Life Cycle Thinking for Sustainable Consumption and Production

Shabbir H. Gheewala

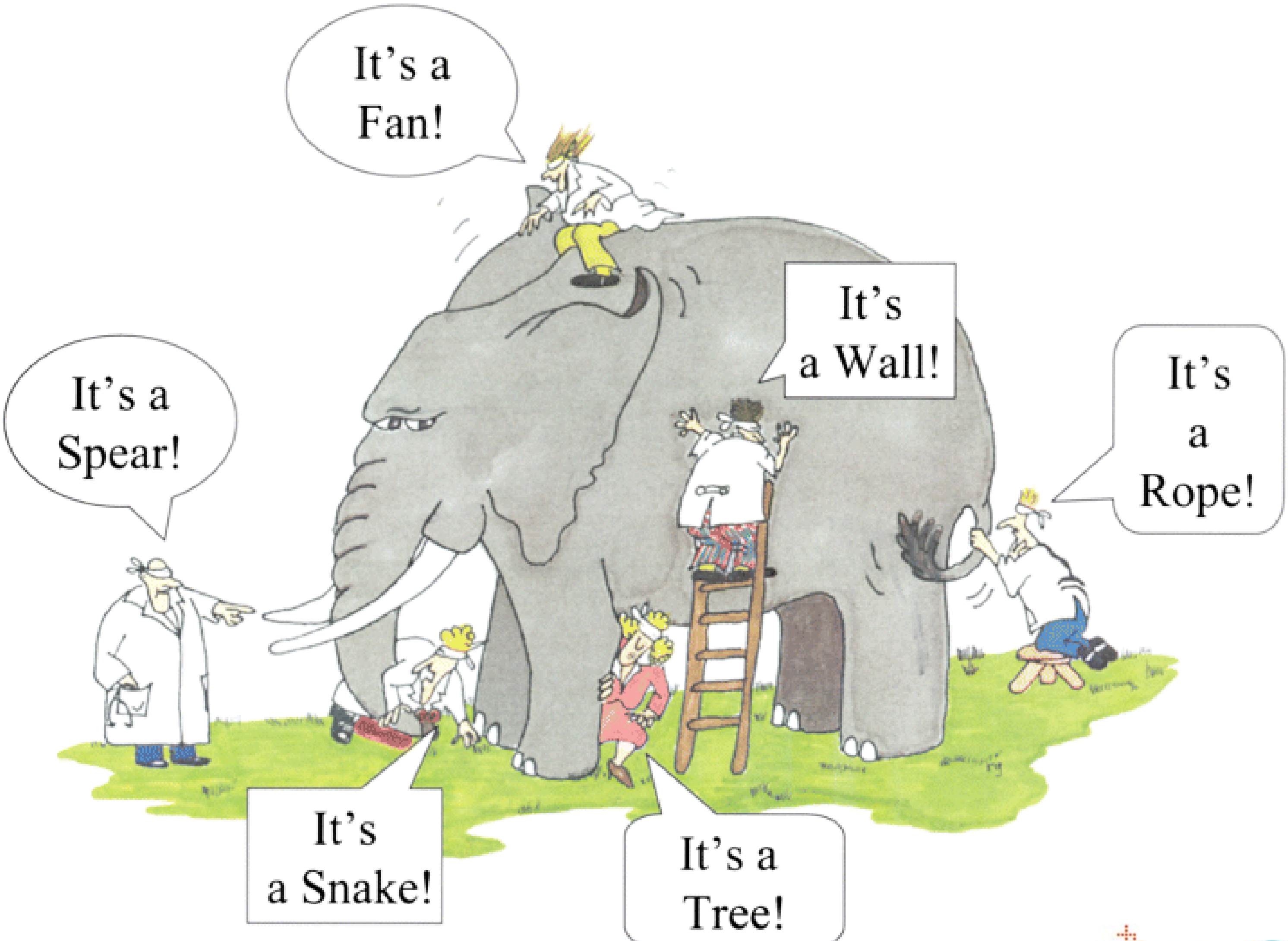
Professor and Head

Life Cycle Sustainability Assessment Lab
The Joint Graduate School of Energy and Environment
King Mongkut's University of Technology Thonburi

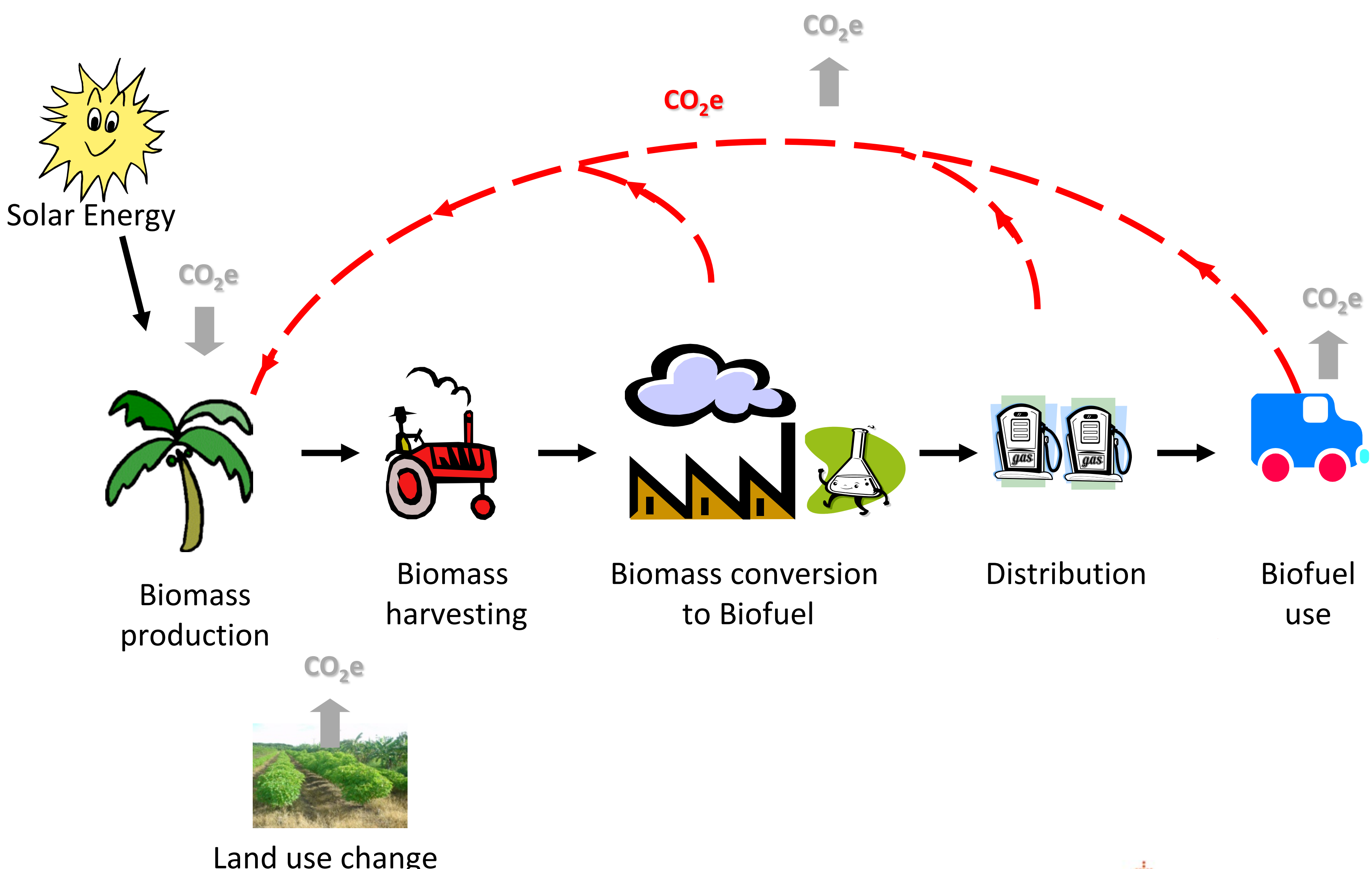
Eighth Researchers Meeting of the International Research Network for Low Carbon Societies
Wuppertal, Germany, 6-7 September, 2016

