

# Life Cycle Assessment (LCA)

- Brief introduction into LCA
- WP3: Life Cycle Assessment

## SEAT – Inception Meeting

Jeroen Guinée – René Kleijn – Patrik Henriksson

Institute of Environmental Science (CML)

Department of Industrial Ecology (IE)

Leiden University

Rayong Rim Pae, 14-16 January 2010



Universiteit Leiden

The Netherlands

# **Brief introduction into LCA**

# Which is performing environmentally better ?



Ceramic mug or plastic cup?

**Note: hypothetical case, data & results:  
no real-life conclusions possible !!**

# What should be part of the analysis ?

- Which aspects to include:
  - Environmental impacts (all)
    - Which impacts?
  - Social aspects ?
  - Safety ?
  - Economic costs ?
- Which processes to include (all):
  - Production
  - Use (including wash up)
  - Waste treatment
  - Production & extraction raw materials
- Product or function/service as the object of the study

integrative, holistic approach:

-cradle-to-grave;

-all generic impacts

# Research question

- Which performs better in terms of environmental impact as a coffee container: a ceramic mug or a plastic cup ?

**Goal & Scope definition**

# Functional Unit

- containment of 1000 cups of coffee
- 1000 plastic cups (?)
- 0.1 ceramic mug (?)

**Goal & Scope definition**

## Data collection (upstream)

- production of plastic cup
- production of plastic
- production of ethylene
- production of oil
- winning of crude oil
- (transport & capital goods)

**Inventory analysis**

## Data collection (downstream)

- use of the cup
- washing up of the ceramic cup
- waste collection
- waste treatment
- (transport & capital goods)

