Life Cycle Based Research In Food and Agriculture

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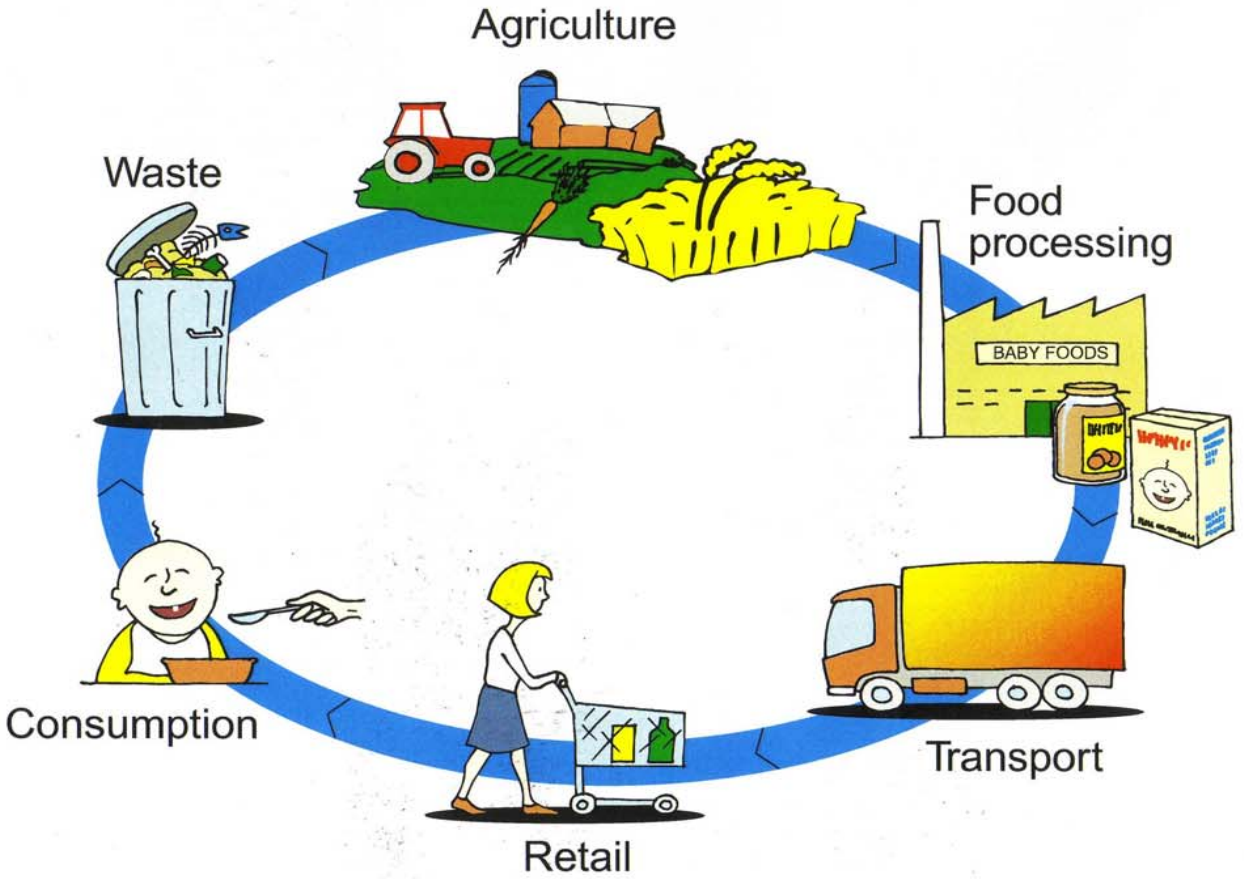
LIFE CYCLE ASSESSMENT (LCA)

LCA is a method for environmental assessment of products ("functions")