WHY LCA?

Six blind-folded men and the elephant



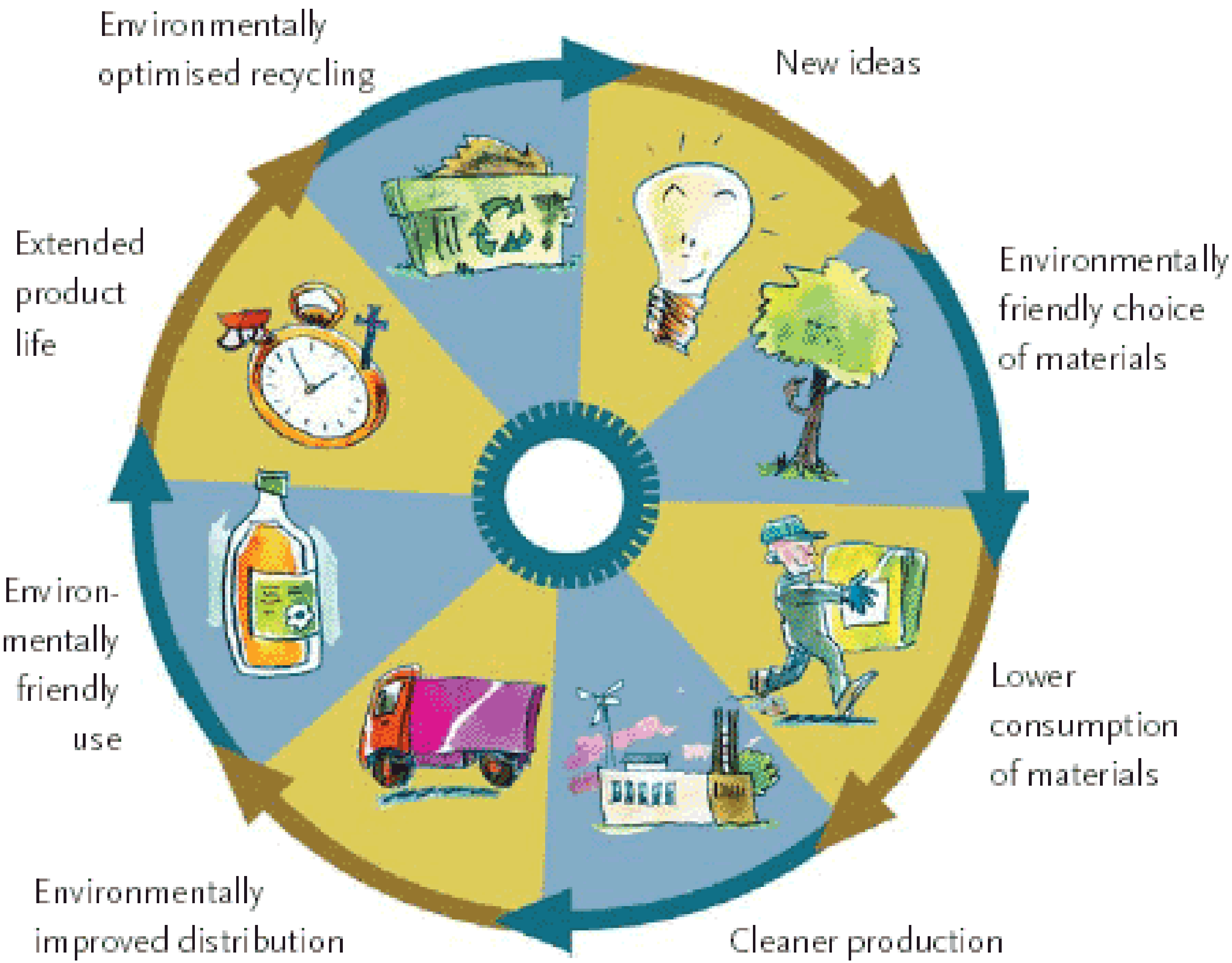
Why are biofuels considered green?