**Inventory analysis**

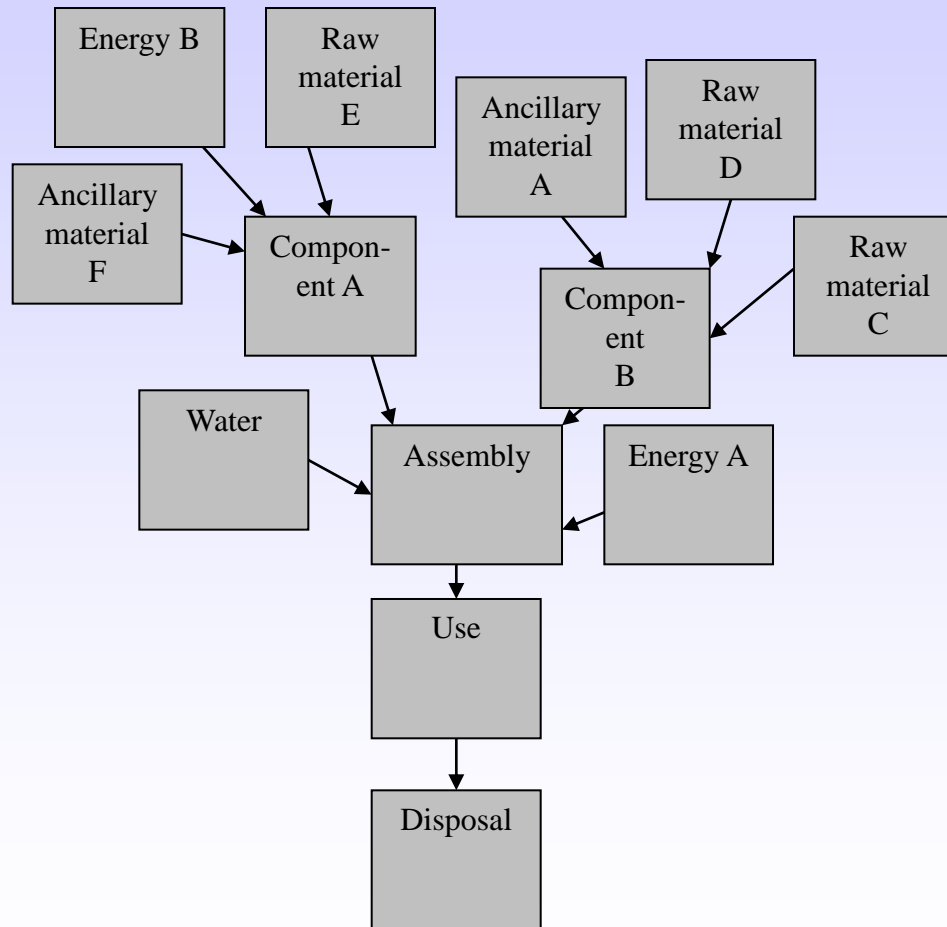


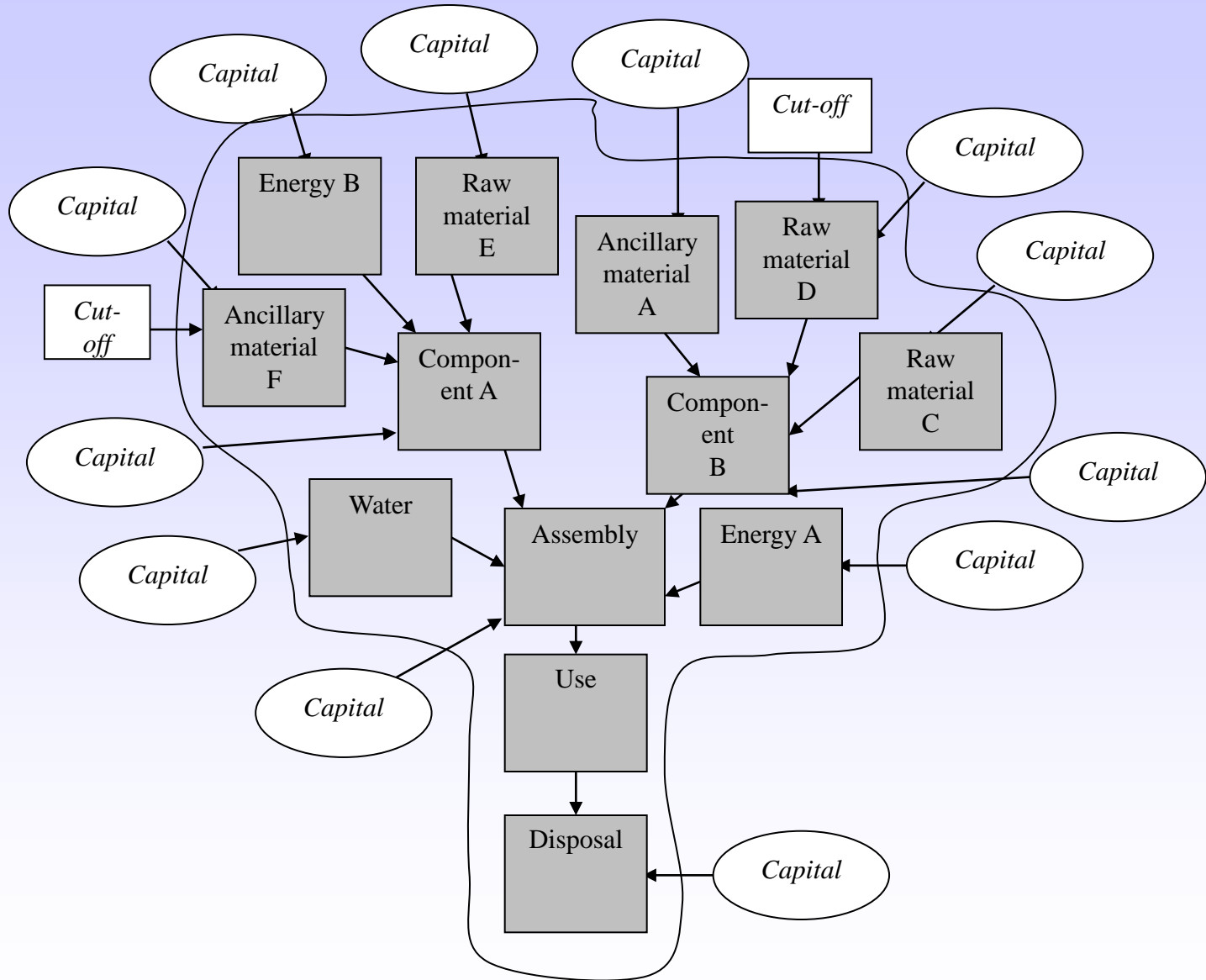
# Linking the processes to create a product system