We identify the environmental impact of the product from raw material to waste



The Phases of Life Cycle Assessment

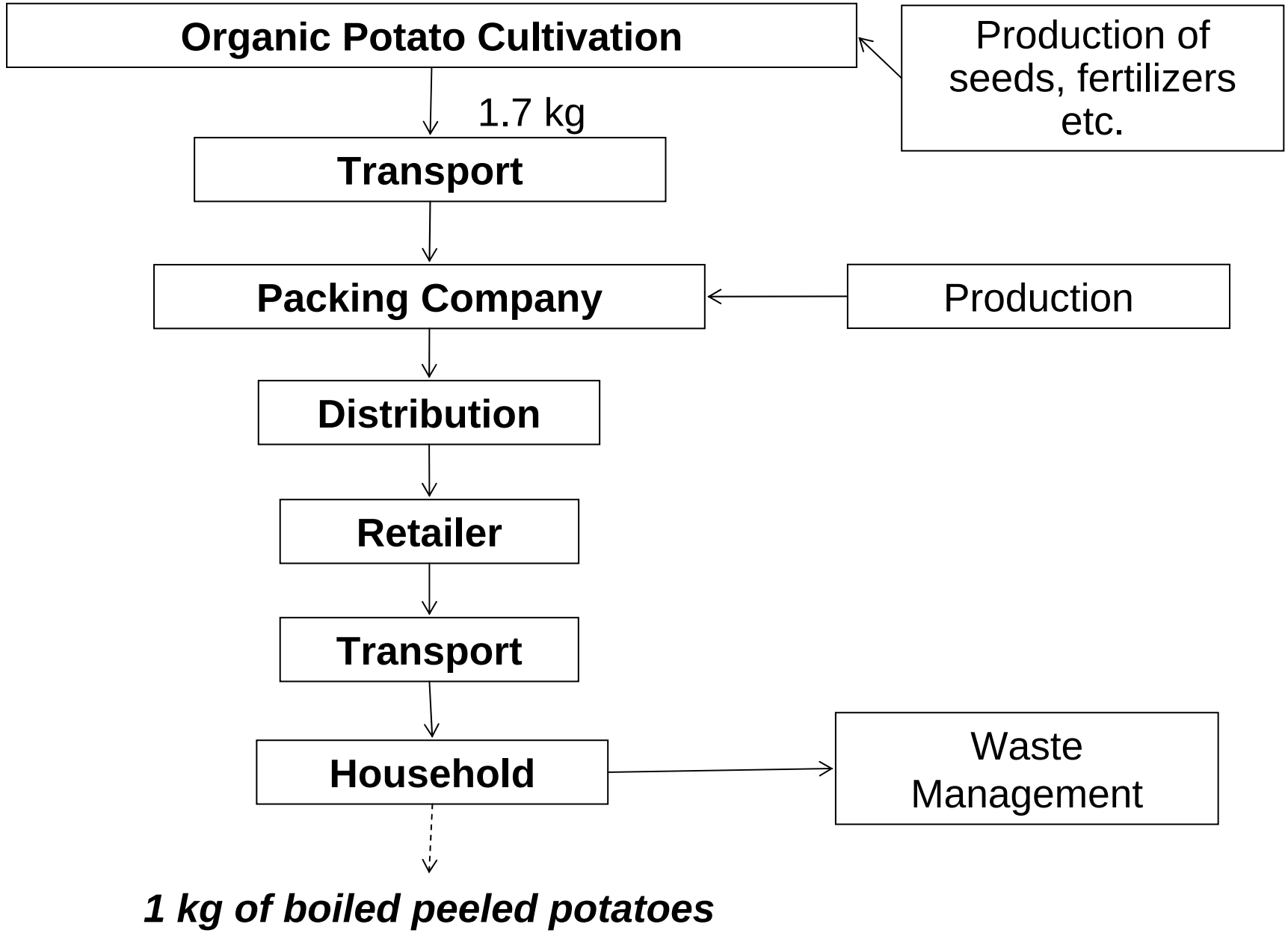
Goal and Scope Definition

Inventory

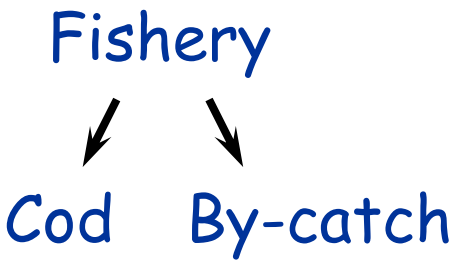
Categorisation

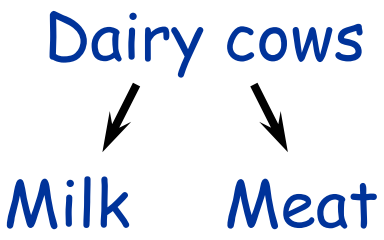
Interpretation

Functional Unit !


Organic Potato Cultivation
Production of seeds, fertilizers etc.
1.7 kg
Transport
Packing Company
Production
Distribution
Retailer
Transport
Household
Waste Management
1 kg of boiled peeled potatoes

Allocation of environmental impact

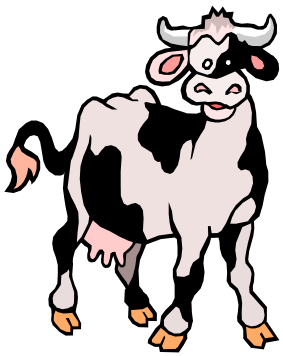




Very common in agriculture!