KMUTT King Mongkut's University of Technology Thonburi

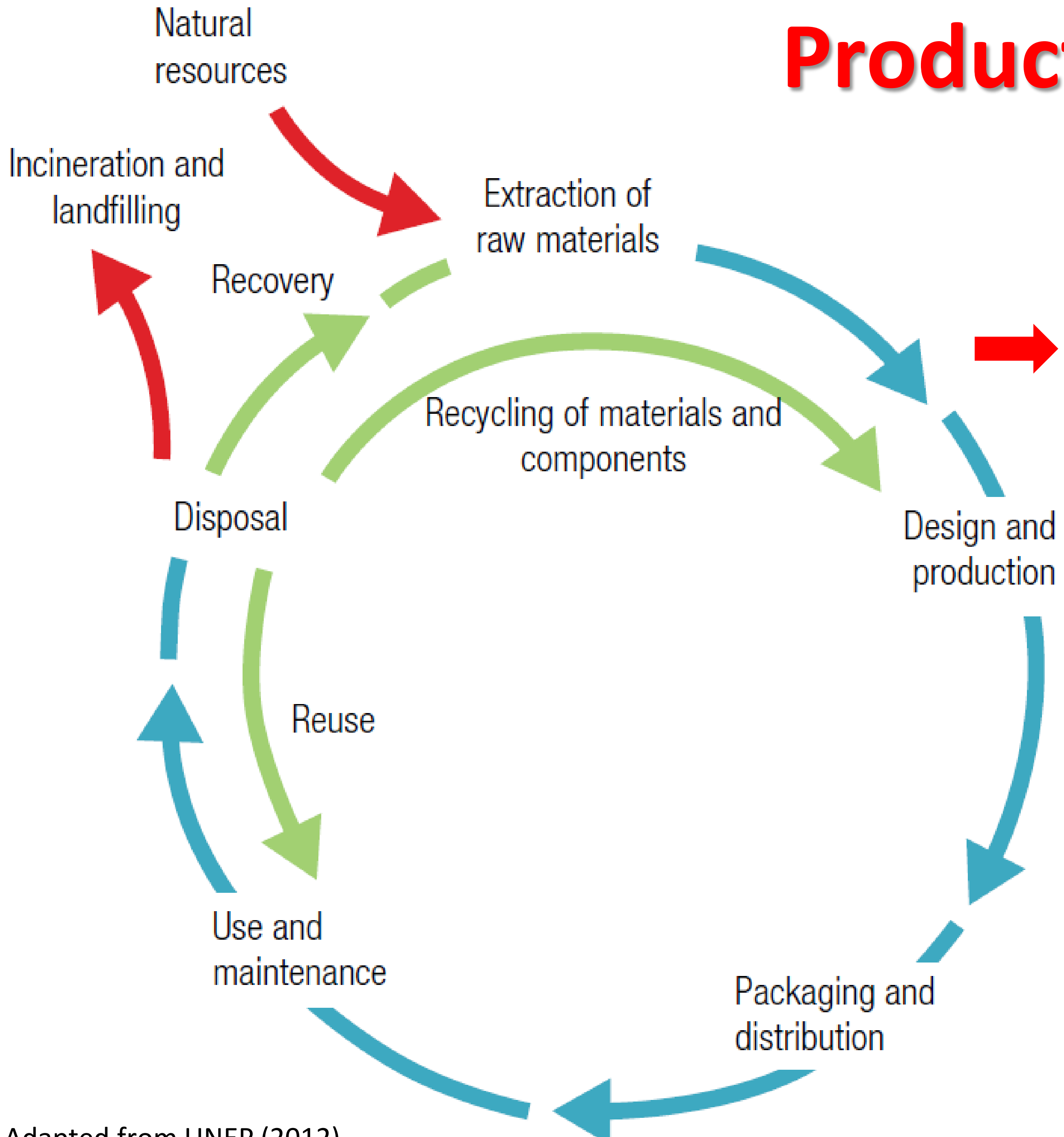
LCSAL

Life Cycle Management



Gade and Mortensen, 2003

Product life cycle



Adapted from UNEP (2012)

- Emissions to air
- Emissions to water
- Use of resources

Impacts on:
- Human health
- Ecosystems
- Resources

APPLICATIONS OF LCA FOR SCP IN THAILAND

Summary:
Life Cycle Thinking - Pathway of Thailand

Technological Institute for LC Sustainability & Trade ??

1990
Cleaner Technology

1993
Life Cycle Thinking (Type I)
- Green label

1997
- LCA Pilot Projects

2000
Life Cycle Network
- Thai LCA Network
- LCA in academics

2002
LCA/Eco-Design Capacity Building
- Supported by JP government.

2005
LCI Database Project
- Supported by MoI

2007
- **National LCI Database**
- **Thai Green Design Network**

2008
- **Eco-design excellent center**

2009
LCA Applications (+ in Policy)
- **National Carbon Footprint**
- **Eco-Product Directory**
- **Thai Eco-Design Award**

2010
- **Carbon Footprint Organization**

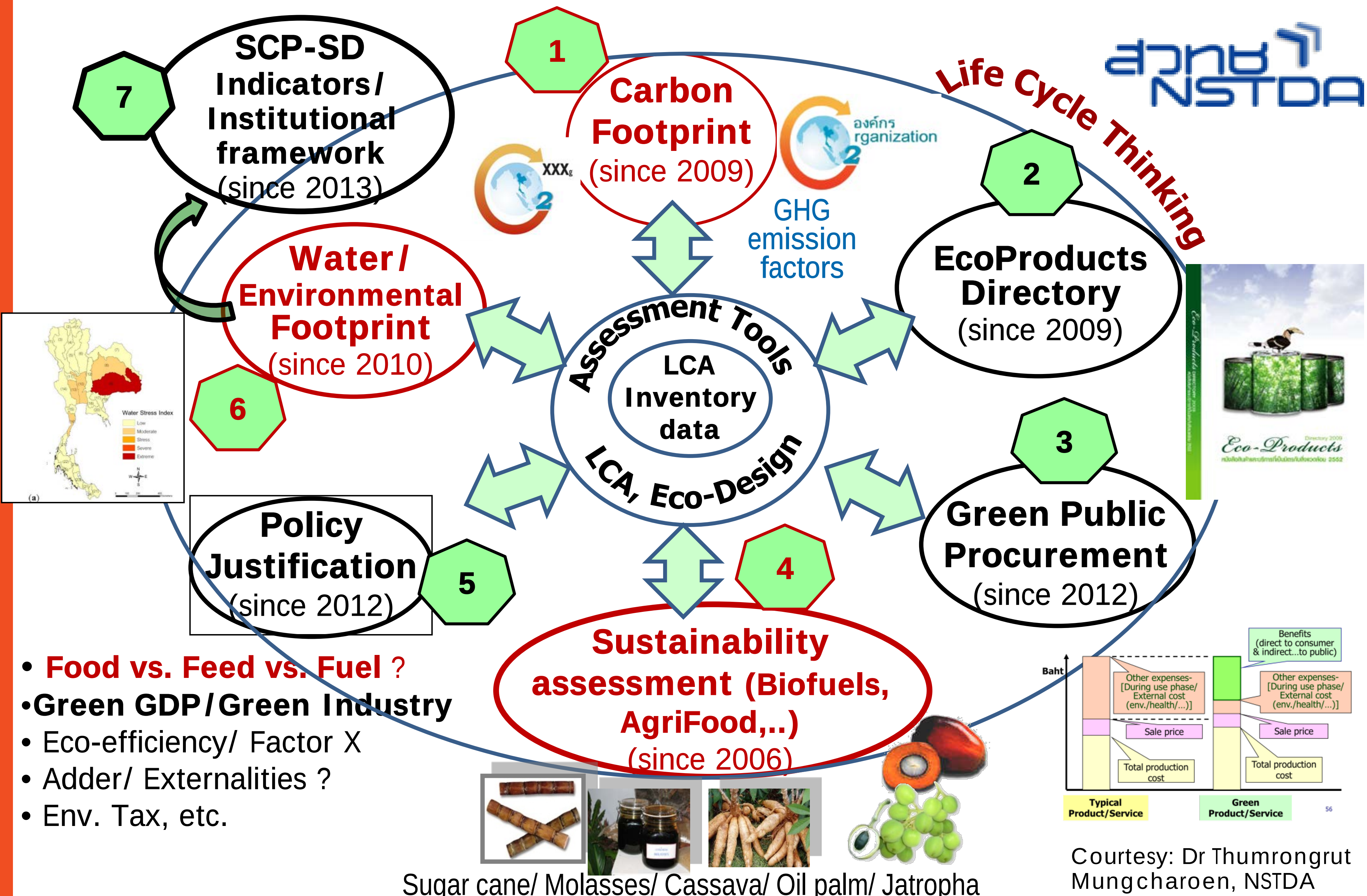
2011
- **Government Green Procurement**
- **Sustainability Biofuel Study**

