Life Cycle Thinking for Food, Fuel, and Climate Change

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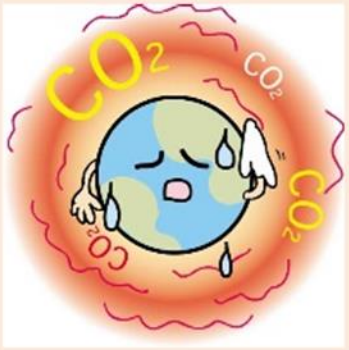
17th NSTDA Annual Conference (NAC2022), 31 March 2022

RESEARCH DRIVERS

Future challenges for food



Climate change

Non-Tariff Trade Barriers (Sustainability)

Limited resources (Land, Water)

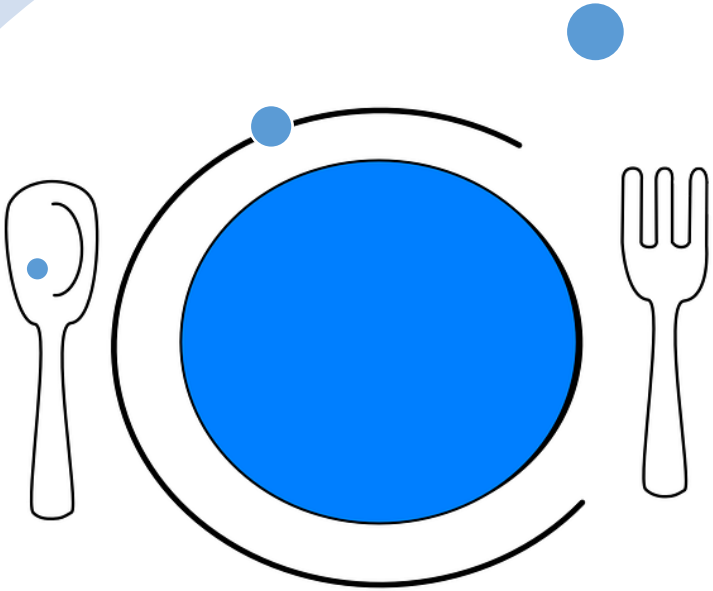
Traditional agricultural practices (Low productivity)

Why food, fuel and climate change?

Increased population

Economic growth

Human-well being



Food

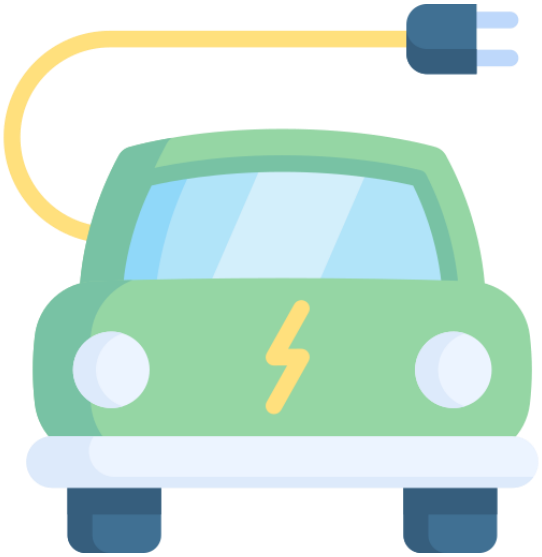
Economic activity and growth

Government promotion

Concerns on environment

Fuel

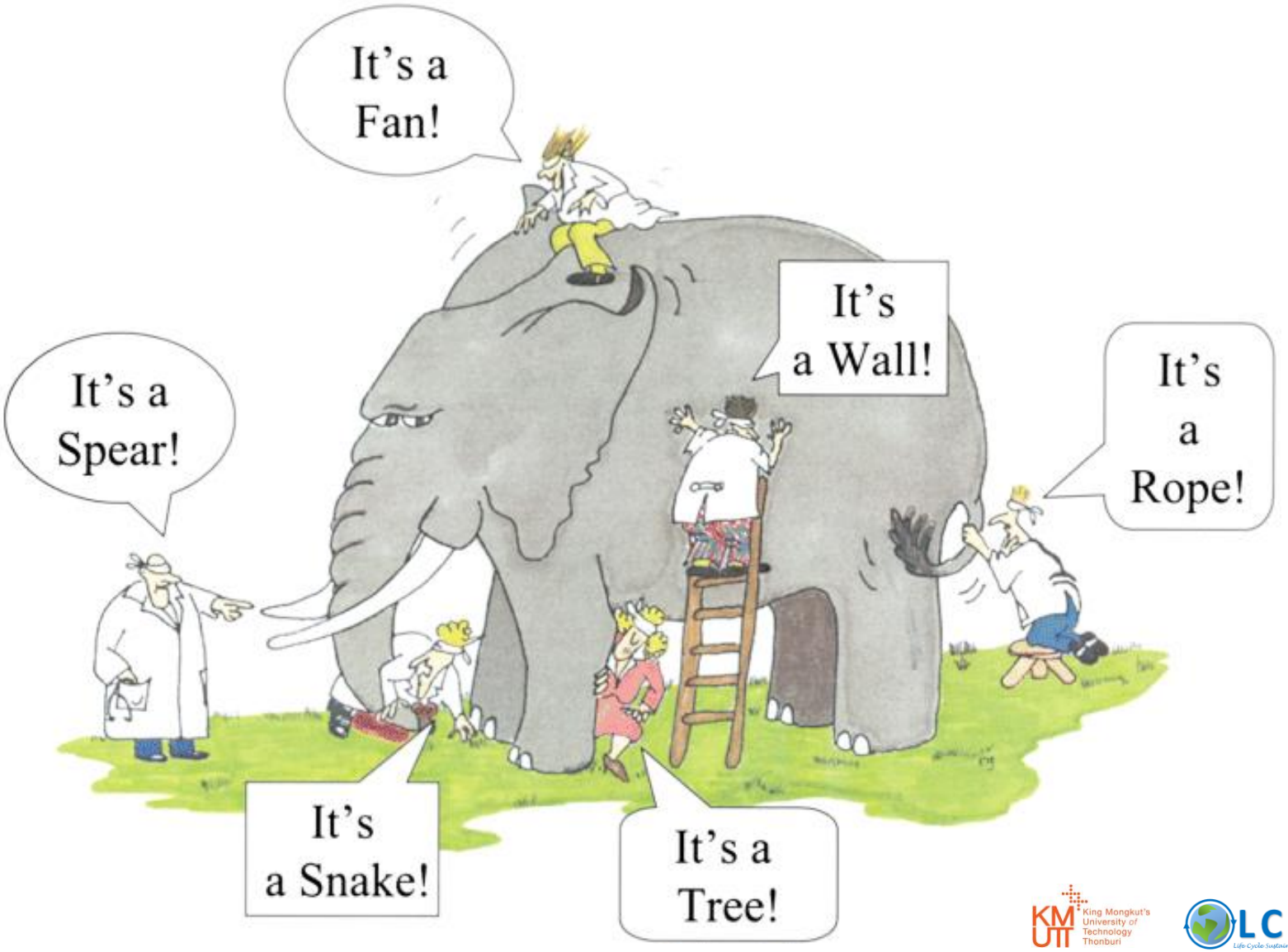
Why should we consider the entire life cycle?



