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UNIVERSITY OF TECHNOLOGY

*Switching focus from product function  
to business profit:*

# Introducing Business Model LCA

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# Intro: Economy and sustainability

- Historically, economic growth coupled with environmental damage
  - *Need for decoupling*
  - *From a company's perspective: important to find ways of reducing impacts while maintaining profit levels*



=> Change business models, e.g., make money from renting instead of selling

- *Product-Service Systems, Sustainable Business Models, Circular Business Models*
- *Often assumed to be more sustainable*
- How to know which ways of making money can lead to decoupling?
  - *LCA??*

# Lacking environmental assessments of business models

- LCA usually applied to products and not to business models (i.a., Kjaer et al., 2016)
- Problematic to use standard LCA to assess business models
  - *Excludes economic aspects*
  - *Can't model business dimension => forced to make assumptions to translate business aspects into physical consequences, e.g. different lifetimes or different number of uses*
- LCC+LCA is sometimes used
  - *Complementary, not integrated*
  - *Can't model the relation between the business and the technical system*
- **Method aim: Adapt LCA to analyse business models in a relevant way**

# Re-frame LCA for business model assessment

What is a business model & what is its relationship to the product?

The purpose of a business is to be economically viable, to **make money**

- A **business model** refers to a company's plan for making a profit (a 'money-making system')

=> The functional unit should reflect 'business', i.e., be expressed in economic terms, an measure of business (e.g., profit per financial period)

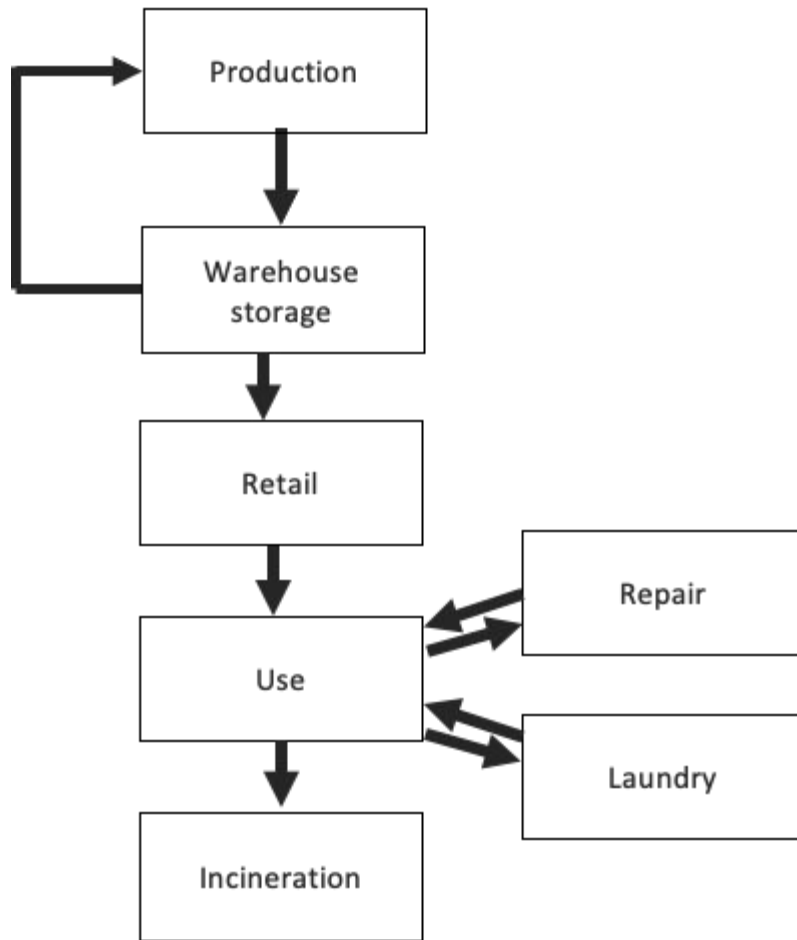
The product is a means for business

- There are relationships between the product and the business around it that determine profit levels (e.g., pricing, marketing, design, production costs)