Systems expansion – a method to avoid allocation

DAIRY COW



MILK

MEAT

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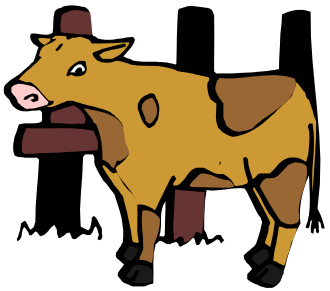
BEEF COW



MEAT

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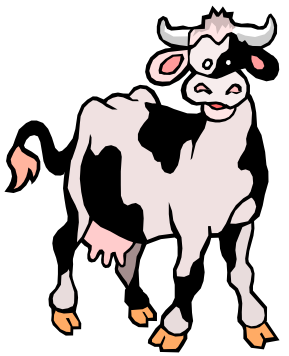
DAIRY COW



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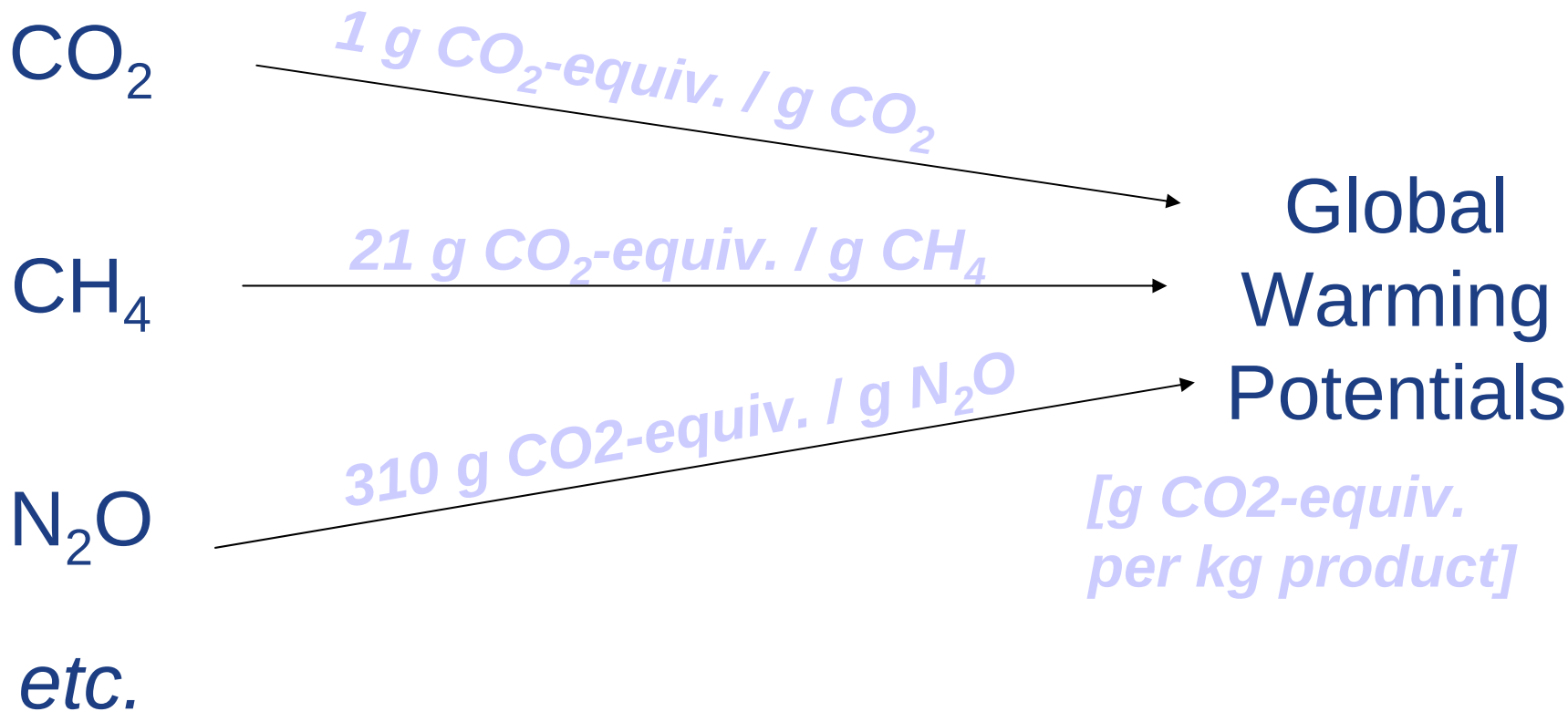
LCA and Environmental Impact Assessment