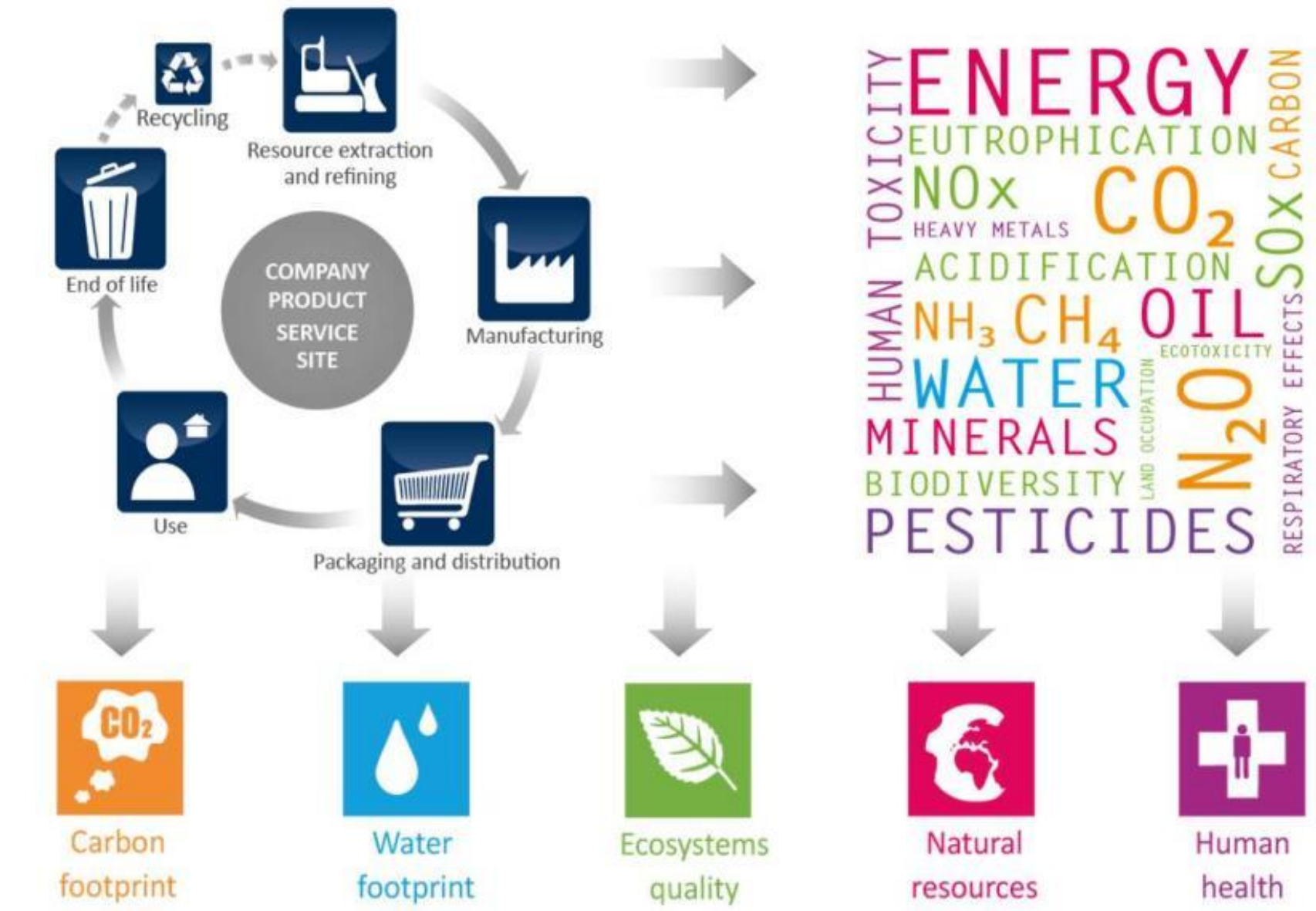
Electric car

Icons made by Freepik from www.flaticon.com

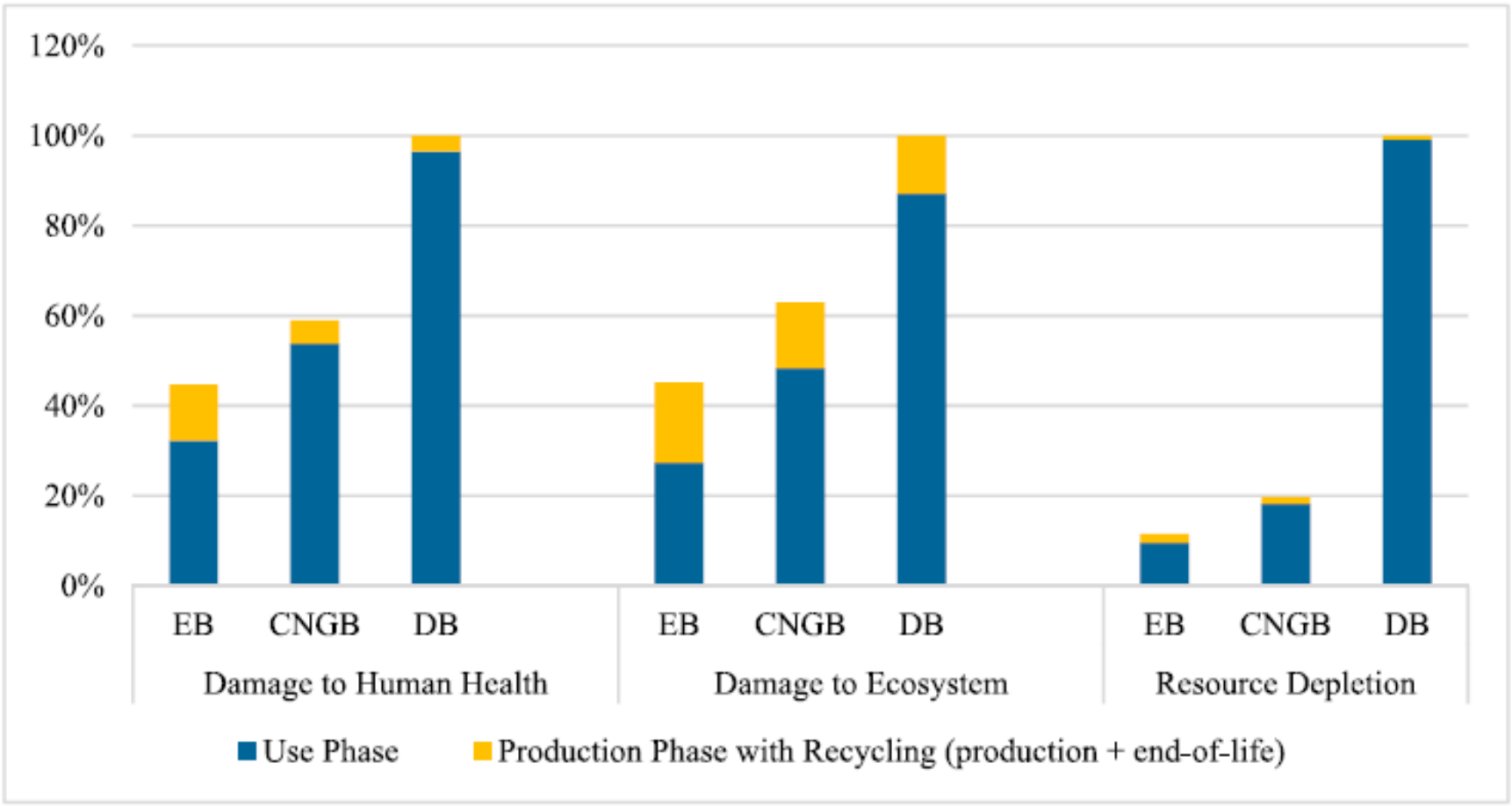
Six blind-folded persons and the elephant