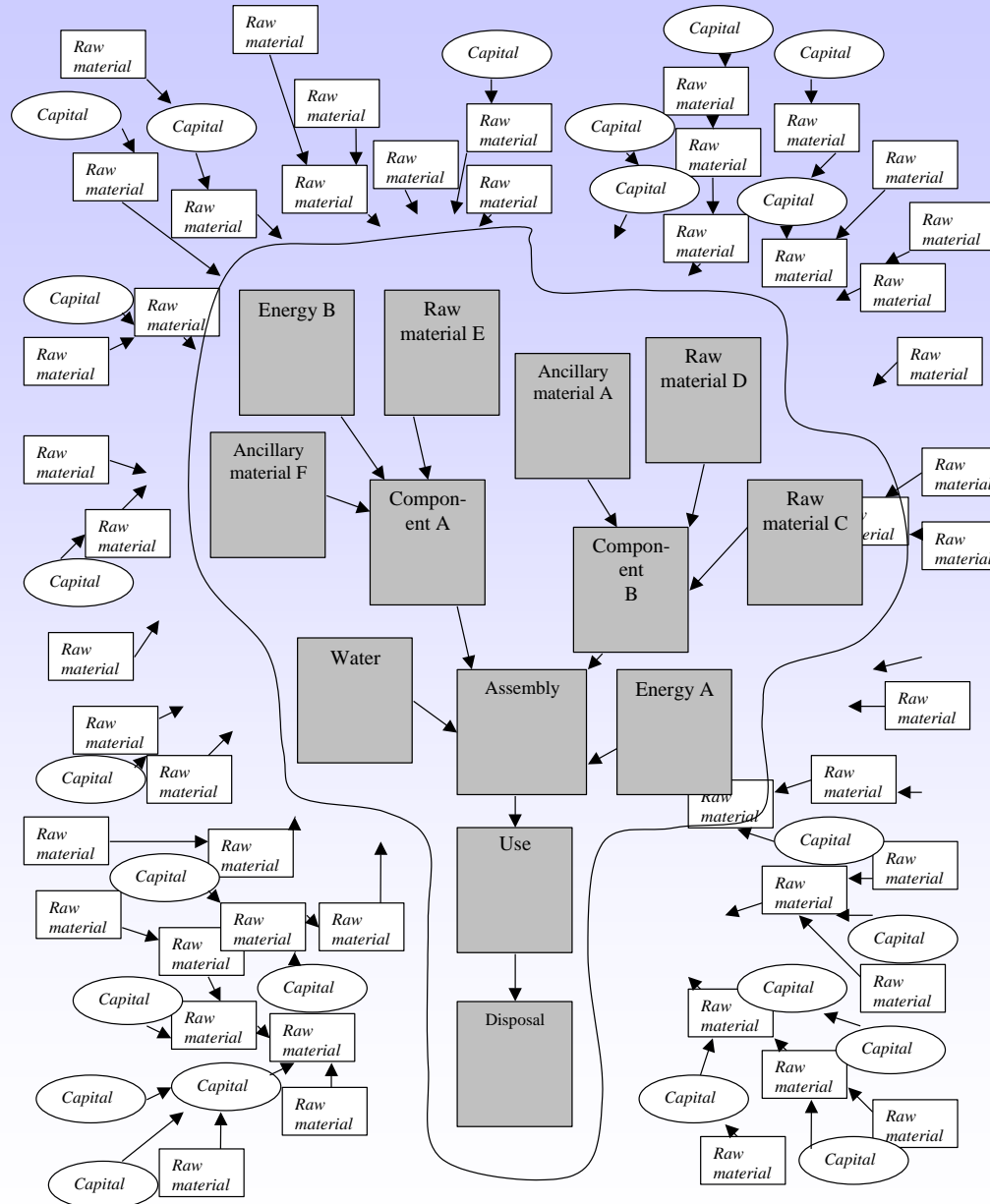
- Linking and scaling the processes
- Adding up all emissions and extractions
- Result:
  - Long list of emissions and extractions

