Lecture 9: Life cycle assessment

10 Life Cycle Assessment = LCA

- Various names
  - *Life cycle analysis, LCA*
  - *Life cycle inventory, LCI*
  - *Also: material flow analysis, eco-balancing, cradle to grave analysis, LCIA: life cycle impact assessment (ecological dimensions), SLCC: Social life cycle costs….*
- A study of a product's, service's or particular action's environmental effects deriving from the whole life cycle of the product
- Includes
  - the indirect effects and emissions, for e.g. a car
    - manufacturing process of a car, extraction of raw materials, final disposal
  - operational stage (which would in a car's case include fuel consumption, tyres, lubrication, repair parts etc.)
- LCA does not take economical or social aspects into consideration??
  - The economists use similar LCC (life cycle costs); SLCC

Life Cycle Assessment = LCA

- Main idea – think of *a product*
  - *Materials needed to produce the product*
  - *Energy needed to produce the product*
  - *Transportation to end users*
  - *Use of the product*
    - *Need of energy during the use*
    - *Need of maintenance (e.g. paint)*
  - *Discarding the product*
- *Calculate for all stages above*
  - *all materials, energy and emissions*
  - *environmental impacts (global warming, air pollution, water pollution, environmental health consequences…)*
- *Have this all in numbers to be able to compare two products*

LCA, what is it for?

Companies

- Cleaner processes with good cost efficiency
- Benchmarking of processes
- Comparison of products
- Product declarations
- Marketing, spreading fact based information
- Focusing research and development actions
- Strategic management
- Defining the life cycle costs

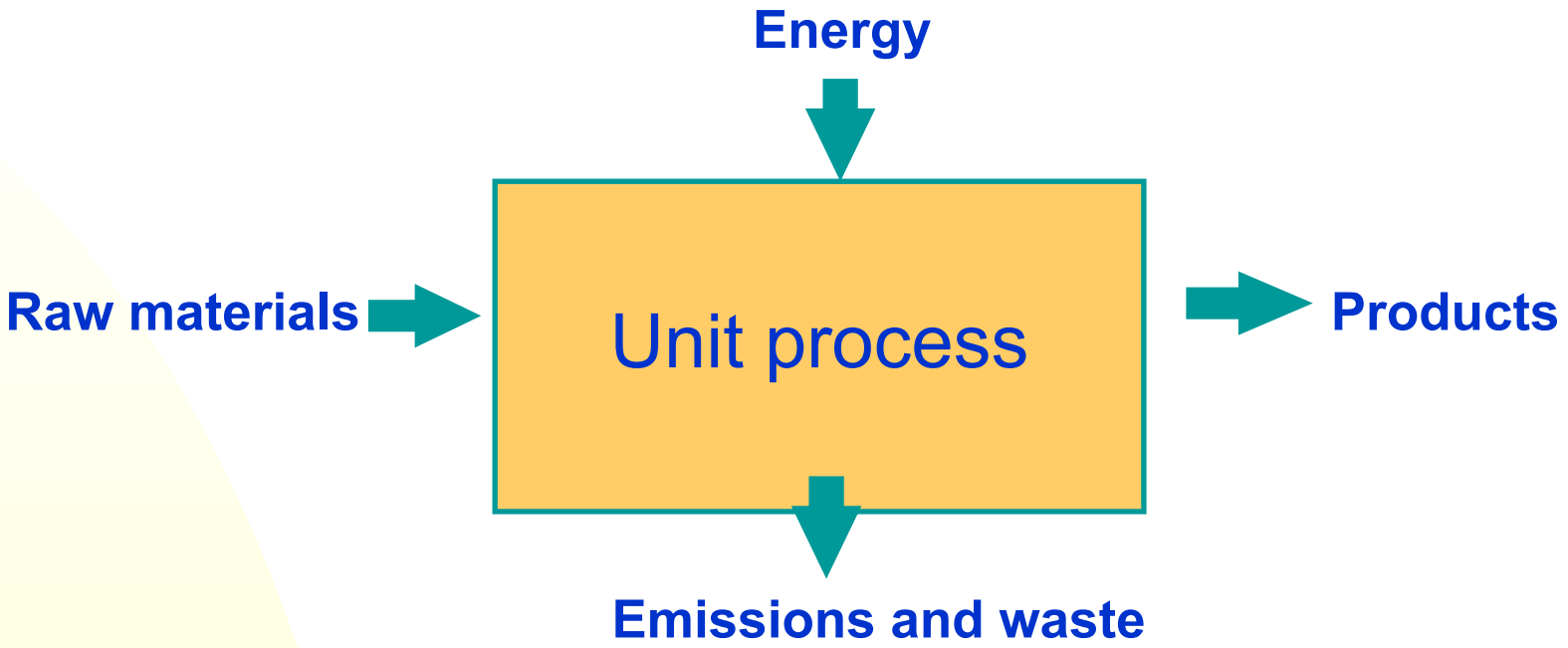
  (LCC=life cycle costs)

Politics/decision makers

- Sanctions and support mechanisms based on environmental performance
- Product policies
- Waste management policies
- BAT = best available technology
- Criteria for environmental labeling…
- Focusing rresources to the right places
- Etc. Etc.