Life Cycle Assessment



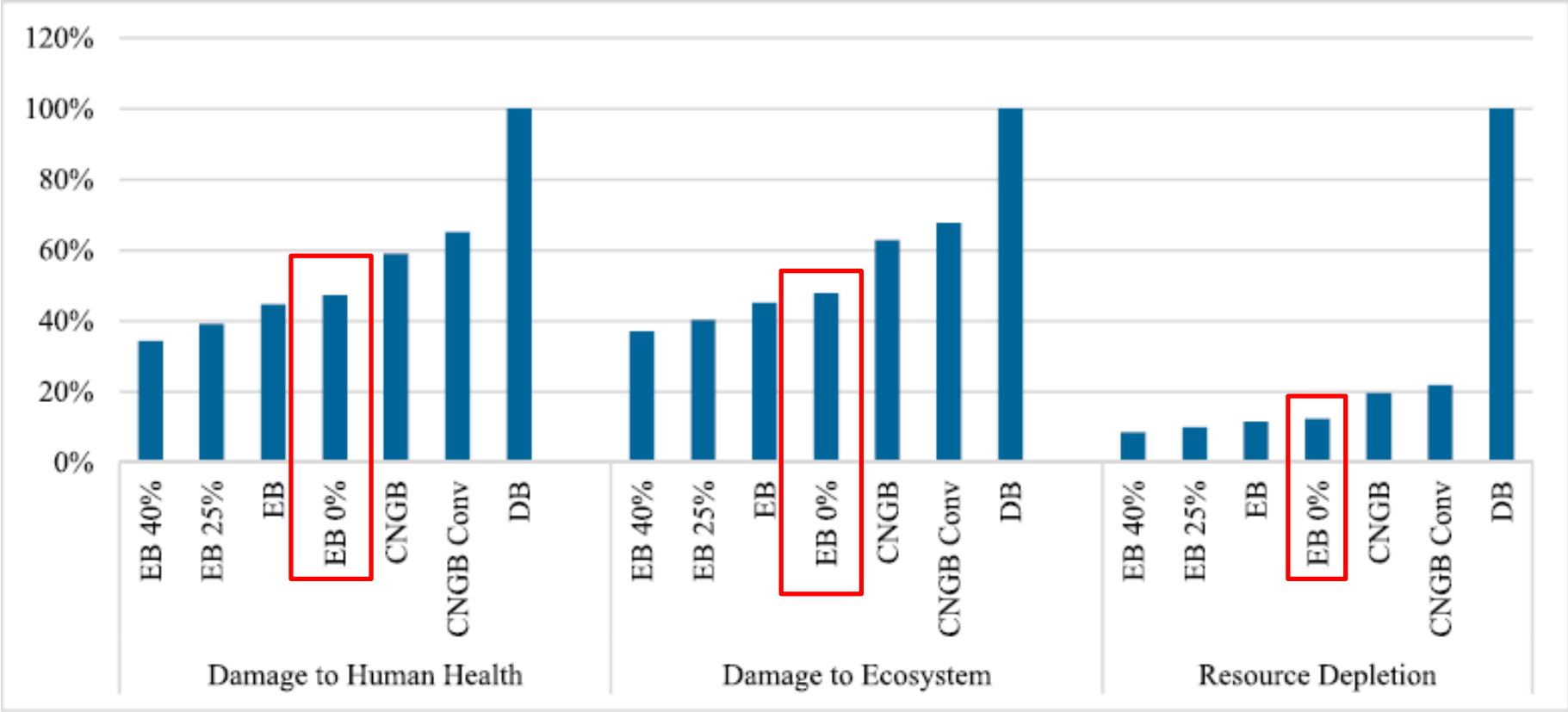
LCA for E-buses



EB = electric bus; CNGB = compressed natural gas bus; DB = diesel bus

Gabriel et al. (2021) A Comparative Life Cycle Assessment of Electric, Compressed Natural Gas, and Diesel Buses in Thailand, Journal of Cleaner Production, Vol. 314, 128013