2012
2014-
Sustainable Development
- National committee on SD
- Water Footprint
- Env. Footprint,
- Green GDP, SAFA
- SCP/SD indicators

Source: STI

Courtesy: Dr Thumrongrut Mungcharoen, NSTDA

LCA Applications & Initiatives



- **Food vs. Feed vs. Fuel ?**
- **Green GDP/Green Industry**
- Eco-efficiency/ Factor X
- Adder/ Externalities ?
- Env. Tax, etc.

Courtesy: Dr Thumrongrut Mungcharoen, NSTDA

LCA-based labels in Thailand

Type 1

Ecolabel
based on LCT

Type 3

Carbon footprint labels
based on LCA

Green label: 460 products from 65 companies (117 product criteria valid)

Product carbon footprint label: About 1,800 products from 400 companies!

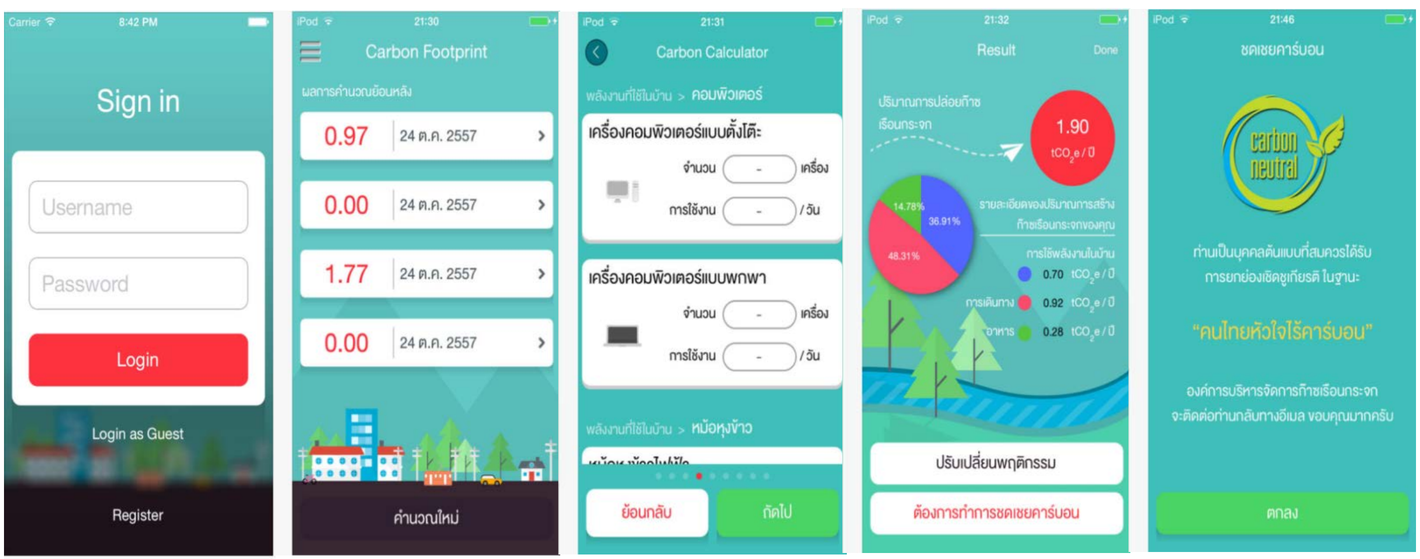
Progression of carbon labels

TGO

Carbon footprint reduction label:
GHG reduction = 880,000 t CO_2e
122 products from 32 companies