=> The modelled system should cover both the technical system related to the product **and** the company's monetary flows related to the business



Source: pixabay.com



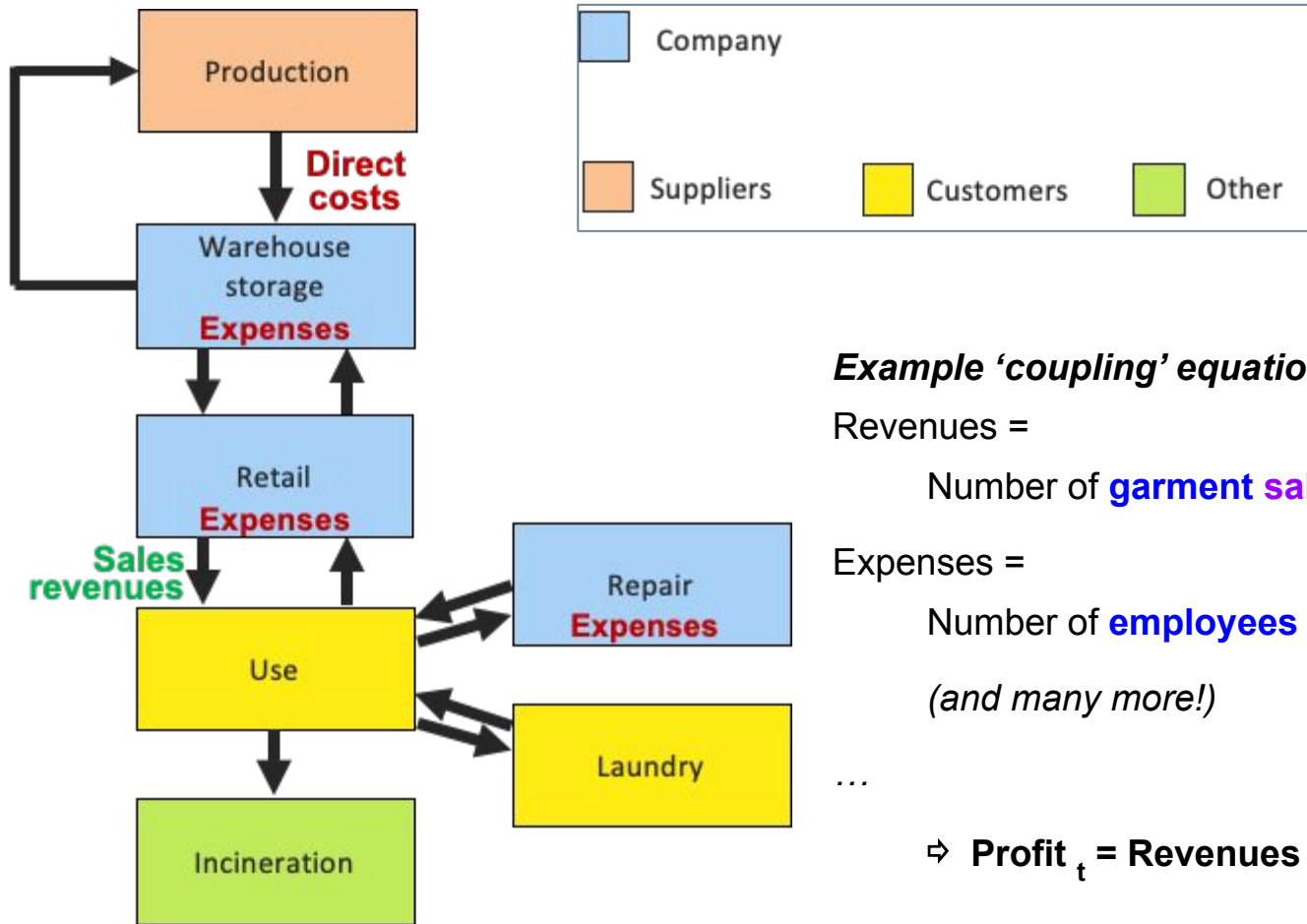
Describe the  
product system

Describe the  
business model

Identify the company's processes  
and those owned by other actors

Identify its costs and revenues for the  
business with the product

Couple monetary flows to physical flows  
(with equations)