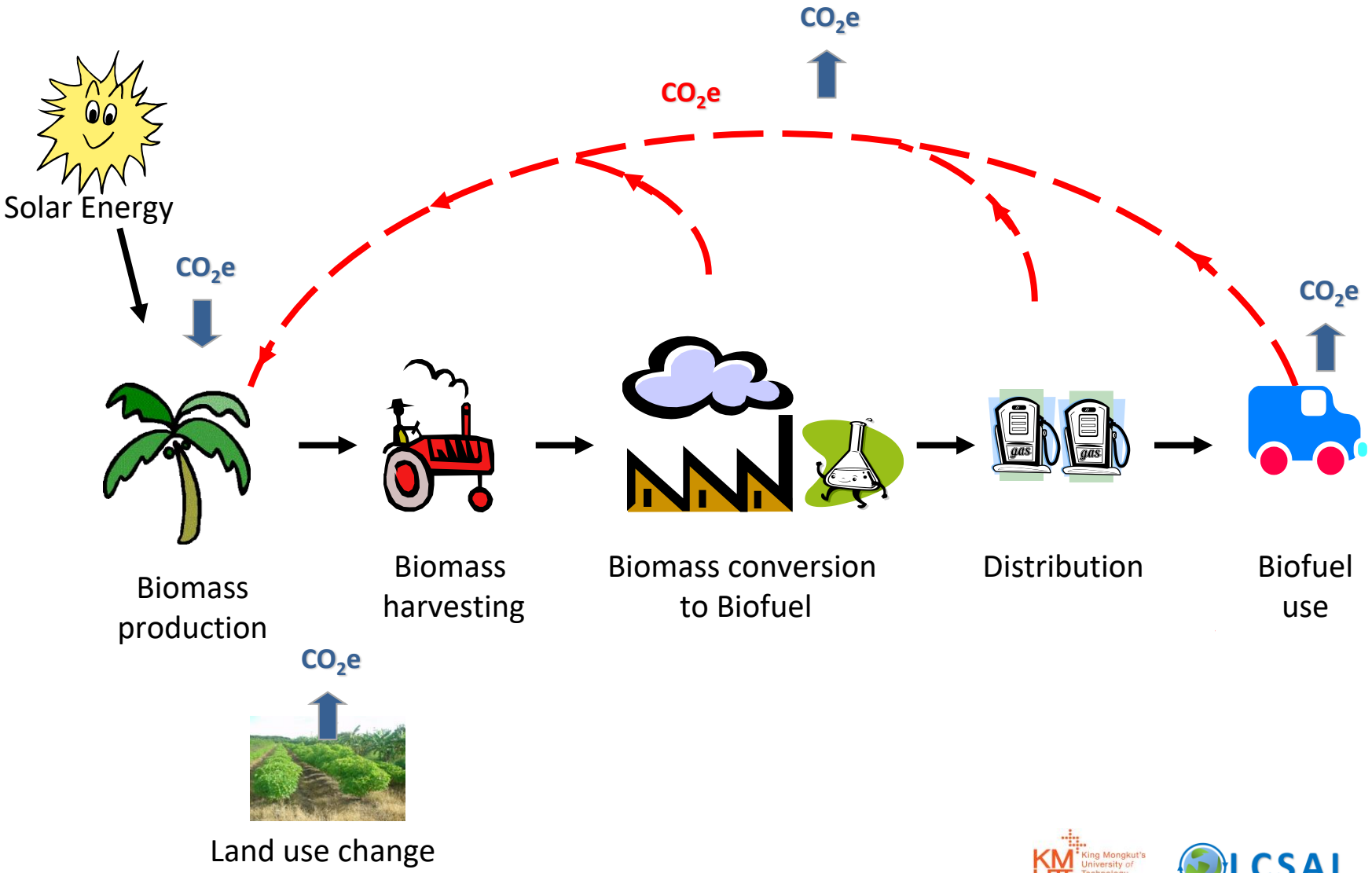
LCA for E-buses



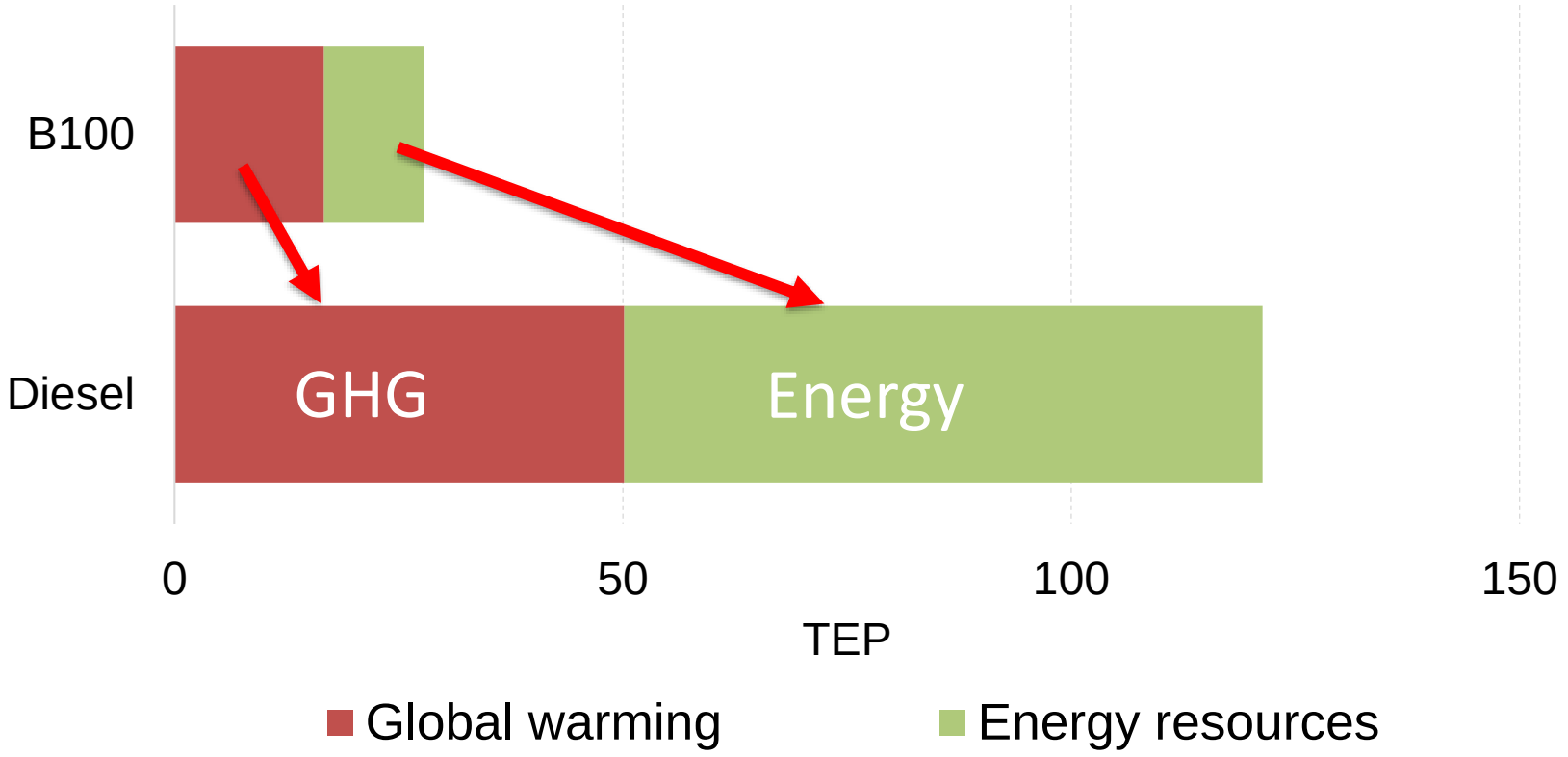
EB 40% = E-bus with 40% RE; EB 25% = E-bus with 25% RE; EB = E-bus with 8% RE (current);
EB 0% = E-bus with 0% RE; DB = diesel bus.
CNGB = CNG bus with lightweight body; CNGB Conv = CNG bus with a conv. body;

Gabriel et al. (2021) A Comparative Life Cycle Assessment of Electric, Compressed Natural Gas, and Diesel Buses in Thailand, Journal of Cleaner Production, Vol. 314, 128013

Why are biofuels considered green?