Carbon offset and neutral program:
GHG reduction – 12,000 t CO_2e

CO_2 UPCYCLE

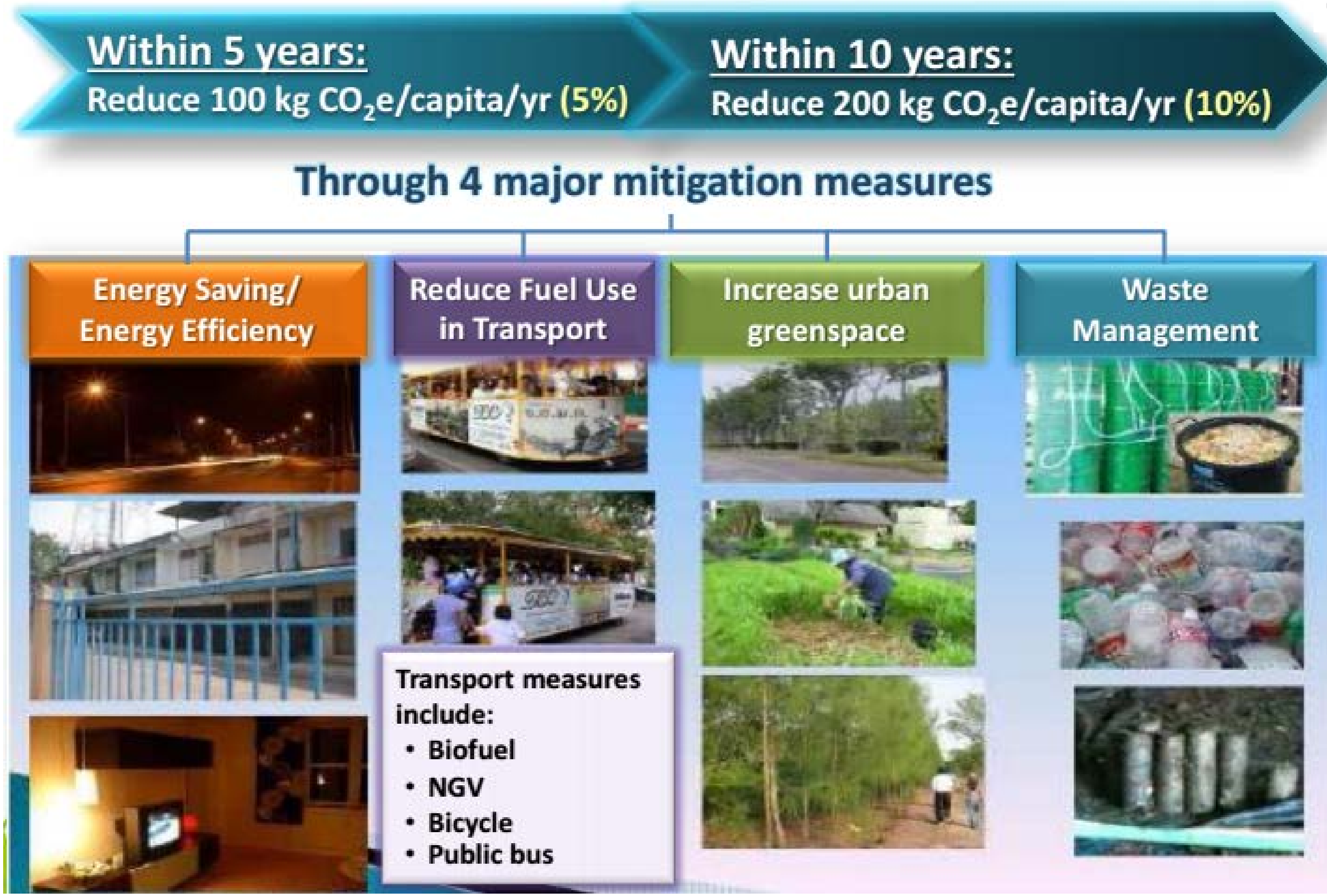


Personal carbon neutral program: GHG reduction – 325 persons / 1,600 t CO_2e

KMUTT King Mongkut's University of Technology Thonburi

LCSAL

Muangklang City's Low Carbon Goals



- Low carbon municipality program started since 2011.; 100 municipalities joined this program.

- total GHGs reduction is 12,000 t CO_2e, accounted from electricity and fuel saving, solid waste management, etc.

Product carbon footprinting and labeling in Thailand: experiences from an exporting nation

Carbon Management (2013) 4(5), 547–554

Shabbir H Gheewala*[1,2] & Rattanawan Mungkung[3]

Product carbon footprinting has gained much attention in recent years as many national and international standards have been formulated as well as several carbon labeling schemes. Thailand has also made efforts in this direction over the past several years and is in fact the first country in the southeast Asian region to have developed national guidelines for carbon footprint calculation and labeling. During the process of conducting product carbon footprinting for pilot studies, many issues of concern were raised, some of which may be common to all countries, while others were more specific for tropical countries exporting agricultural products. Experiences are drawn from the study of several national (Publicly Available Specification 2050, Japanese and Thai national guidelines) and international (ISO14067) standards, including the application of some of these to several product carbon footprinting studies. Issues of data collection, grouping of products, co-product allocation, land-use change, product category rules, type of carbon label and consumer understanding have been discussed, with some possible solutions given to address these issues. The cost of carbon footprinting and labeling are also discussed, along with their implications on companies implementing carbon footprinting. Finally, suggestions are made for issues to be discussed at the international level with a view to harmonizing the carbon footprinting methodology, as well as to address the specific concerns of developing countries that have a large volume of agriculture-based exports.

Perspective

The bioenergy and water nexus

Shabbir H. Gheewala, The Joint Graduate School of Energy and Environment, Bangkok, Thailand and Center for Energy Technology and Environment, Ministry of Education, Thailand
Göran Berndes, Chalmers University of Technology, Sweden
Graham Jewitt, University of KwaZulu-Natal, South Africa

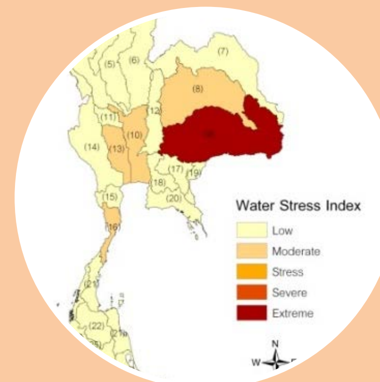
Received January 7, 2011; revised and accepted March 17, 2011
View online at Wiley Online Library (wileyonlinelibrary.com); DOI: 10.1002/bbb.295;
***Biofuels, Bioprod. Bioref*. 5:353–360 (2011)**

Abstract: Promotion of energy from biomass for reducing greenhouse gas emissions has led to increased usage of freshwater, especially during the cultivation of biomass. This has raised concerns about the increase in water stress, particularly in countries that are already facing water shortages. Attempts are being made to characterize the effect of water demand induced *inter alia* by increased bioenergy usage. Also, alternatives are being developed to mitigate such impacts by improved management so that bioenergy can be beneficially utilized. Future studies on bioenergy will need to take into consideration the water aspect so that the trade-offs between climate change mitigation and water stress are addressed.

Water footprint and impact of water consumption for food, feed, fuel crops production in Thailand

Water requirement for crop cultivation

- crop water requirement (CWR)
- $ET_c = K_c \times ET_0$
- Effective rainfall



Potential impact on water use

- water stress index (WSI)