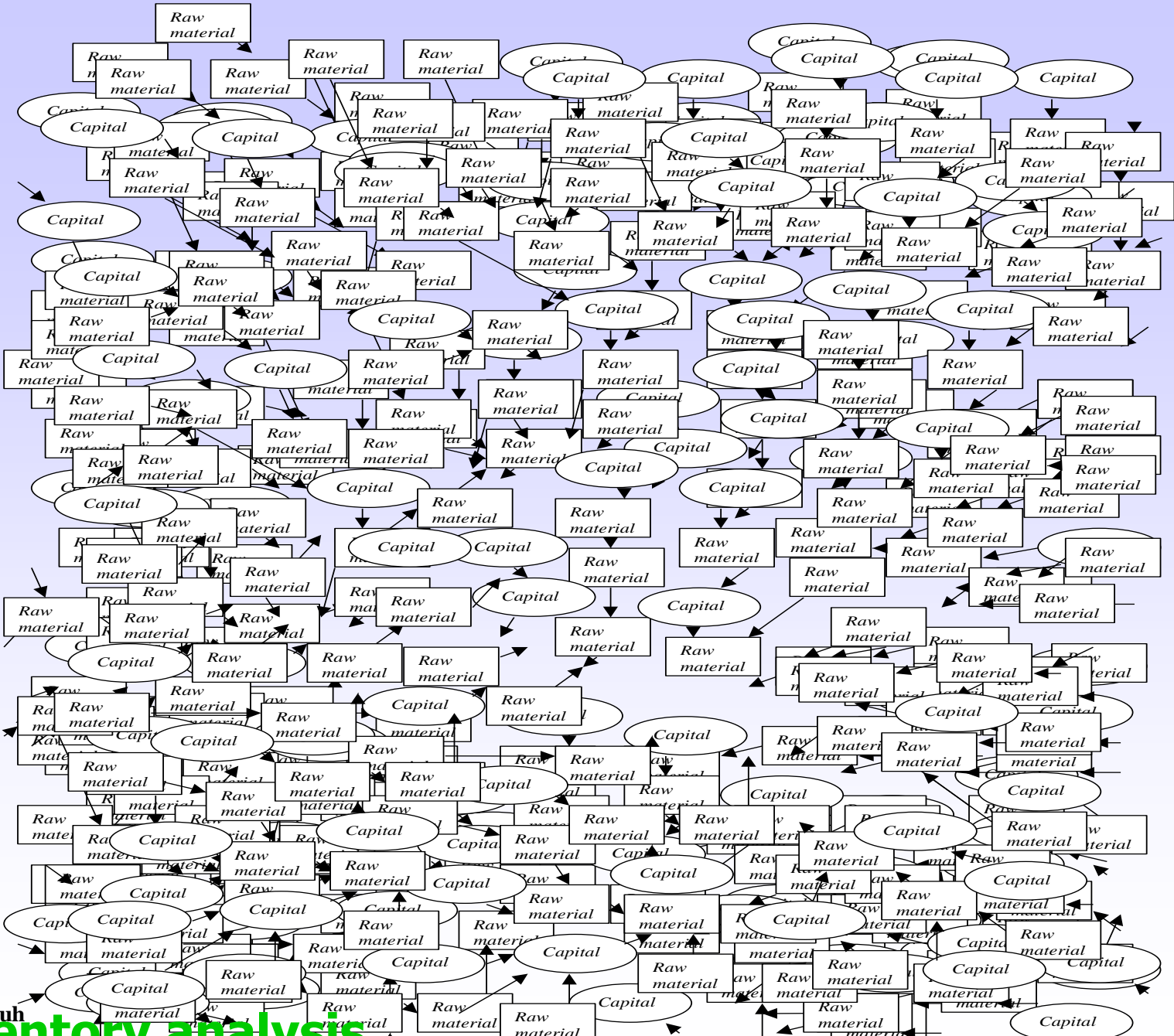
**Inventory analysis**

# Linking processes – many, many ....









# Inventory analysis

## Which is better ?

---

Ceramic cup	Plastic cup
<ul style="list-style-type: none"><li>• 10 kg crude oil</li><li>• 1 kg iron ore</li><li>• 5 kg hardwood</li><li>• 100 l water</li><li>• 10 kg sand</li></ul>	<ul style="list-style-type: none"><li>• 5 kg crude oil</li><li>• 2 kg iron ore</li><li>• 1 kg hard wood</li><li>• 10 l water</li><li>• 6 kg sand</li></ul>
<ul style="list-style-type: none"><li>• 100 kg CO<sub>2</sub></li><li>• 10 kg CH<sub>4</sub></li></ul>	<ul style="list-style-type: none"><li>• 50 kg CO<sub>2</sub></li><li>• 10 kg CH<sub>4</sub></li></ul>
<ul style="list-style-type: none"><li>• 1·10<sup>-9</sup> kg dioxin</li><li>• 5 kg NO<sub>x</sub></li></ul>	<ul style="list-style-type: none"><li>• 4·10<sup>-9</sup> kg dioxin</li><li>• 0.1 kg NO<sub>x</sub></li></ul>

---

# Converting emissions & extractions to environmental impact contributions

---

## Examples of impact categories

- 
- Depletion of abiotic resources
  - Depletion of biotic resources
  - Impacts of land use
    - land competition
    - loss of life support function
    - loss of biodiversity
  - Climate change
  - Stratospheric ozone depletion
  - Human toxicity
  - Aquatic ecotoxicity
  - Terrestrial ecotoxicity
  - Photo-oxidant formation
  - Acidification
  - Eutrophication
  - Etc. ...
-

# Adding up emissions that contribute to same environmental problem, e.g. Global Warming

Global Warming Potential (GWP): measure for Global Warming in terms of radiative forcing of a mass-unit

Suppose: CH<sub>4</sub> and CO<sub>2</sub>

CH<sub>4</sub> has an impact per kg which is 25 times higher than CO<sub>2</sub>

Example calculation:

5 kg CO<sub>2</sub> (GWP = 1)