Results: GHG emissions and energy

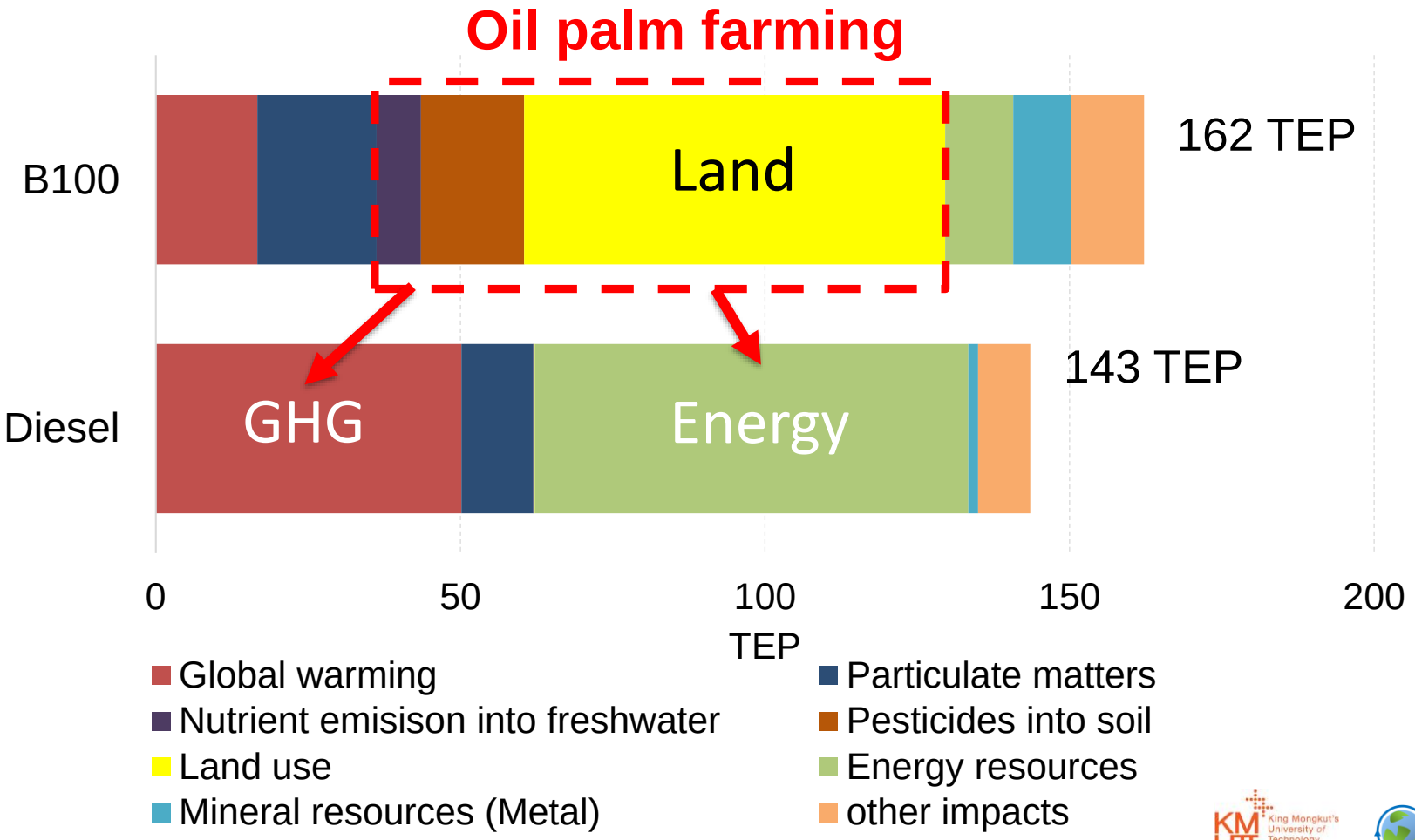


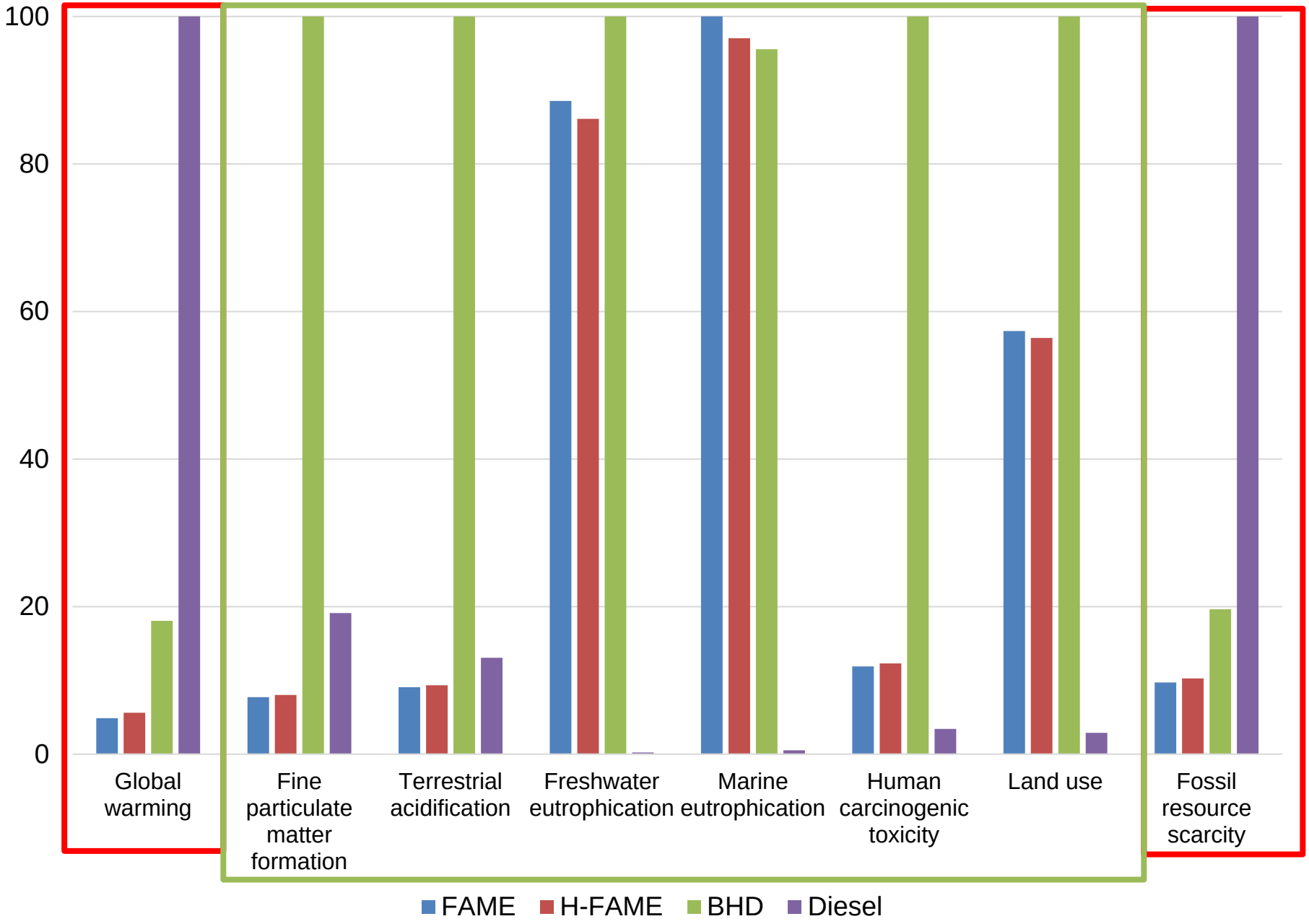
TEP = Thai Eco Points

Lecksiwilai N., Gheewala, S.H. (2020), Life Cycle Assessment of Biofuels in Thailand: Implications of Environmental Trade-offs for Policy Decisions, Sustainable Production and Consumption, Vol. 22, pp. 177-185

Results: All environmental impacts

» Diesel has lower total impact score (around 15%) even though having high GHG and energy resource impacts.

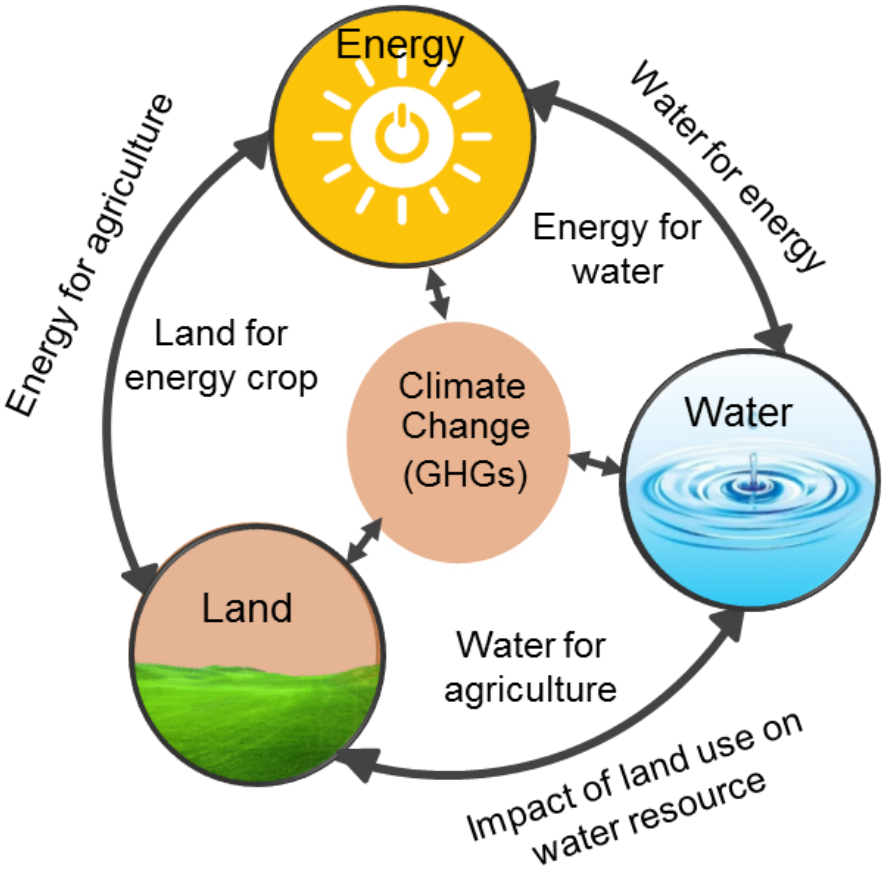




Permpool, N., Ghani, H.U., Gheewala, S.H. (2020) Sustainability, Vol. 12(22), 9415; doi:10.3390/su12229415

Water-Energy-Food Climate nexus

Nexus = "Connection"



- **Water-Energy nexus**
  - The interdependency between water and energy in their supply, processing, distribution, and use.
- **Water-Energy-Food nexus**
  - The complex interdependencies, trade-offs and synergies between water, energy and food
- **Land (Food)-Water-Energy-Climate nexus**
- **Water-Energy-Food-Ecosystems nexus**

KMUTT King Mongkut's University of Technology Thonburi

LCSAL Life Cycle Sustainability Assessment Lab

Water-Energy-Food Climate nexus

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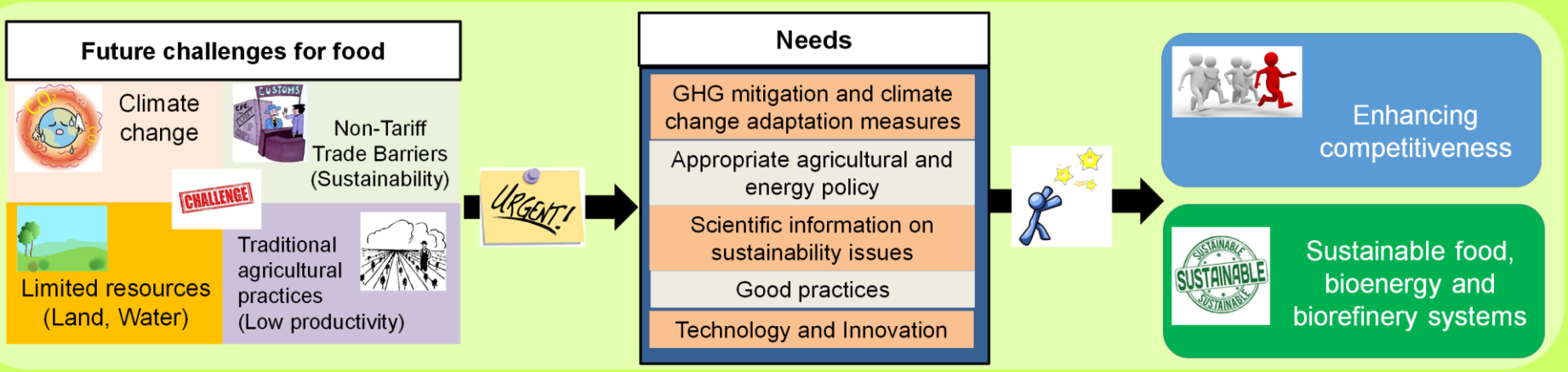
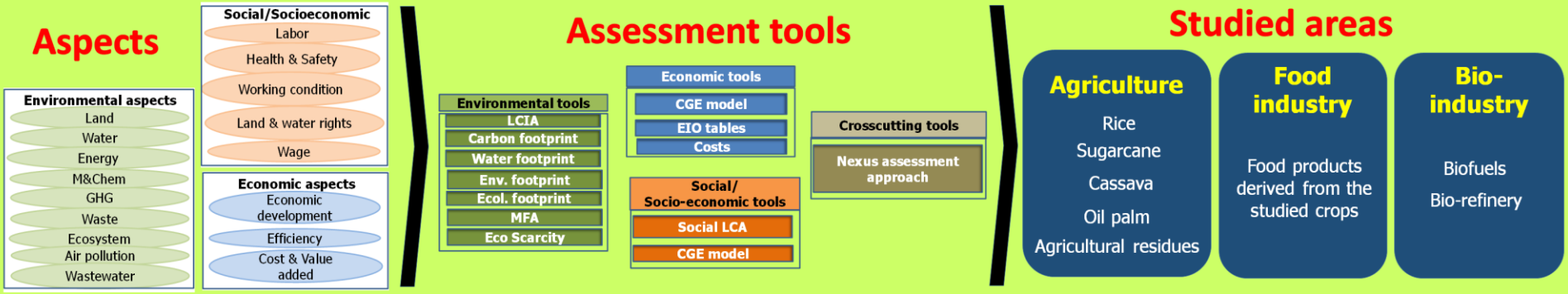
LCSAL Life Cycle Sustainability Assessment Lab