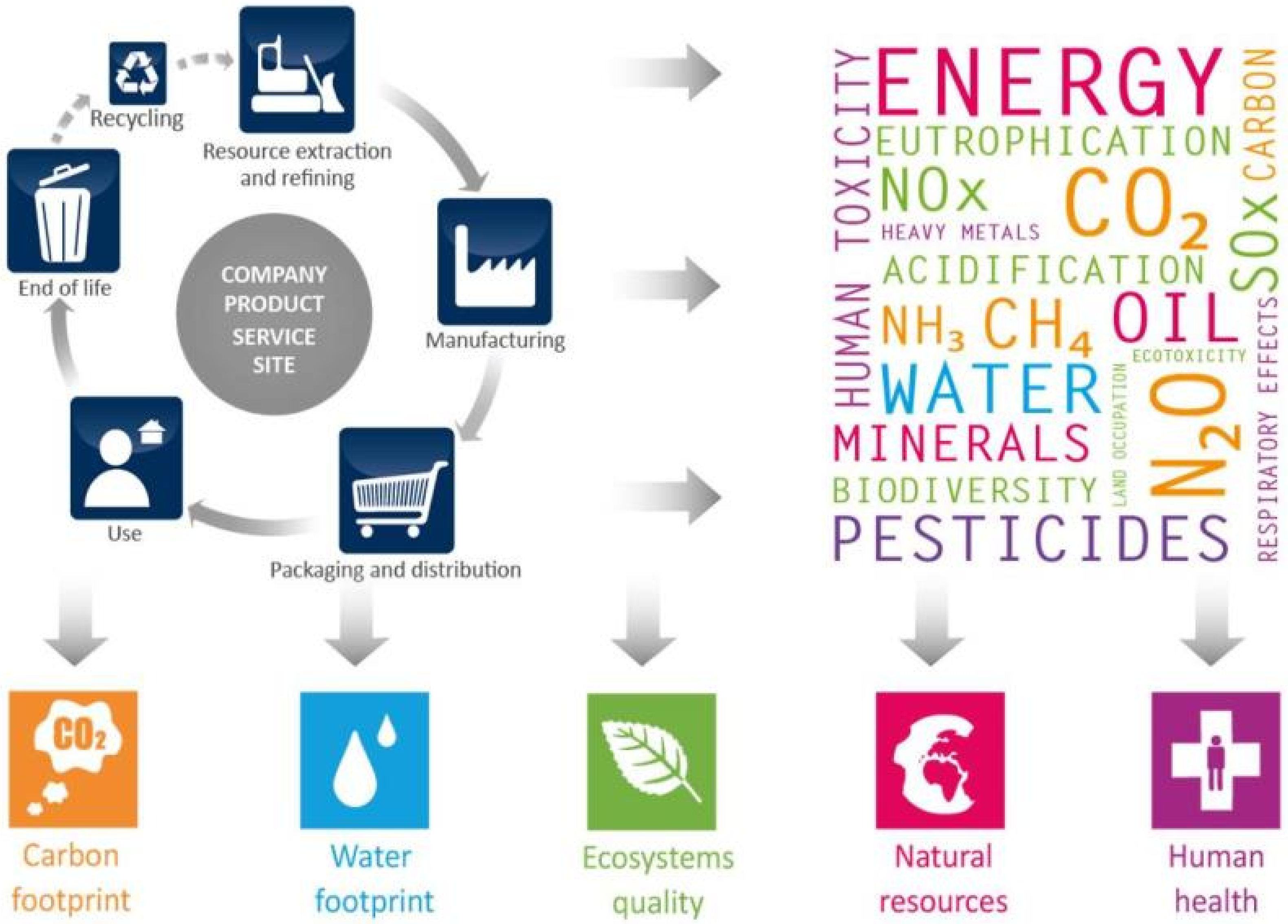
$$WSI = \frac{1}{1 + e^{-6.4 * WTA * \left(\frac{1}{0.001} - 1\right)}}$$

- Water deprivation

Water deprivation ($m^3 H_2O_{eq}$ unit^{-1}) = Water deficit (m^3 unit^{-1}) × WSI

Gheewala et al. (2014), Water 6(6): 1698-1718

Multiple impacts in Life Cycle Assessment



Life Cycle Environmental Sustainability Assessment of Oil Palm Plantations in Thailand

Life Cycle Inventory Data Collection	→	Sustainability Assessment	→	Outputs

Independent Smallholders

Group of Smallholders

Mini Estates

Mills with plantation

→

- Land use and conversion
- Materials and fuel used
- Fertilizers & Agrochemical
- Water use
- Wastes
- Agricultural practices

Sustainability Assessment

- Life cycle inventory
- LC-GHG emissions (Carbon Footprint)
- Water requirement, footprint and impact potential
- Water requirement, footprint and impact potential
- Land use and HCV areas

↓

Identification of environmental hotspots and recommendations for supporting sustainable oil palm production

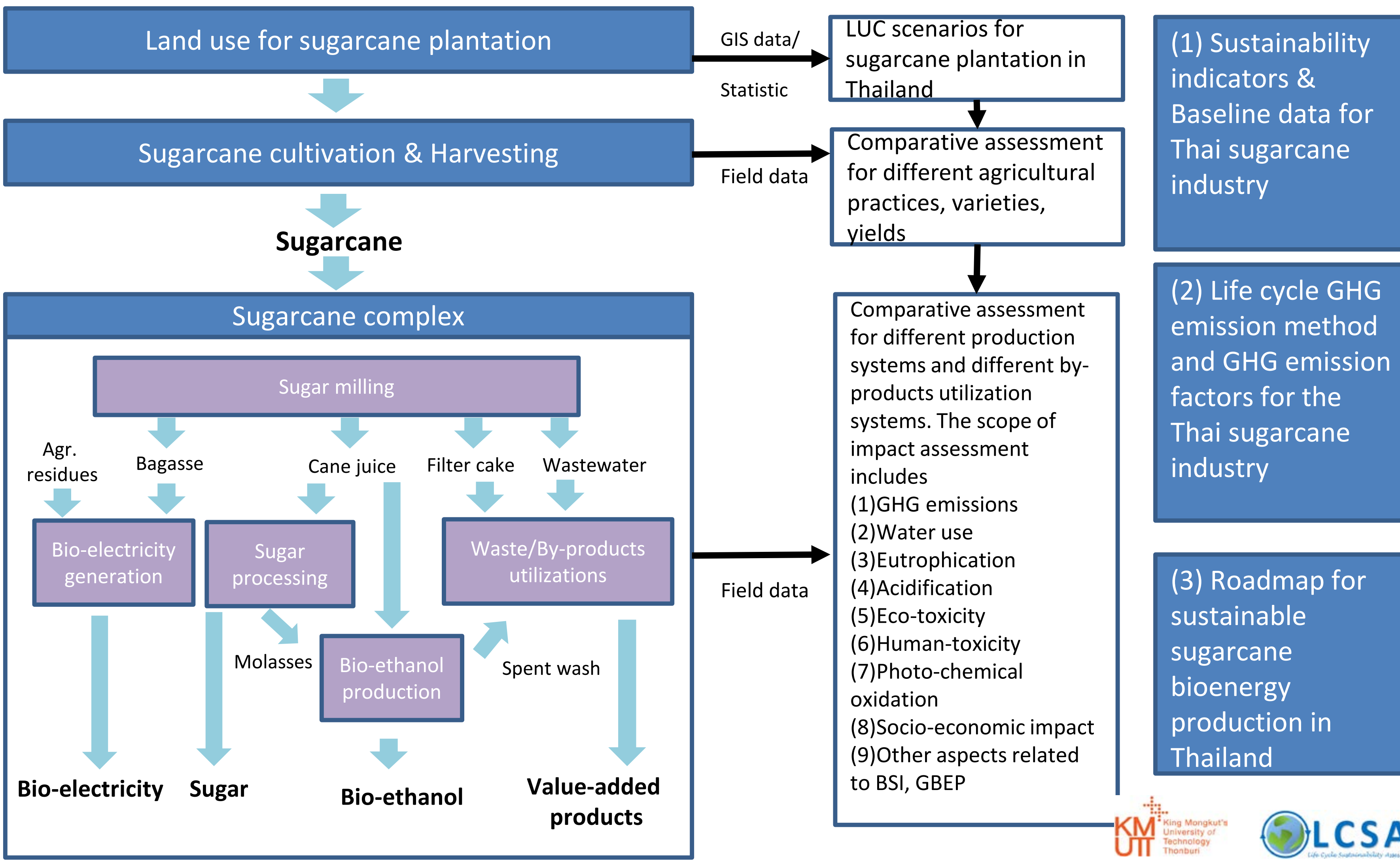
Outputs

Data for supporting Thailand National LCI Database of Oil palm plantations (Province/Region levels)

