCAs can give totally different sustainability results than carbon footprints
- Which one is used in marketing?





## Problems with LCA

- LCA is very time consuming
- Understanding the results requires a lot of knowledge and concentration
- Separate analyses are not comparable
- Analyses have many uncertainties
- LCA can be used as a marketing tool
- Results may not be transparent

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# Logistics of food packaging



# Logistics and sustainability

- Logistics have a big role in product-life
- Transportation between actors
- Packaging is shielding the product from the environment
- ...and the environment from the product
- Packaging has to withstand varying circumstances: sun, rain, dropping, shaking, piling, transportation with any vehicle, rats, flies, birds, thieves...



# Packaging in logistics

## Tertiary packaging



Picture: IS.fi

# Packaging in logistics

## Secondary packaging



# Finally

- If packaging fails, all resources used for the product and packaging, as well as energy in transportation, were used in vain
- Therefore, in principle packaging is always sustainable
- Overpacking is costly, basically only in the case of cosmetics the cost of packaging can be moved into product costs
- Overpacking is also forbidden by packaging legislation



# Key takeaways

- **Takeaway 1.** Modern packaging is designed based on circular economy. All packaging is designed for recycling and minimising material consumption.
- **Takeaway 2.** Sustainability of packaging can be evaluated by using LCA, and carbon footprints, among other metering technologies. However, these analyses are complicated and require high levels of know how. LCA is a good tool for the purposes of industry, not for marketing. Transparency is required.
- **Takeaway 3.** Packaging is essential in modern logistics and retail. It is saving work and energy at each step of the food chain. Overpacking or packaging waste generation is regulated by law. Thus packaging is always a sustainable solution.



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