Network for Research and Innovation for Trade and Production of Sustainable Food and Bioenergy

RESEARCH DRIVERS



RESEARCH SCOPE

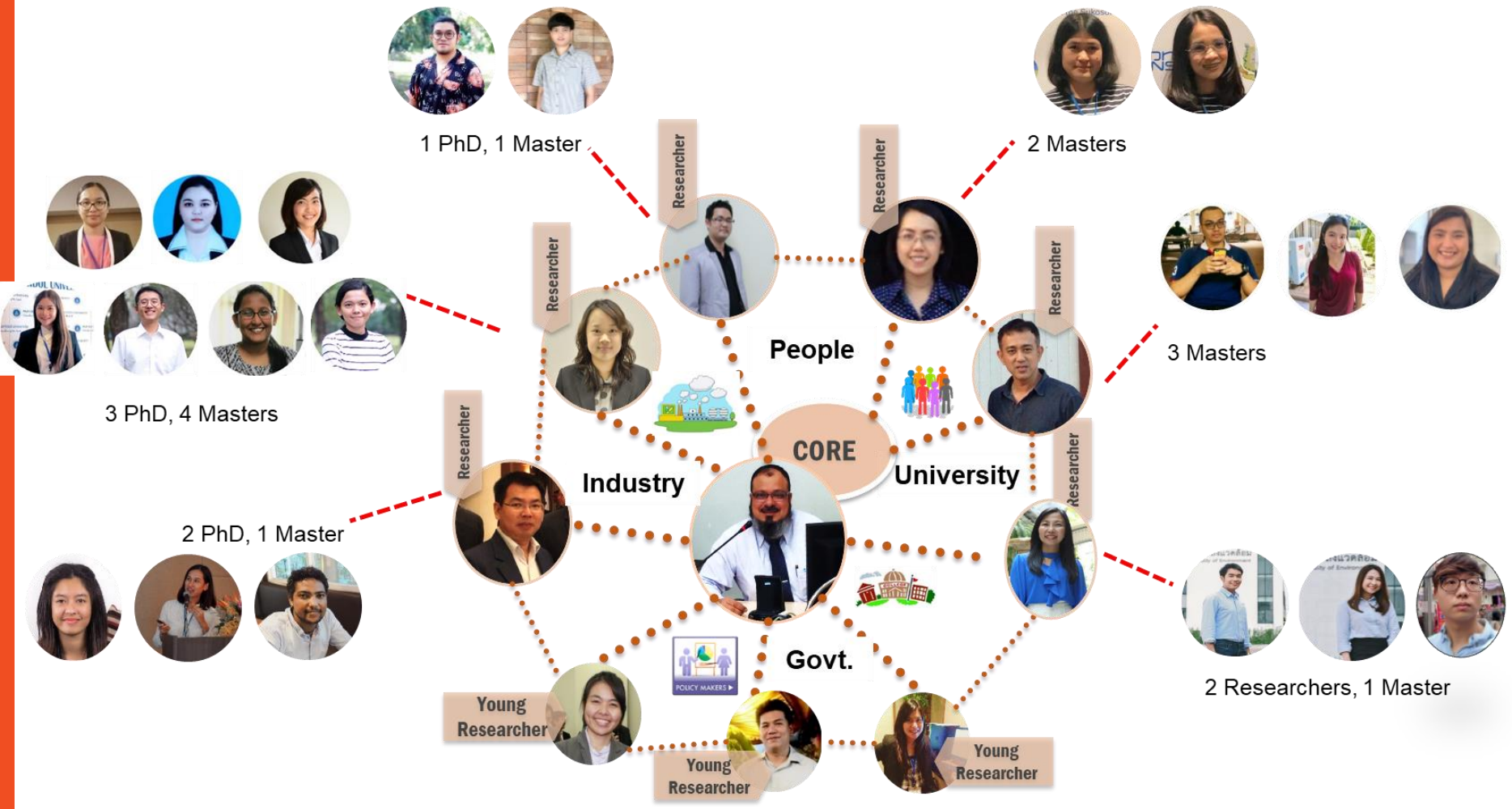


NSTDA JGSEE The Joint Graduate School of Energy and Environment PERDO

NSTDA Research Chair Grant 2016

Network for Research and Innovation for Trade and Production of Sustainable Food and Bioenergy

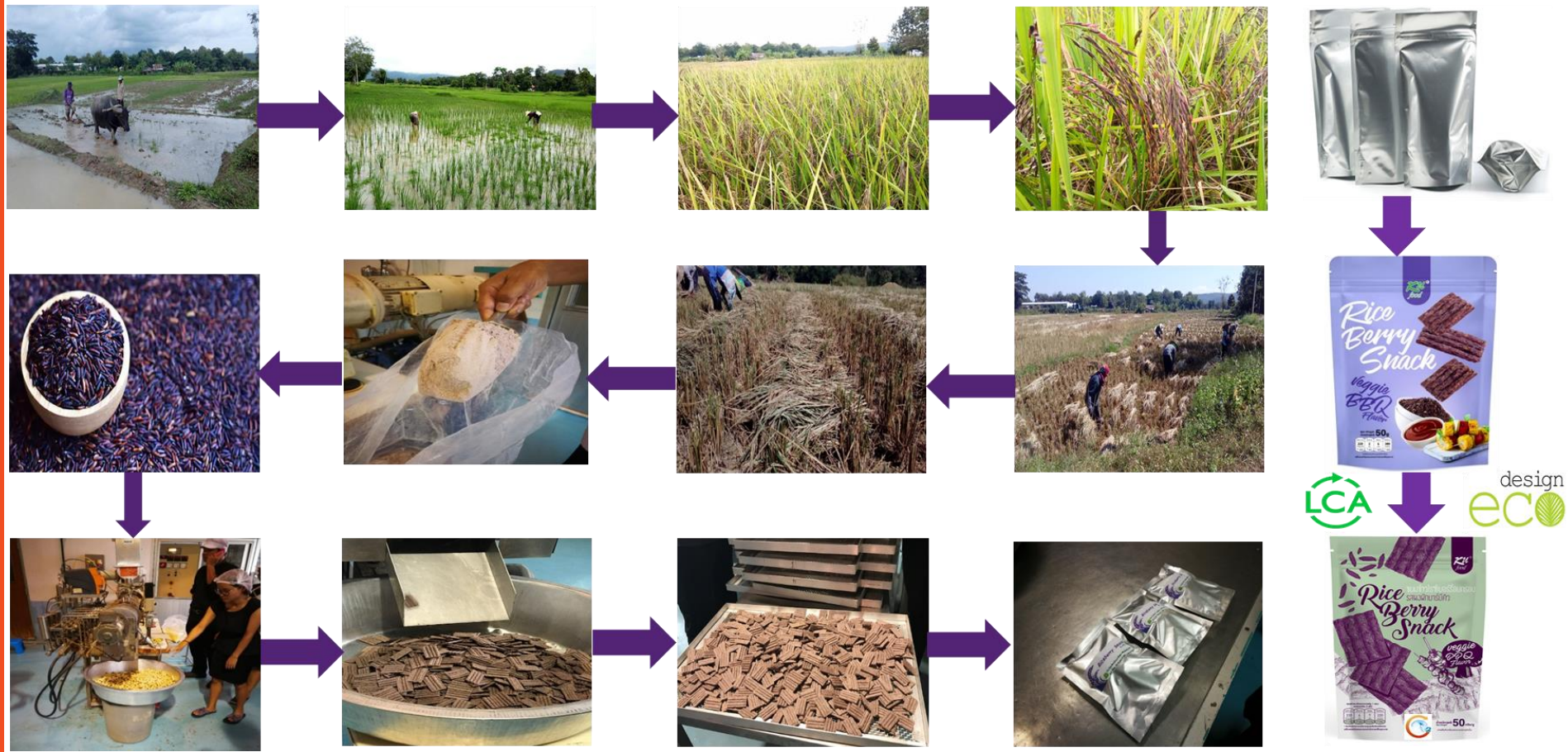
NSTDA Research Chair Grant 2016: Extended Network