+

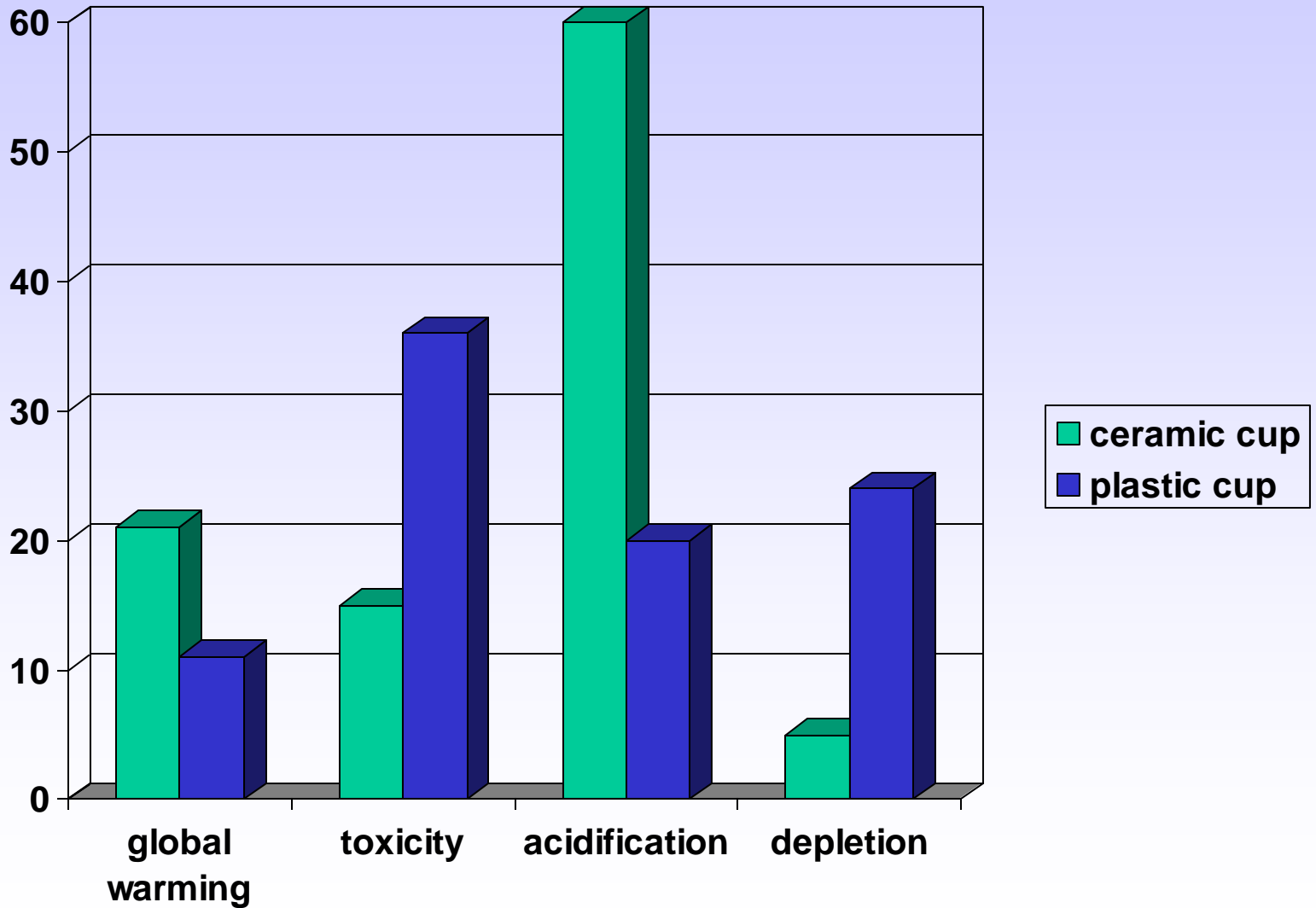
3 kg CH<sub>4</sub> (GWP = 25)

=

1 x 5 + 25 x 3 kg CO<sub>2</sub> - equivalents (= 80 kg CO<sub>2</sub> – equivalents)