Impact Categories

Resource use

Energy use

Water use

Land use

Climate change

Photooxidant formation

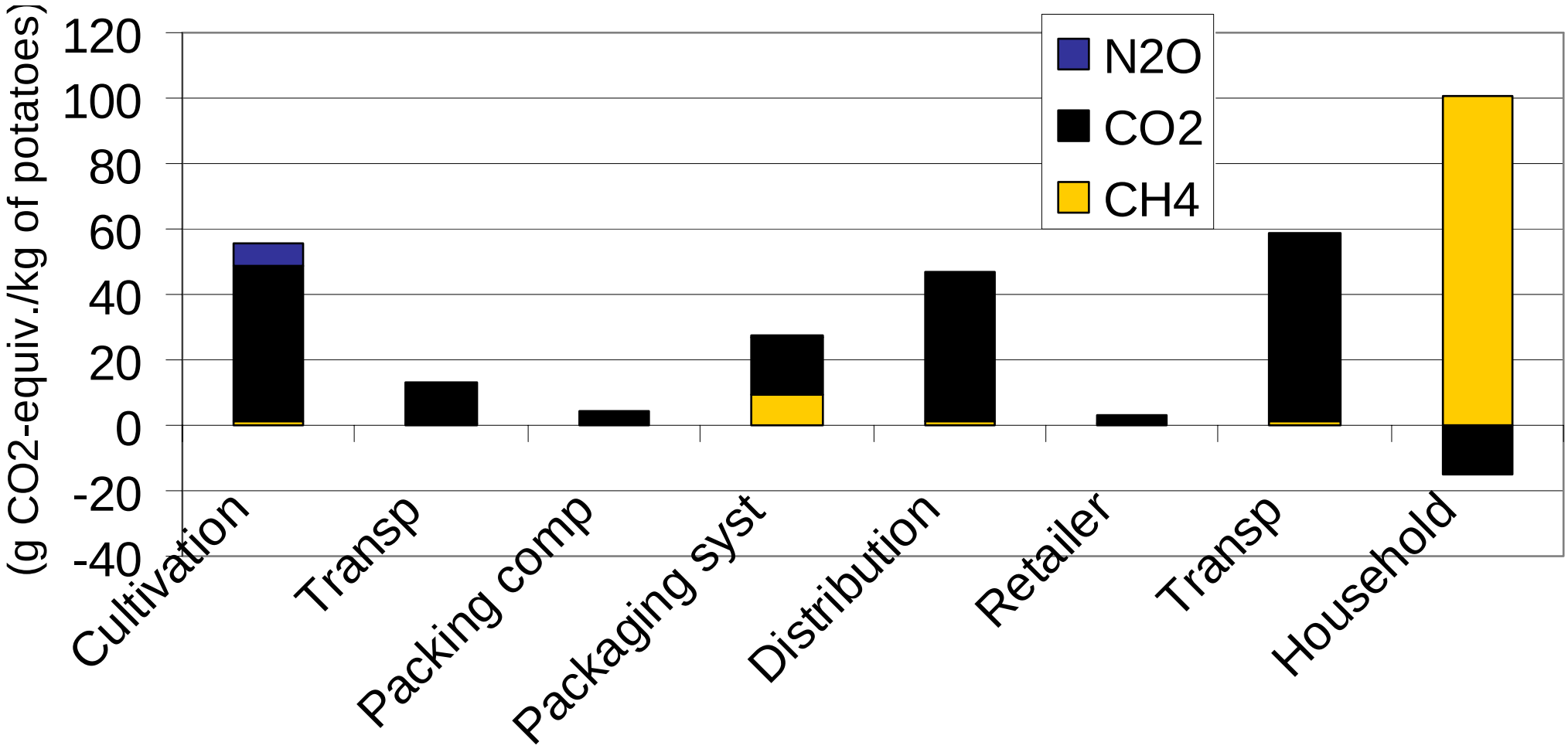
Ozone depletion

Acidification

Eutrophication

Toxicity

Climate change



LCA, research case studies

- **Bread**
- **Ketchup**
- **Baby foods (carrot puree, cereal based drink)**
- **Milk production (farming)**
- **Dairy processing (Cleaning)**
- **Cheese**
- **Cod**

LCA, contract studies

- **Vegetable oils**
- **Milk**
- **Beef**
- **Pork**
- **Poultry**
- **Hamburger bread**
- **Potatoes**
- **Lettuce**

General results

- Primary production (agriculture, fishery) is often very important, especially for foods of animal origin
- Eutrophication is the most important environmental effect for foods, followed by energy use
- Toxicicity is very difficult to assess
- Food systems have specific environmental impacts, since the production is performed in open systems
- The function of foods is difficult to define

General results (continued)

- Agriculture (Eutrophication, Energy, pesticides)
- Industry (Energy)
- Packaging production (Energy, acidification)
- Truck transport (Energy, Acidification)
- Retail (Energy)
- Households (Energy, Acidification)
- ”Post-consumption” (Eutrophication, Energy)

Conclusions from using LCA on food products

- The method provides a snapshot of the system
- A very good accounting of a products environmental impact
- A static presentation
- But, improvement analysis needs to be developed

Development based on LCA - Two main lines

1. **Modelling of future systems**

2. **Environmental assessment of changes in the production system (technological, organizational, product development etc.)**

Environmental assessment of changes in the production system (1)