**Example ‘coupling’ equations:**

Revenues =

Number of **garment sales** x **Price** of **garment**

Expenses =

Number of **employees** x **salary** / **store**

*(and many more!)*

...

$$\Rightarrow \text{Profit}_t = \text{Revenues}_t - \text{Expenses}_t$$

# BM-LCA

is an

**LCA with an 'expanded' goal and scope phase**

- *for integrating the financial aspects into the LCA... or tie the business to the product system*

(For details, see Böckin et al 2020, *Environmental assessment of two business models*. chalmers.research.se)

Phase	Description of each step
Goal and scope: descriptive phase	Give general description of the setup of each business model to be compared and of the related product(s) and state the time period to consider.
	Define system boundaries and environmental impact categories of the assessment. Map actors in the product chain.
	Find the connection of how the amount of production, $q$ , depends on the number of transactions, $t$ , for each business model.
Goal and scope: coupling phase	Step 1: Define the functional unit as the profit, $\pi$ , that each business model must achieve.
	Step 2: Identify all of the business' costs and revenues associated with running one of the business models for the stated period. Find conversion factors, $f$ , to couple costs and revenues to customer transactions, $t$ . Set up an equation for the profit as revenues minus costs:
	$\pi = f_{revenue} * t - f_{direct} * t - f_{indirect} * t - f_{contingent} * t$
	Step 3: Solve the equation to find the transactions, $t$ , required to reach the profit. Derive the required amount of production, $q$ .
	Step 4: Repeat steps 2 and 3 for every business model to be compared.
Life cycle inventory	Construct a system model and quantify all environmentally relevant flows, scaled according to the functional unit.
Life cycle impact assessment	Aggregate all flows from LCI and quantify their effects on the chosen environmental impact categories.
Interpretation	Analyse the results and scrutinise their robustness to identify pros and cons of compared business models.

# Example case: shell jackets

... put on the market by a Swedish company via 2 business models

## Sales model

- Jackets price is 5000 SEK

## Rental model

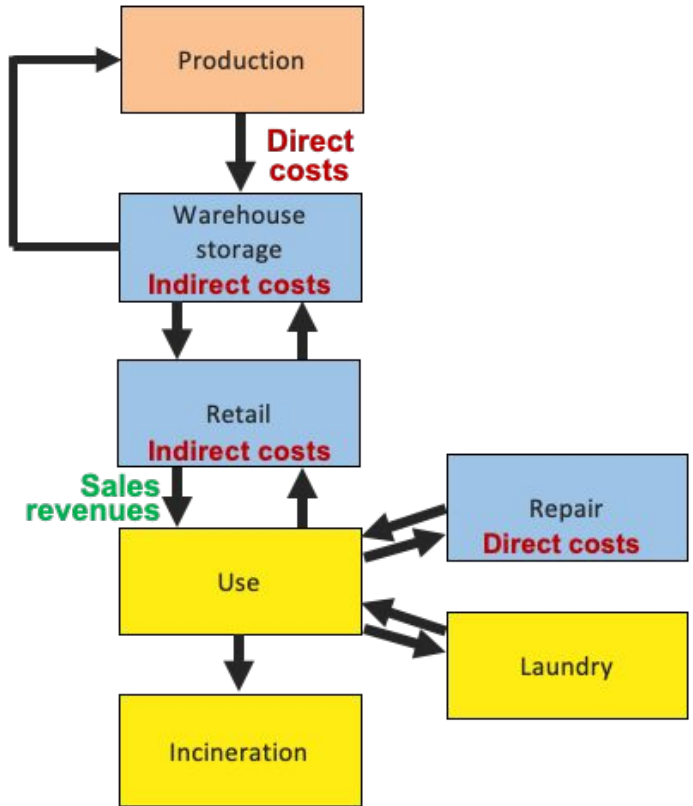
- Rental price is 600 SEK for 5 days
- Jackets are washed after every rent
- Jackets not looking new or fresh are removed from the rental stock and sold 2nd hand