Sustainable Product Development:
Life Cycle Design for Innovative Riceberry Product

Assoc. Prof. Dr. Rattanawan Mungkung from Kasetsart University

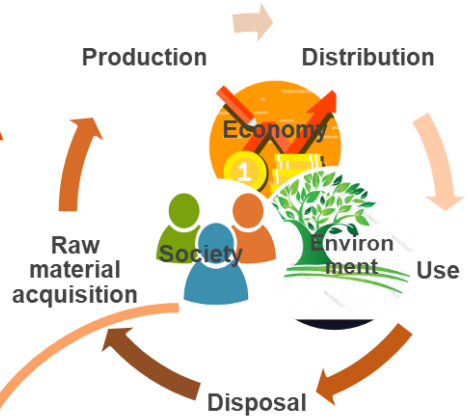
LIFE CYCLE DESIGN OF RICEBERRY SNACK



Social LCA: Approach to assess the Social Life Cycle Impacts of Food and Bio-Energy Value Chains

Assoc. Prof. Dr. Jittima Prasara-a from Mahasarakham University

Social Life Cycle Assessment: S-LCA



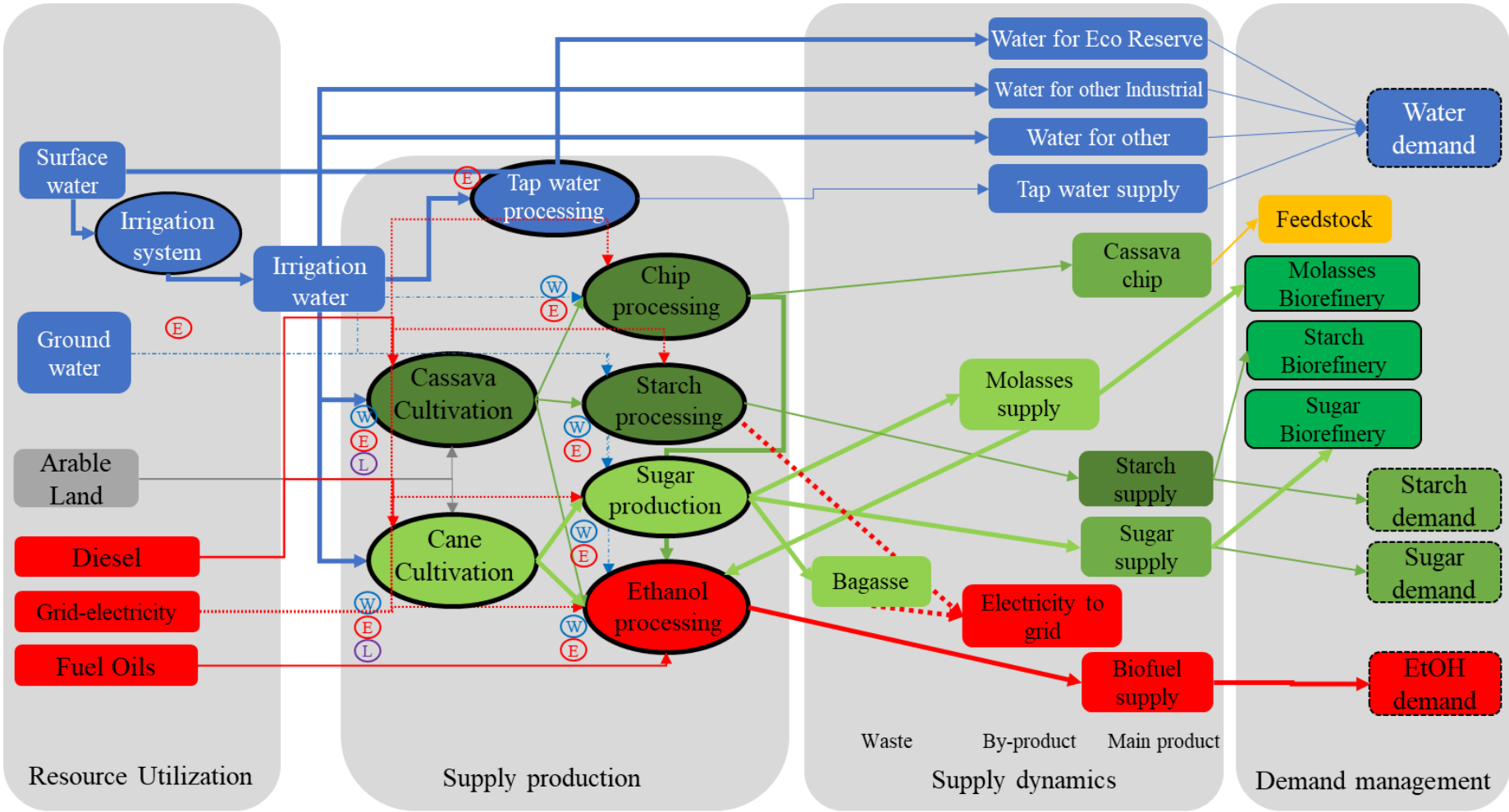
Technique to assess social and socio-economic aspects, both positive and negative, for stakeholders involved along a life cycle of a product

S-LCA is used to complement other aspects of life cycle sustainability

Common stakeholders groups

Water-Food-Energy Nexus:
Nexus Assessment in Food and Biofuel Supply Chains

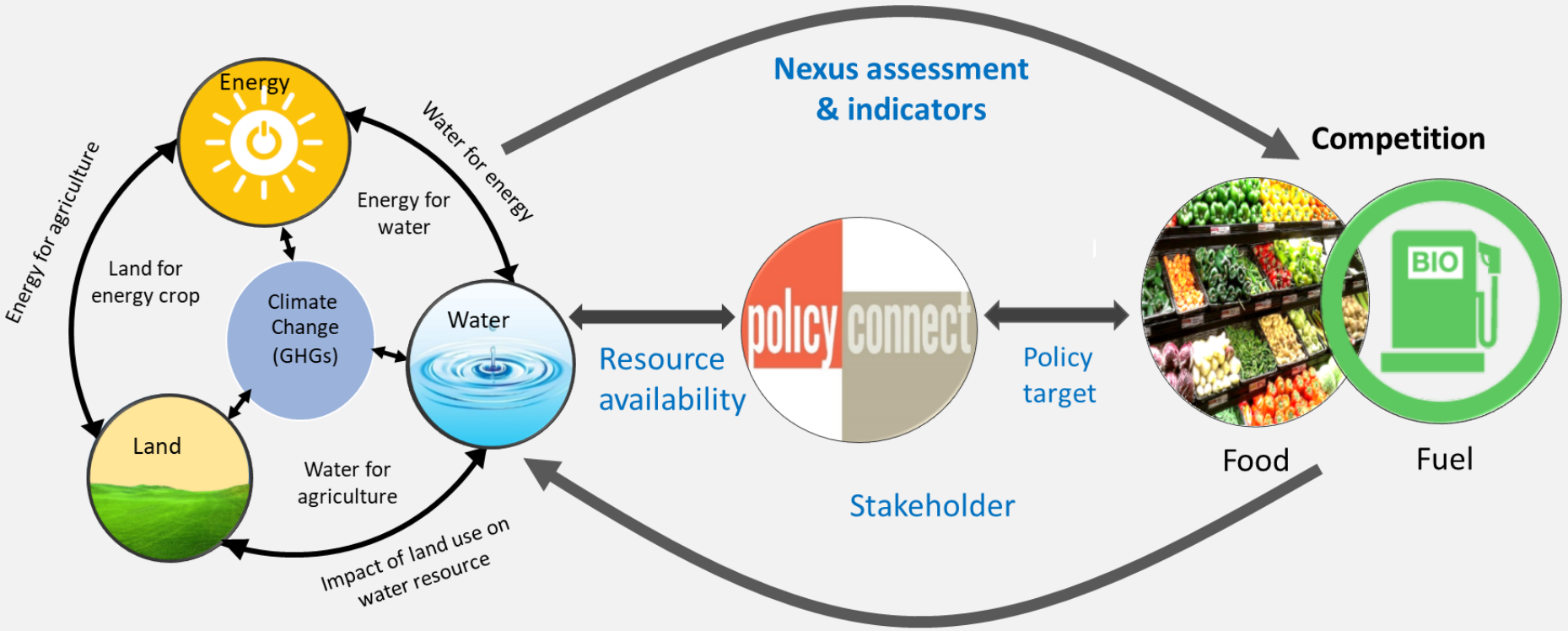
Asst. Prof. Dr. Napat Jakrawatana from Chiang Mai University