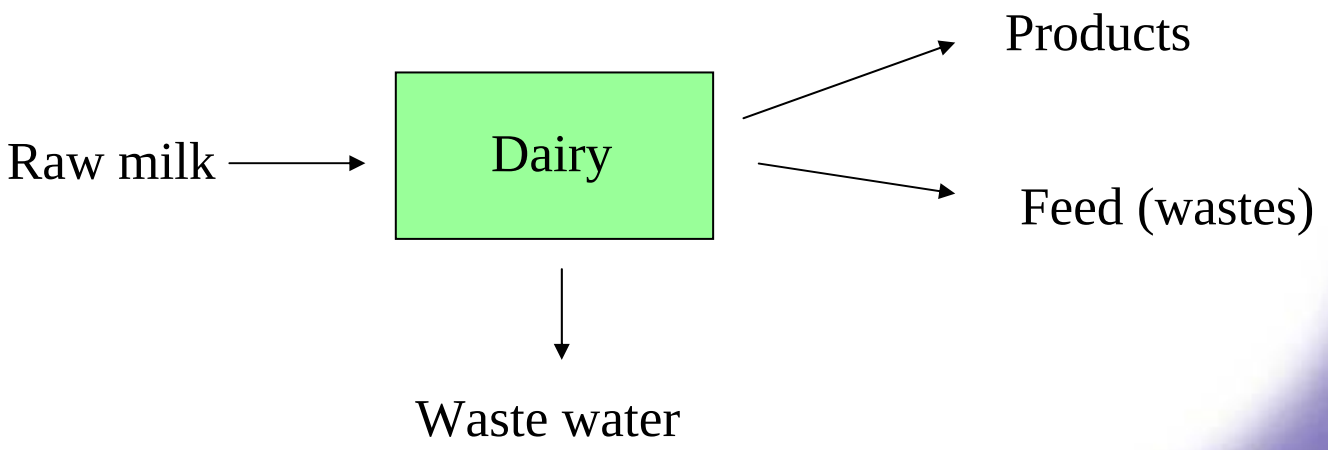
- **Driving forces / need for development: How should the environmental impact of changes be evaluated?**
  - **New technology**
  - **New products**
  - **New production organisation**

- **Systems approach, using LCA methodology**

Environmental assessment of changes in the production system (2)

Example: Zero discharge dairy, reducing emissions from dairies by:

- New measurement- and control technology
- Filtration and reuse of waters and wastage
- An environmental assessment using LCA was performed for the improvements suggested within the project

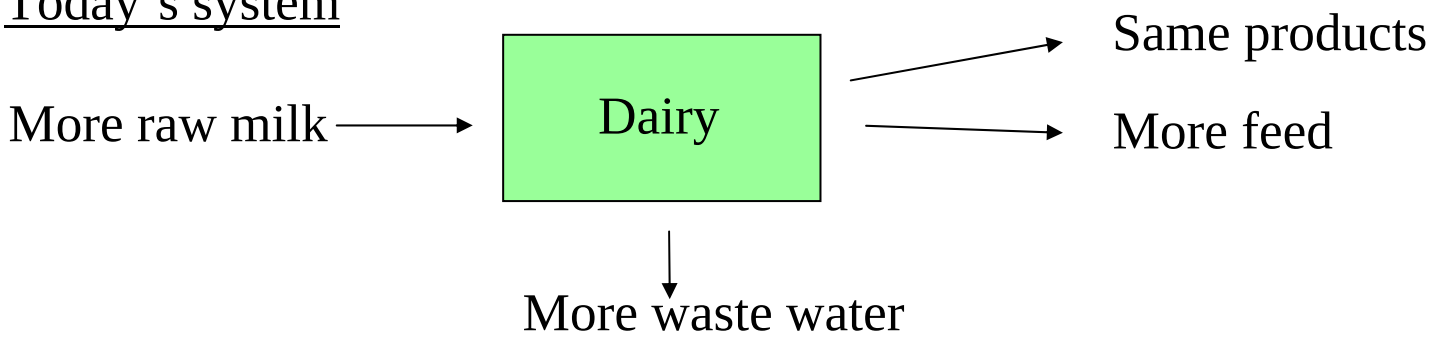


Environmental assessment of changes in the production system (3)