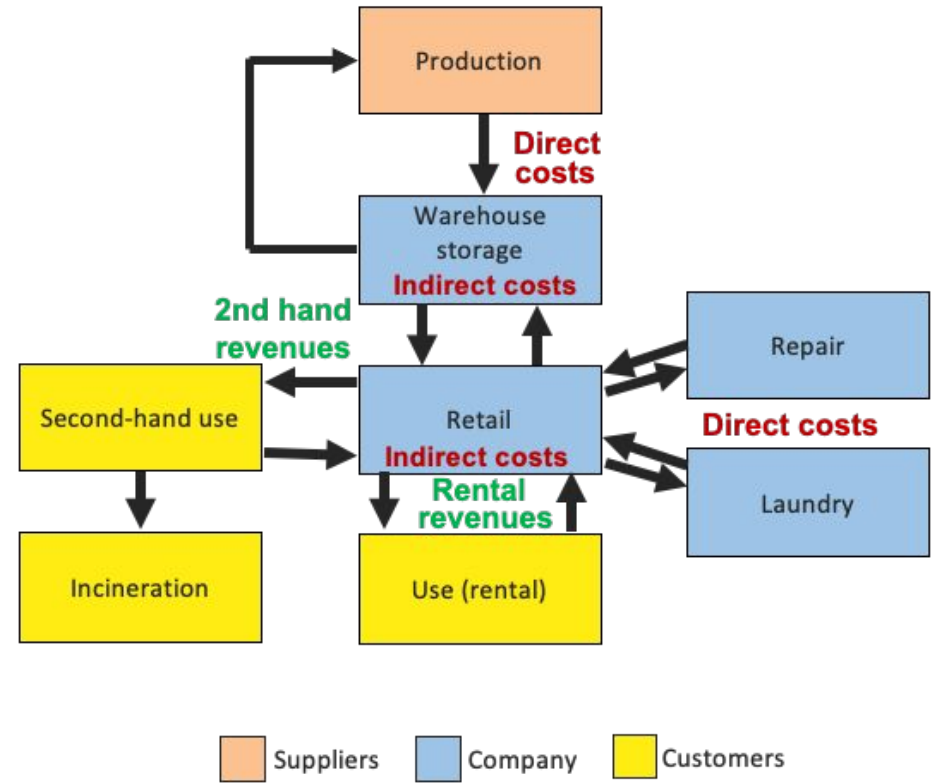
Source: pixabay.com

	Sales	Rental
Profit/month	320 000 SEK	320 000 SEK
Transactions	A	B
Jackets produced	A	C

# Sales

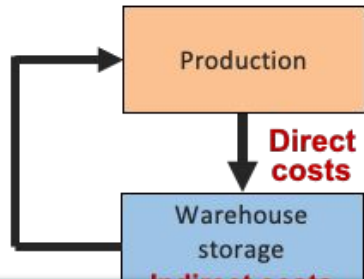


# Rental

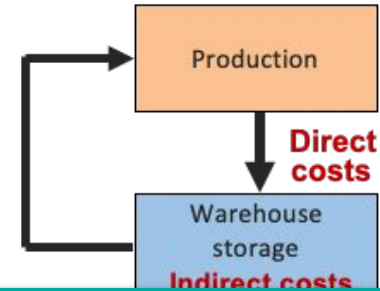


Suppliers    Company    Customers

## Sales



## Rental





$$t_r = \frac{\pi_r}{\left( P_r - k_{maint} + (P_{2nd} - k_{prod} - k_{distr} - k_{EoL} * CR) * \frac{R_r * U_r}{E_r * T} - \frac{(k_{OH} + k_{emp} * EPS) * U_r}{30 * E_r * SS} \right)}$$