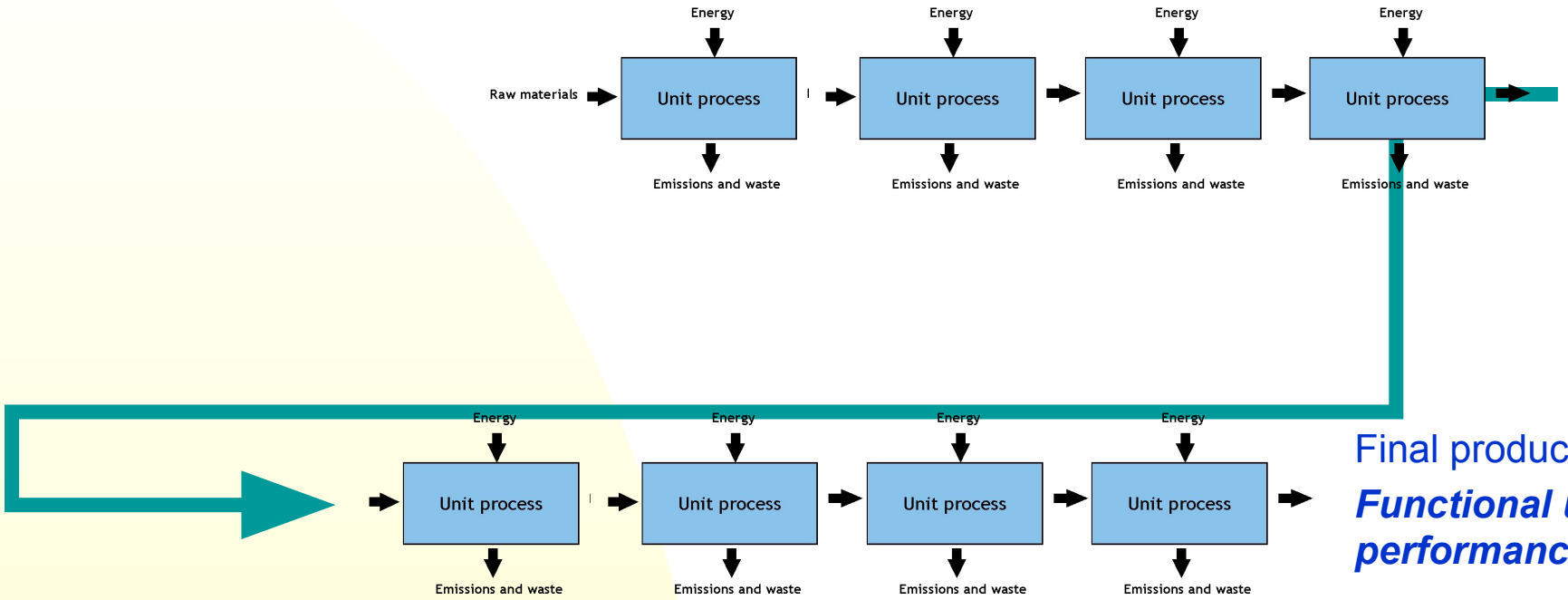
- ***Public?***
  - Carbon footprints
  - Car's CO_2 emissions
  - Etc.

Unit process



A unit process can be e.g.:
- raising a temperature of a room of 9m³ from 19°C to 20°C
- transporting waste in a waste truck with average speed of 50 km/h on a regional paved road, 1 kg * 1 km

A system is made up of several unit processes and leads to a desired outcome, which is called a functional unit.