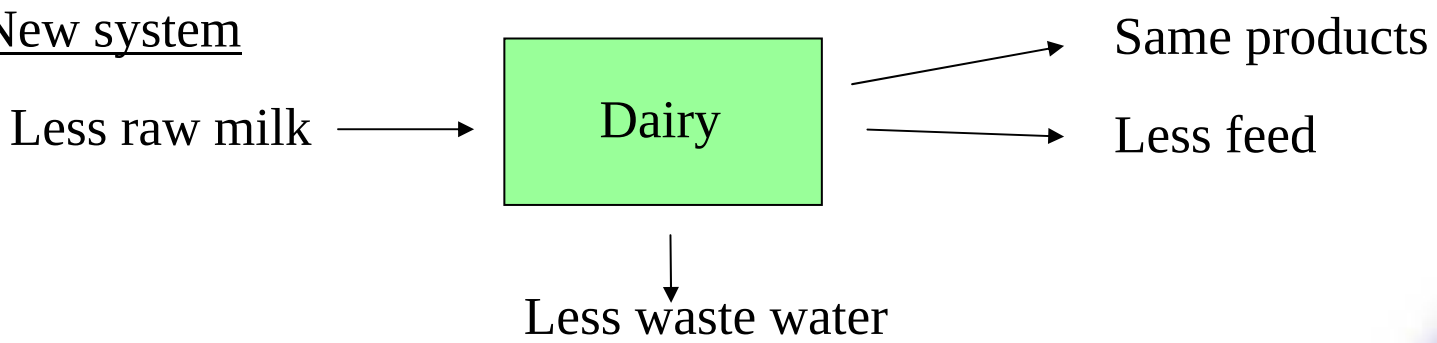
- **Different perspectives how to assess the change, e.g. less wastage in a dairy:**
  - **More products produced**
    - **Less environmental impact per produced unit**
    - **How does this affect other products on the market?**
  - **Less raw material needed**
    - **What happens with the surplus land etc?**

Environmental assessment of changes in the production system (4)