Environmental sustainability indicators and baseline data for oil palm plantation in Thailand for supporting certification of RSPO and/or other sustainability standards

Sustainability Assessment of Sugarcane Complex for Enhancing Competitiveness of Thai Sugarcane Industry

Life cycle of sugarcane systems | **Scenarios for sustainability assessment**

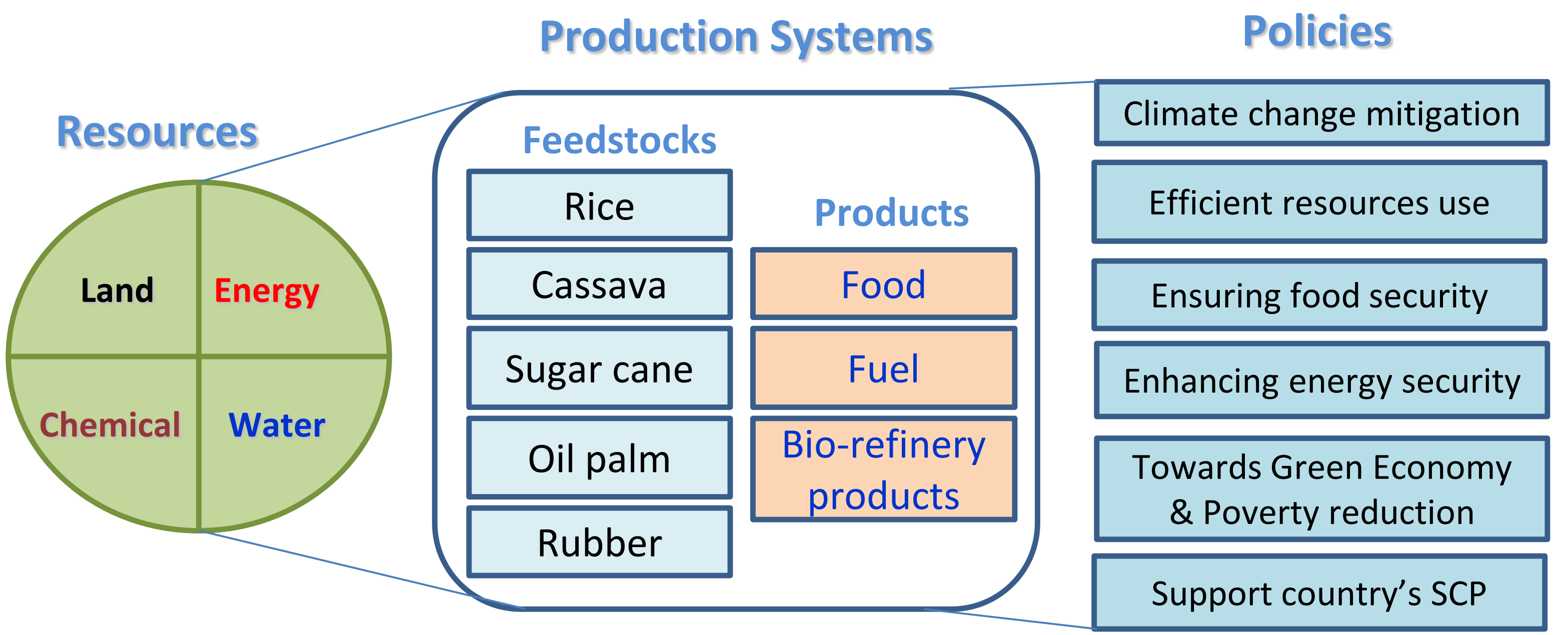


Sustainability Assessment of Sugarcane Complex for Enhancing Competitiveness of Thai Sugarcane Industry

Environment	Economic	Social
1. Climate change	1. Sugarcane productivity	1. Wages paid in sugarcane system
2. Acidification	2. Processing efficiency	2. Income from selling products
3. Eutrophication	3. Net energy ratio (NER) of bioenergy products	3. Employment generation in sugarcane system
4. Human toxicity	4. Product cost/unit of product	4. Working conditions and standards
5. Photo-oxidant formation		5. Land tenure of farmers
6. PM formation		
7. Ecotoxicity		
8. Fossil depletion		
9. Water consumption		
10. Chemicals used		