# Which is better ?

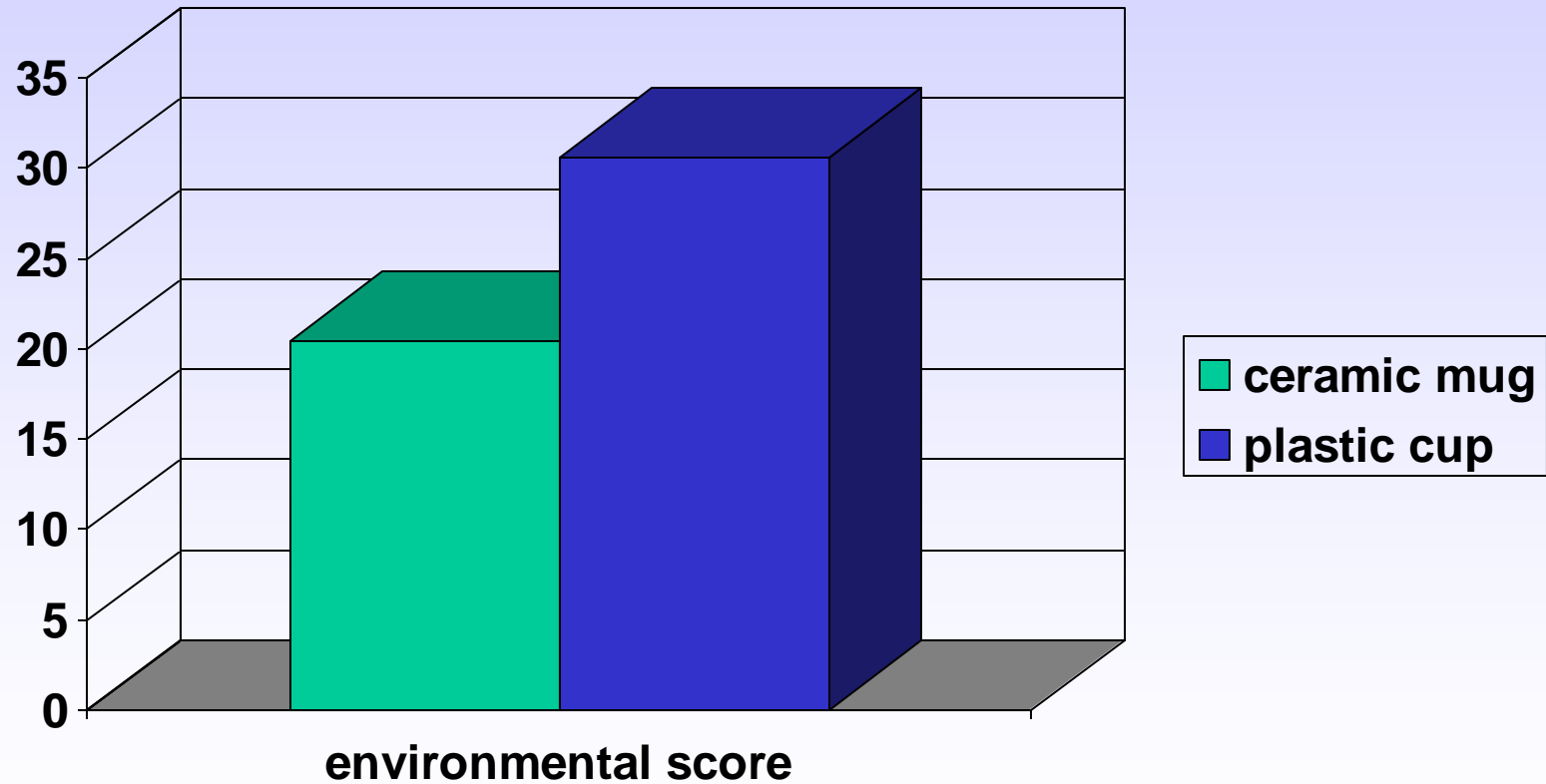


**Impact Assessment**

# Weighting of Environmental Problems

- In order to arrive at a conclusion some sort of weighting is needed
  - e.g. panel of experts