Today's system



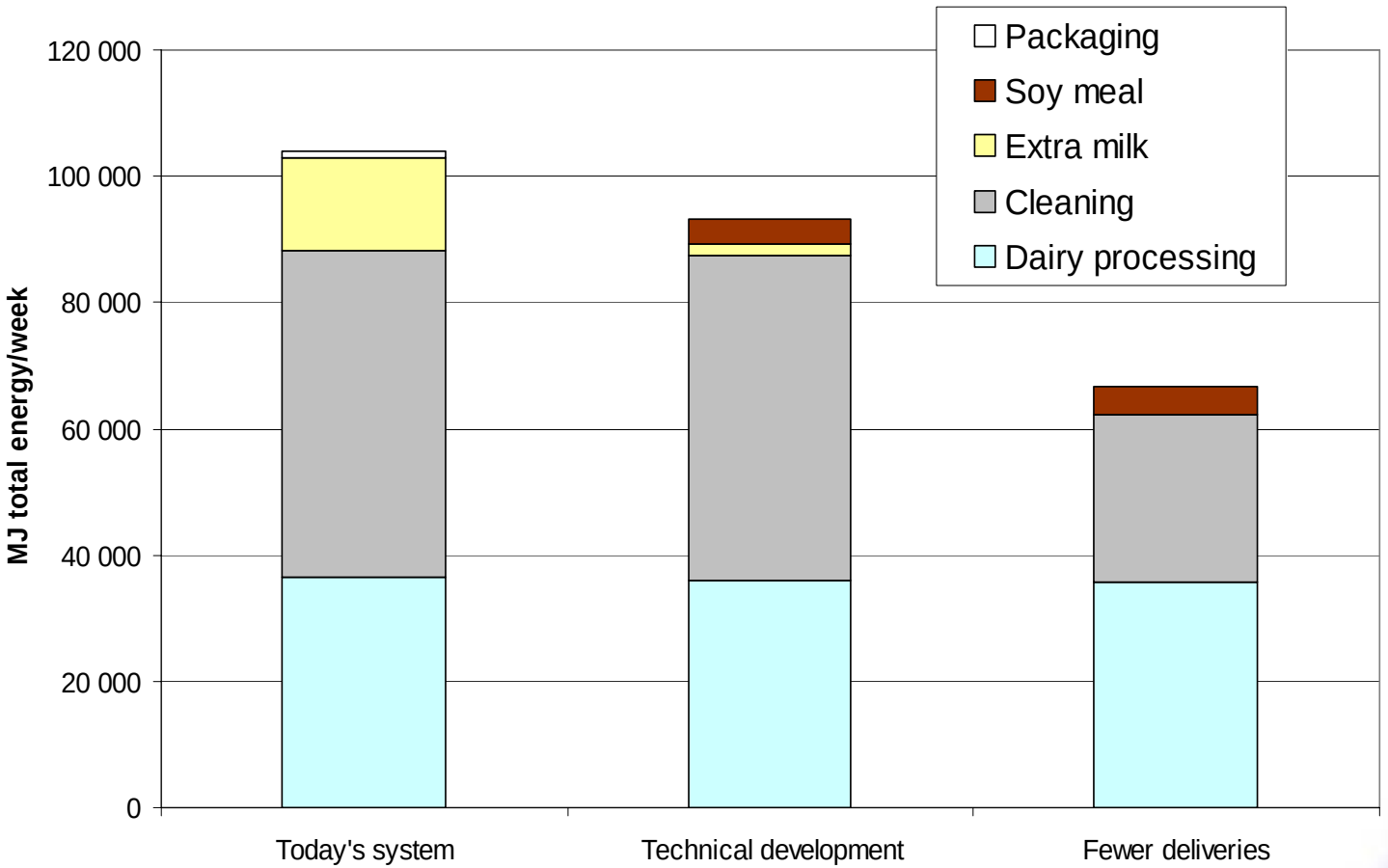
New system



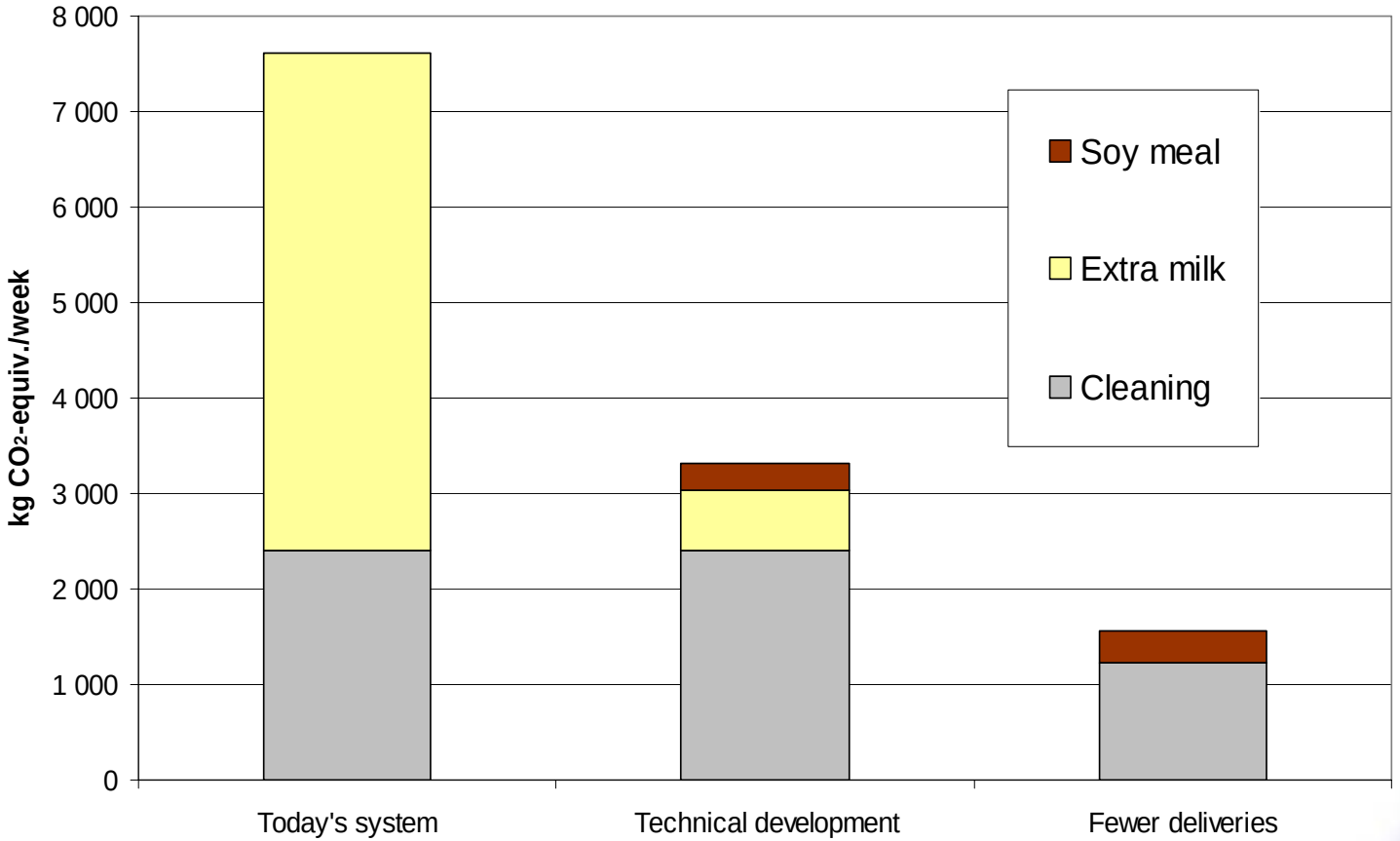
Environmental assessment of changes in the production system (5)

- **Two scenarios were analysed using a simulation model based on LCA methodology**
  - **A combination of the most promising new technology and knowledge from the project, “technical development”**
  - **A changed production planning scheme, “fewer deliveries”.**