Incineration

Suppliers

Company

Customers

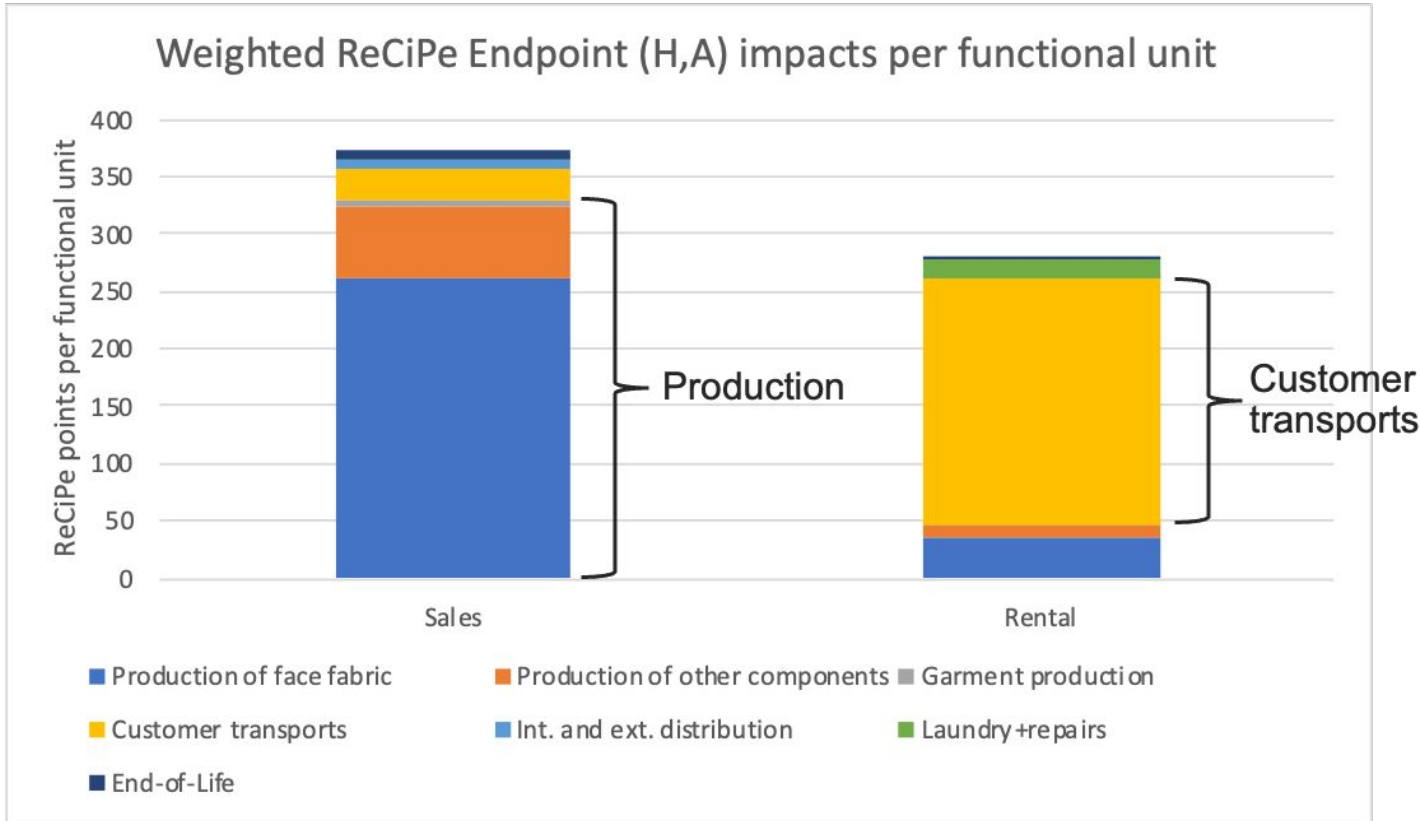
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	Sales	Rental
<b>Profit</b>	<b>320000 SEK</b>	<b>320000 SEK</b>
<b>Transactions</b>	<b>200</b>	<b>1108</b>
<b>Jackets produced</b>	<b>200</b>	<b>28</b>