# The ceramic mug is better !

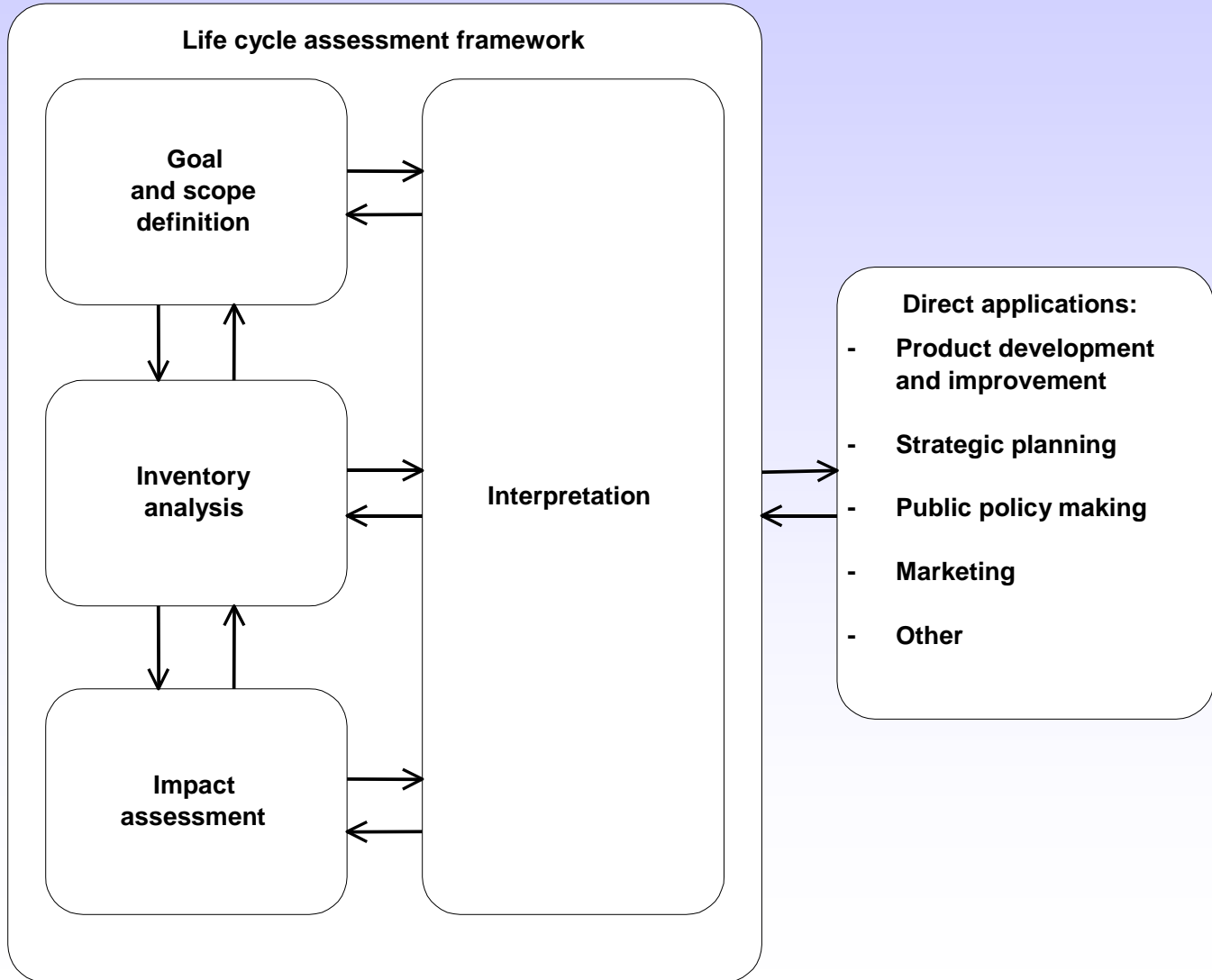


**Interpretation**

## However .....

- Unfortunately LCA is not that simple !
  - LCA training week later on
- There are other tools !!
  - There exists no such thing as a super-tool
- LCA is still developing
  - LCSEA (EU CALCAS project:  
<http://www.calcasproject.net/>)