Research Network for LCA and Policy on Food, Fuel and Climate Change

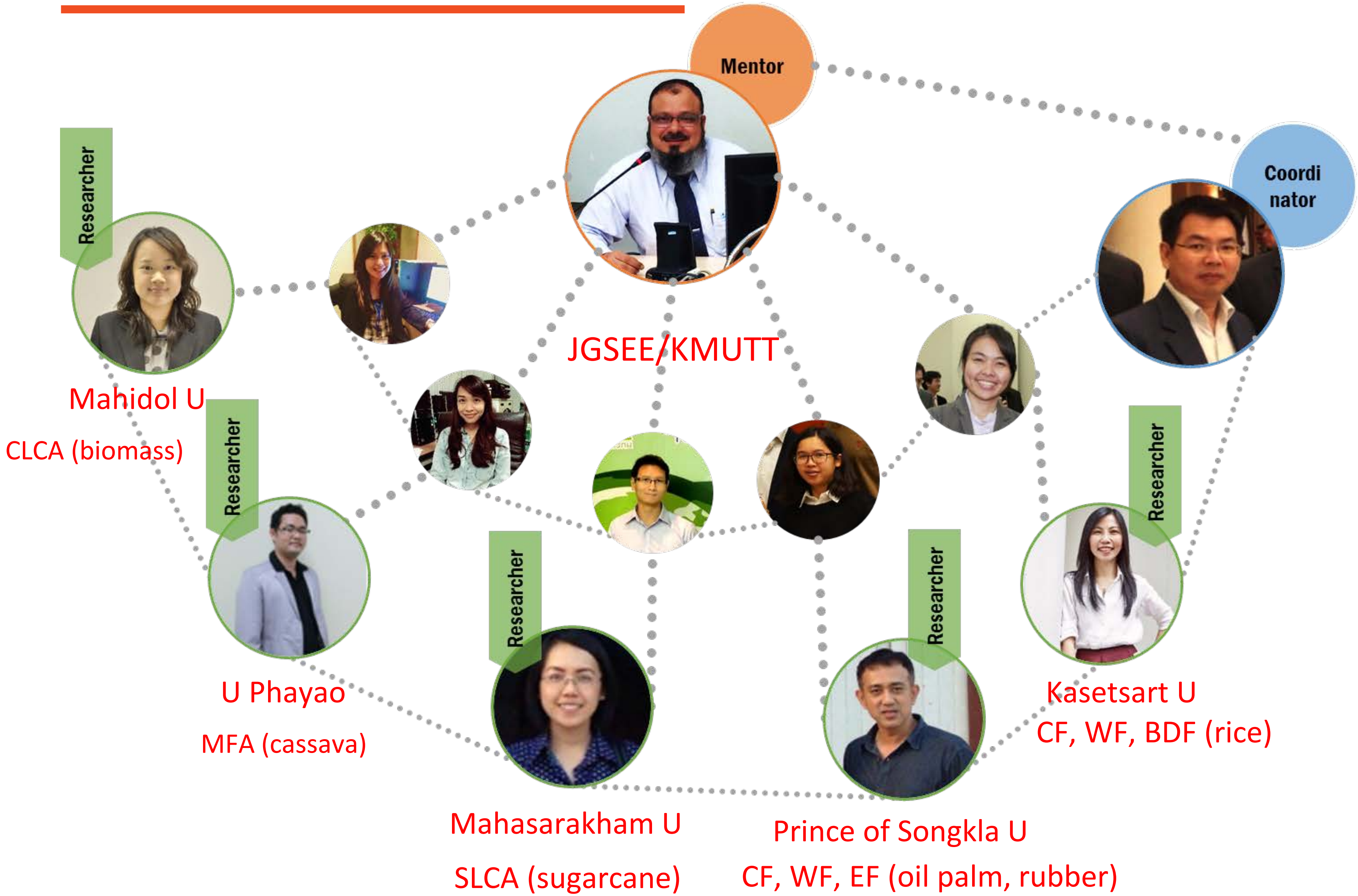
- **Development of capacity and human resources for LCA in Thailand**
- **Policy recommendations on food and fuel issues vis-à-vis climate change**
- **Commitment to continue activities on LCA of the researchers and partners**



Tools used

Life Cycle Assessment, Carbon Footprint, Water Footprint, Ecological Footprint, Biodiversity Footprint, Material Flow Analysis. Consequential LCA, Social LCA, Cost Benefit Analysis

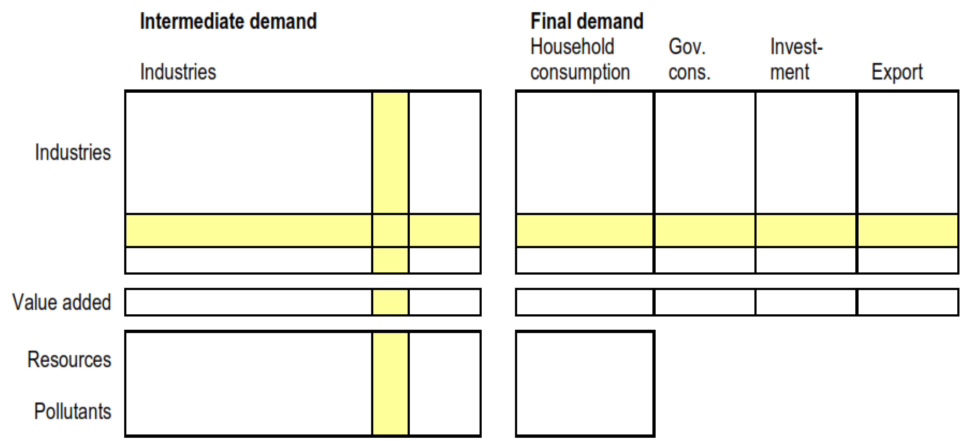
Research Network for LCA and Policy on Food, Fuel and Climate Change

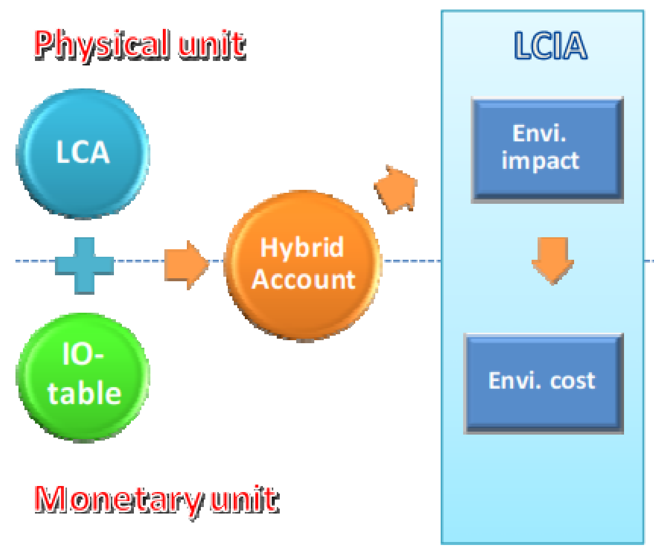


Green GDP

Hybrid LCA approach : Applied **National Life Cycle Inventory (LCI)** incorporated with I/O table to assess the environmental impacts by LCA to quantify environmental damage cost

- Convert environmental impact in physical unit to monetary unit by valuation technique.
- Develop **environmentally extended input-output analysis (EEIOA)**
- Done in broadly economic sectors, 16x16 and elaborating in detail of major industrial sectors and agriculture sectors i.e. petrochemical, paper, stable crops, livestock, etc.





Advantages of life cycle thinking

» Prevents problem shifting

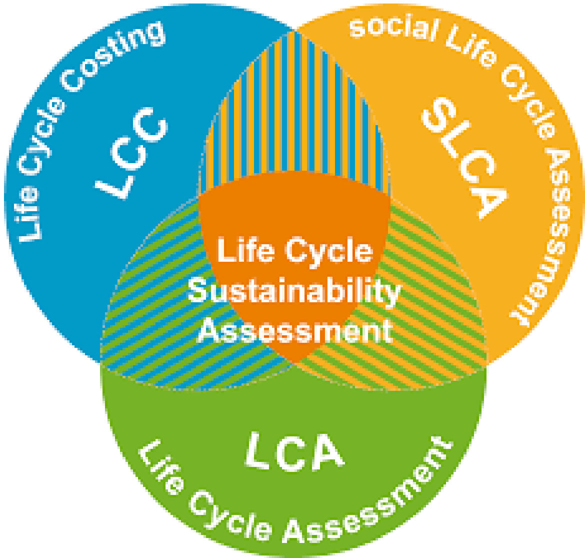
– to other life cycle stages

– to other environmental problems

– to other sustainability pillars

– to other countries

– to the future generations




11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION

THANK YOU