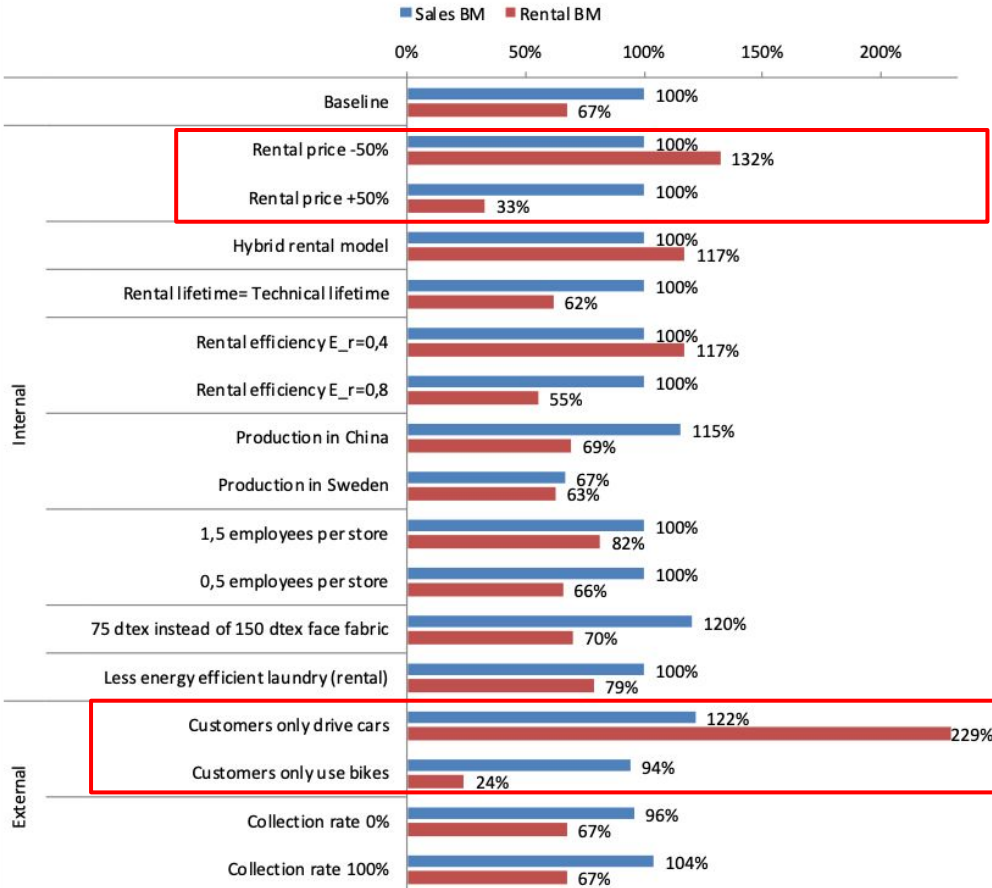


Source: pixabay.com

# Results — base case



## Sensitivity analysis results



# Results: Sensitivity analysis

On both:

- **Business parameters** (e.g., rental price)
- **Technical parameters** (e.g., customers' transportation)

Thanks to the modelled connections between technical and economic systems

# In conclusion: BM-LCA

**With a functional unit based on economic performance => coupling of the physical flows of the product system with the monetary flows of the business model**

- This enables our method to show the impact of business decisions on their environmental performance for a company >> allows LCA to address business as such

**From a business perspective, BM-LCA allows for...**

- Business model innovation for sustainability, since BM-LCA enables analysis of economic parameters and their effects to the physical side of business (decoupling or not)
- Knowing what's within and outside of the company's control, to avoid excessively green claims by managing and try influencing environmentally critical activities

**If using a (conventional) physical f.u. instead of economic performance...**

- Captures changes in product design and technical lifetime, related to product functionality and is more representative of a user (consumer) perspective
- But does not capture the effects of changes in the business model (at least, not without lots of assumptions)



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