# ISO 14040/4 LCA framework

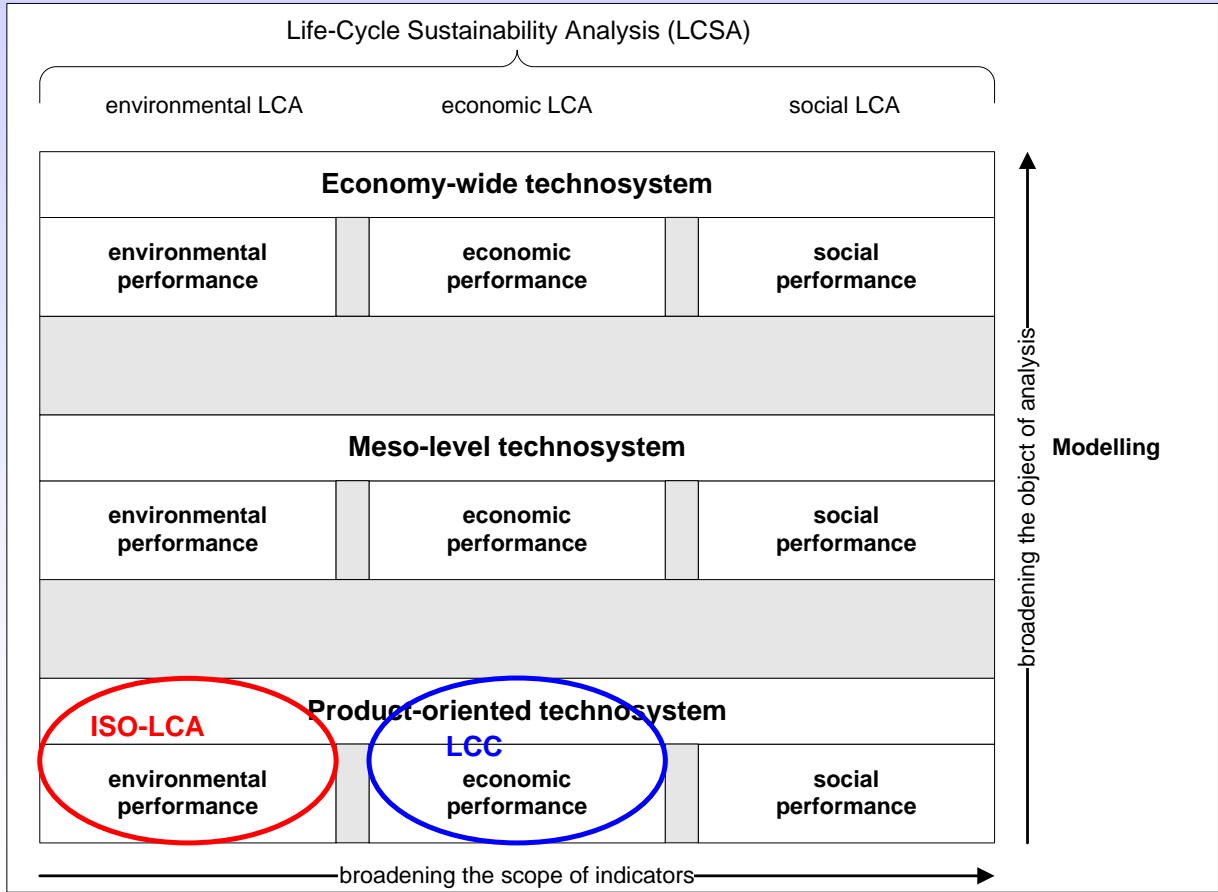


# CALCAS LCSA framework

Goal and scope definition

Goal and scope definition

Modelling



Interpretation

Interpretation

# WP3: Life Cycle Assessment



Universiteit Leiden  
The Netherlands

# Role of LCA in SEAT

- Second S&T objective: to develop improved and transparent measures of sustainability for selected food production systems
  - The methodological approach will use a range of tools including LCA to develop a holistic framework.
  - Develop overall Ethical Aquatic Food Index (EAFI)
- Various types of info are needed for this EAFI, including:
  - Social impacts (WP5)
  - Economic impacts (WP5, LCC)
  - Environmental impacts
    - Local environmental impacts (WP7)
    - Generic environmental impacts (WP 3 : LCA)
- LCA is thus part of a comprehensive sustainability toolbox
  - Holistic framework: whole life cycle of aquaculture systems, all burdens and generic (non-local) impacts; coverage of environmental, economic (and maybe also some social) aspects
  - But .... just one tool !



# WP3 – Life Cycle Assessment (LCA)

## General objectives

1. Training week: all project partners orientated in the basic principles of LCA by transferring expertise and practical experiences on LCA, particularly from EU to ASIA
2. LCA methodology developed for aquaculture systems, i.e. operational guidelines for LCA studies on aquaculture systems
3. Developing LCA data for aquaculture systems
4. Use LCA results to compare environmental performance of products and services associated with the specified Asian finfish and crustacean production systems and warm-water aquaculture systems for the same species in Europe
  - Provide guidance on the least harmful or burdensome options

# Core staff from CML

- Jeroen Guinée

- PhD, senior scientist / assistant professor



- René Kleijn

- MSc, senior scientist / assistant professor



- Patrik Henriksson

- PhD candidate on SEAT project



- Rattanawan “Tam” Mungkung

- PhD, liaison between CML & Asean partners, sub-contracted by CML



# About Dr Rattanawan “Tam” Mungkung

- Sub-contractor of Leiden University
- Specialist on LCA of aquaculture

- Previous experiences:

2005:

- PhD dissertation on “Shrimp Aquaculture in Thailand: Application of LCA to support sustainable development” (THAILAND)

2006:

- Project leader “LCA of frozen white shrimp for participatory environmental management in the supply chain” (THAILAND)
- Specialist “Study on ecolabelling of aquatic products: General view and future considerations for the ASEAN region” (ASEAN COUNTRIES)

2007:

- Researcher “LCA of finfish production system in temperate and tropical areas: Application for sustainability assessment and indicators” (INDONESIA, PHILIPPINES, FRANCE)

2008

- Project leader “Capacity building of Thai food industries on “carbon footprint labelling” to promote the development of low-carbon trade between EU and Thailand for climate change mitigation” (THAILAND, UK, FRANCE, GERMANY)

2009

- Project leader “Carbon footprint and label of agricultural and food products to enhance competitiveness and promote low-carbon economy” (THAILAND)

# Roles of Dr Rattanawan “Tam” Mungkung

- Assist with the organisation of LCA training workshop in BKK
- Contribute to the development of LCA methodology
- Visit the studied sites in China, Vietnam, Bangladesh and Thailand
- Assist SEA partners in applying LCA methodology
- Coordinate with SEA partners in LCI data collection and processing
- Assist a PhD student from Leiden during his work in SEA
- Attend WP3 and relevant project meetings

## Other contributors

Partner	Person-months
UOS	2
CEFAS	2
UCPH	1
WU	1
SOU	26
CU	26
KU	26
BAU	26
WWF	1
WFC	2
UiB	1
DIIS	1

# First task: T3.1 LCA Training

- Objectives:
  - To get all project partners not already familiar yet with LCA acquainted with its basic principles
  - Technical workshop covering principles, inventory collection methods, impact assessment, case studies and small exercises
  - (Standardization of) data collection methods and formats
  - We will use the training to have the trainees develop flow charts of “their own” aquaculture systems
    - Each LCA topic will be dealt with in this way as far as possible
- Date & venue: September 2010, Bangkok ??
- Prepared by CML staff and supported by Tam Mungkung
- Training is primarily meant for scientists collecting the field data

## Other tasks and deliverables

- Planning of other tasks is being made
  - Planning will be finalised and disseminated in next 2 months including proposal for division of tasks among partners



# Summary of urgent issues

- LCA Training
  - Date & venue: September 2010 (month 13!!), Bangkok ??
  
- Site visit schedule
  - All PhDs together on some occasions?
  - Link to meeting, workshop,etc. schedule?