Final product is

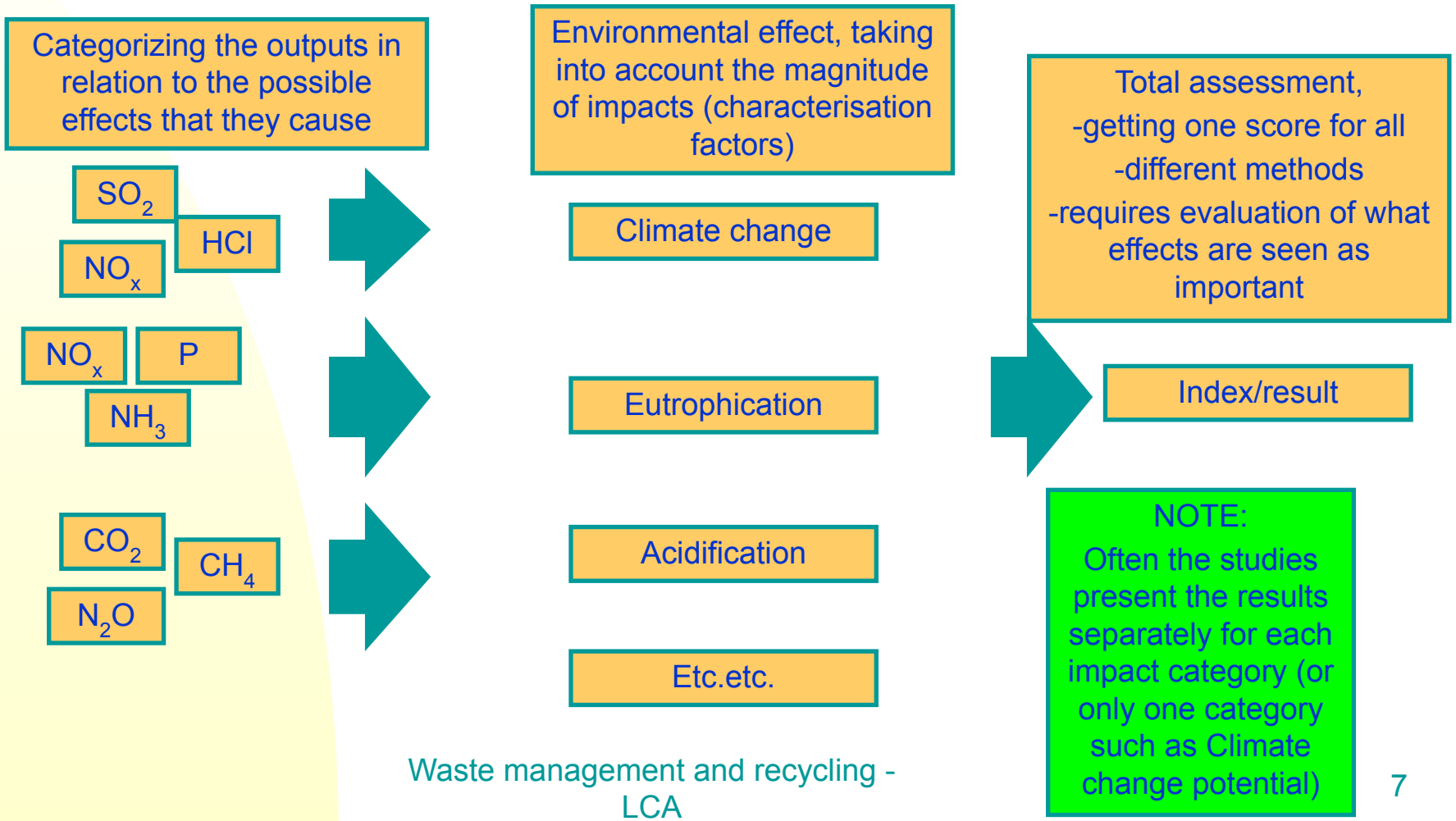
Functional unit= the quantitative performance of a system

A functional unit can be e.g.:
- Keeping the temperature of a room of 9m³ in a steady 20°C temperature for 30 years in Mikkeli
- The waste management of a 4 person family for one year

Emissions are often calculated per functional unit such as
- 1 kg of packaging material / 1 kg of fuel consumed
- 1 km of transport with a vehicle

Different emissions cause different things in our environment

Impact assessment deals with this topic, examples:



Impact assessment methods - Midpoint

- Methods are either Midpoint or Endpoint methods.
- Midpoint is the preferred way according to ISO standard
- Midpoint methods include:
    - Resource use (raw materials, land, energy)
    - Health effects
    - Ecological effects

- The environmental effect indicators should present the results with
    - only a reasonable amount of uncertainty
    - in a form that is usable for the interest groups
- Middlepoint methods leads to the fact that the results may be given in many different units
- This can make it difficult to analyse which effect is the most important in the total system.

Impact assessment methods - Midpoint cont.

Midpoint-oriented methods place indicators relatively close to the interventions

Example:

- Global Warming Potential (GWP) is not expressed in temperature change in the atmosphere (this would be ”quite” difficult), but it is expressed in e.g. CO_2-equivalents
  - Different emissions are valued to the same global warming potential scale with CO_2 by characterisation factors (eg methane’s factor is 21 or 25 depending on the method)
  - Characterisation of emissions by their actual effects is difficult, especially for human health effects or ecotoxicity

  - http://www.waterfootprint.org/?page=files/home

Impact assessment methods –

Endpoint or damage oriented

- **Endpoint or damage oriented methods** take a step further than midpoint methods
- Endpoint methods present results in the following categories:
  - Resource extraction
  - Human health
  - Ecosystem quality

- Endpoint= the negative phenomena in the environment, human health or natural resources that can be linked to a ceartain emission that causes it

- E.g. climate warming will cause problems for human health
  - Human heath is the endpoint
  - Emissions that cause the damage to human health are middlepoints.
- In real world, the characterisation factors for certain emissions vary according to the surrounding environment. Global effects are however different: Climate change and ozone layer depletion are truly global problems, it does not matter where you produce the emissions