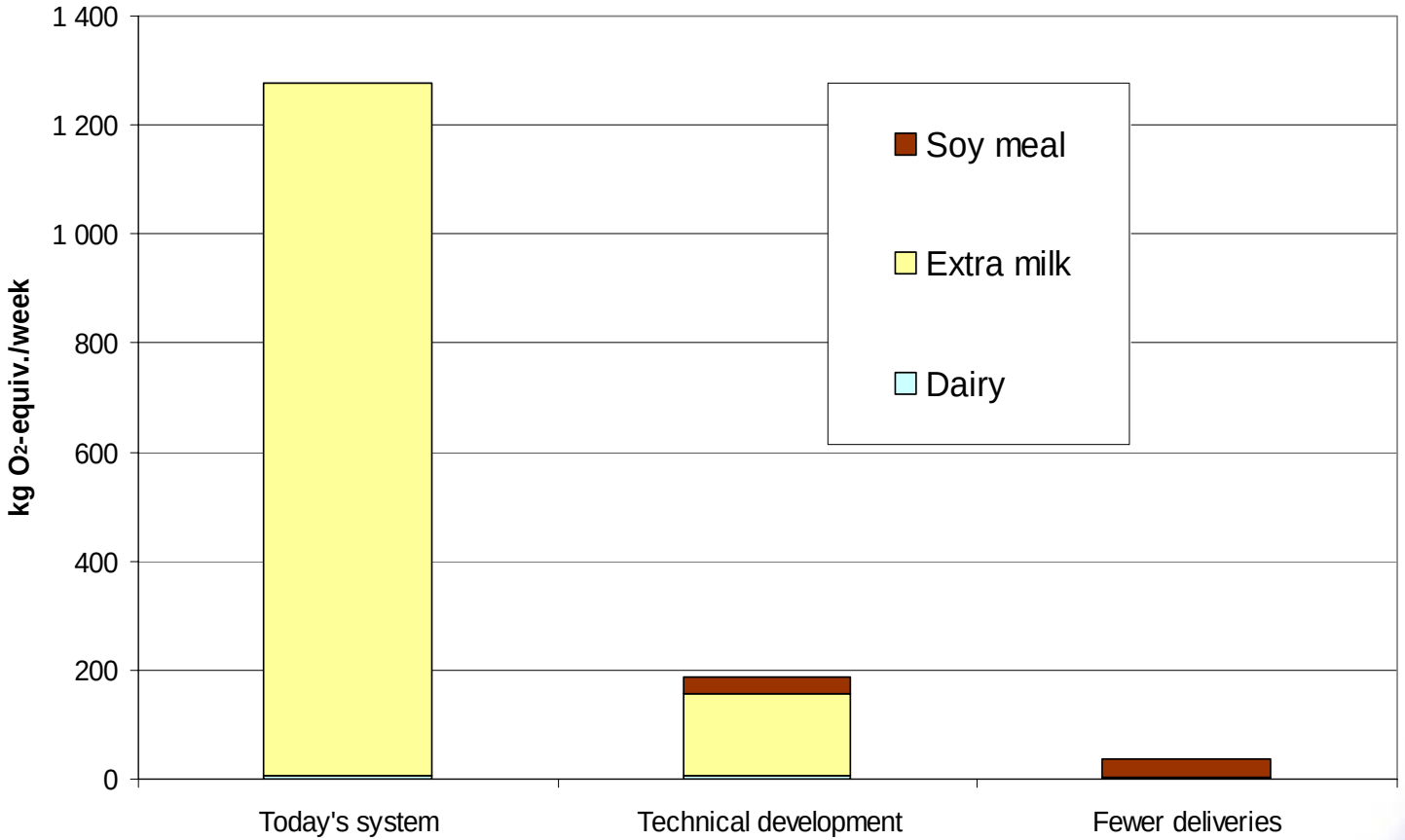
Energy use


Packaging
Soy meal
Extra milk
Cleaning
Dairy processing
MJ total energy/week
120 000
100 000
80 000
60 000
40 000
20 000
0
Today's system
Technical development
Fewer deliveries

Global Warming



Eutrophication



Modelling of future systems (1)

- **Questions:**
  - **What environmental impact will future systems have?**
  - **How could more sustainable supply chains look?**

- **Modelling to perform ”LCA for future systems”**

- **Food Chain 21 project, modelling of future supply chains for:**
  - **Dairy**
  - **Potato**
  - **Wheat**
  - **Meat**

That's it, what's next?

- **LCA is a very useful tool, or approach, when analysing food systems, but more "basic" development is needed**
  - **Ecosystem effects, e.g. of fishery and grazing animals**
  - **Toxicity (both eco- and human toxicity)**
  - **Land use**

- **Analysis of future systems can use LCA as a concept but the scenario methodology needs to be further developed**
  - **What are the functions of food?**
  - **How design scenarios for entire food systems?**
  - **How will changes in production affect the market?**