Water-Food-Energy Nexus:
Nexus Assessment in Secondary Biofuel Supply Chains

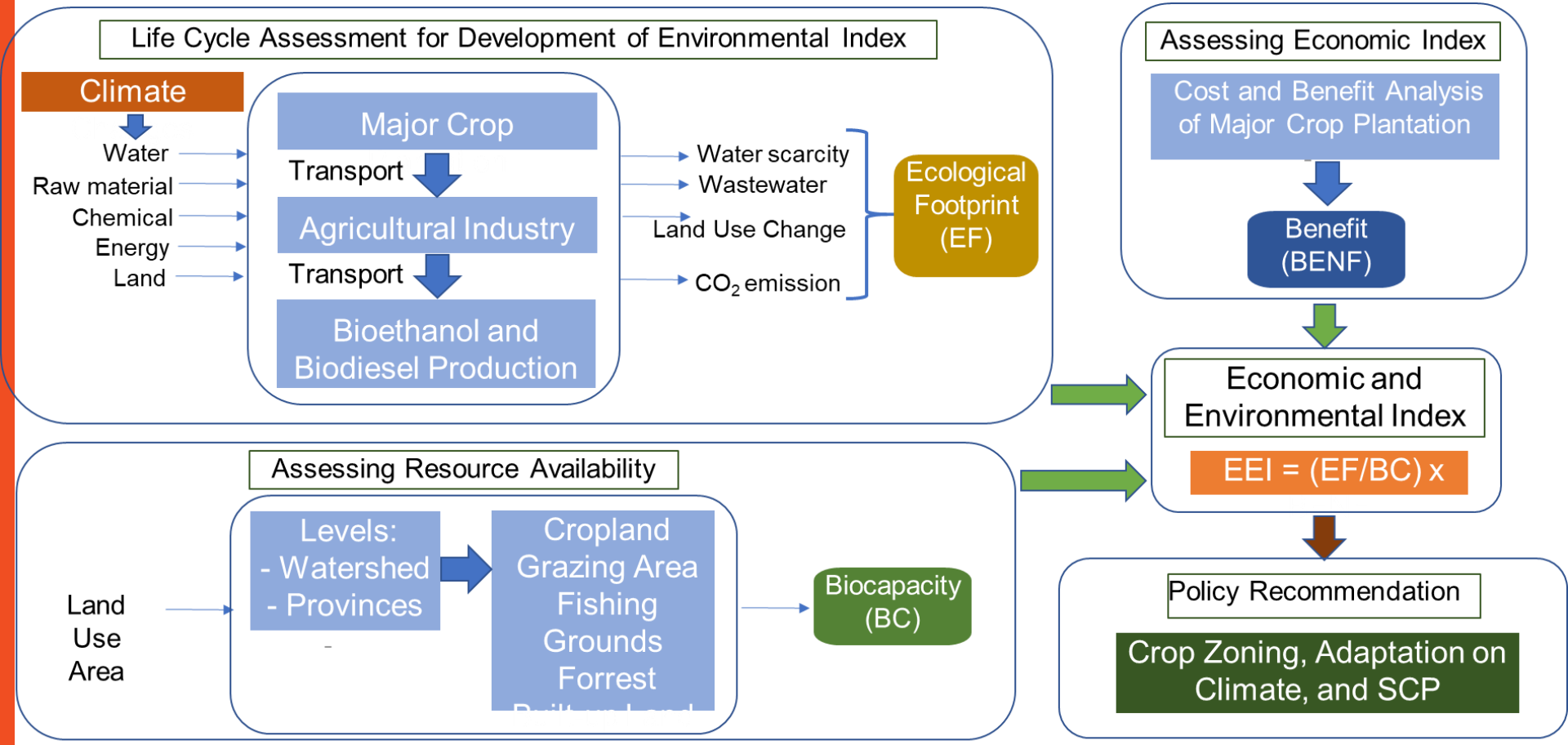
Assoc. Prof. Dr. Thapat Silalertruksa from King Mongkut's University of Technology Thonburi

BECAUSE... EVERYTHING IS CONNECTED



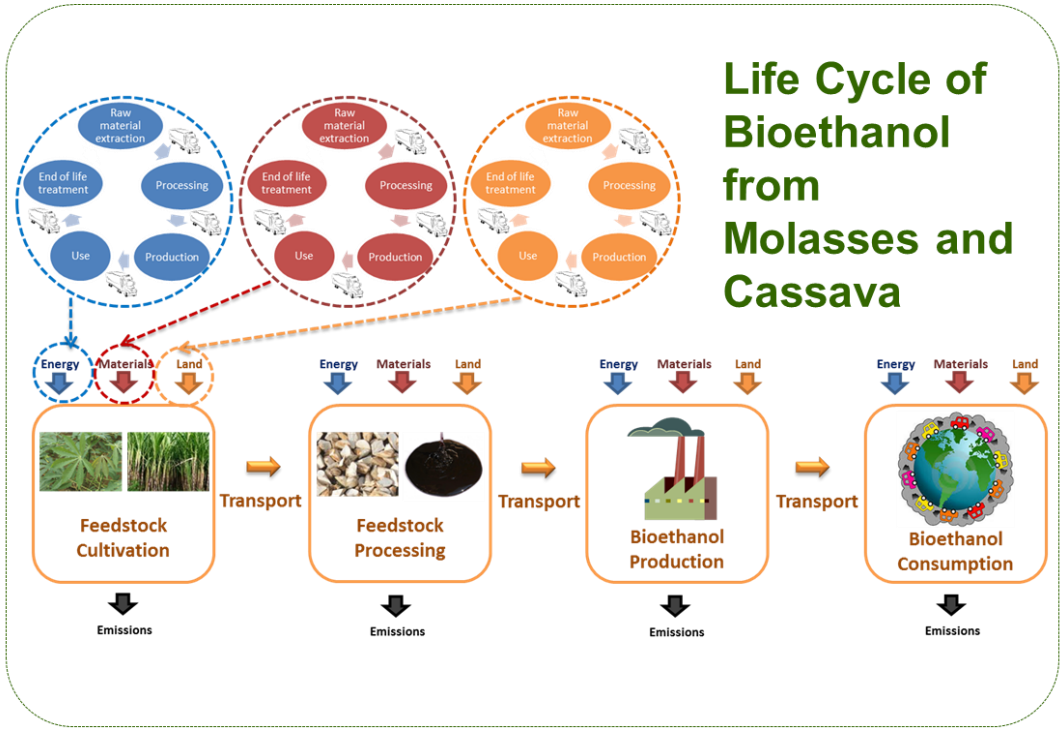
Sustainable Crop Production: Assessing the Ecological Footprint and Biocapacity of Thai Agriculture

Assoc. Prof. Dr. Charongpun Musikavong from
Prince of Songkla University



Life Cycle Impact Assessment: Methodology development for Thailand

Assoc. Prof. Dr. Trakarn Praspaspongsa from Mahidol University



Environmental impacts from indirect emissions throughout supply-chain will be assessed by using a global-based LCIA method

Environmental impacts from direct emissions in Thailand will be assessed by using **the ThaiSD method**

ThaiSD Method
Thai Spatially Differentiated Life Cycle Impact Assessment Method

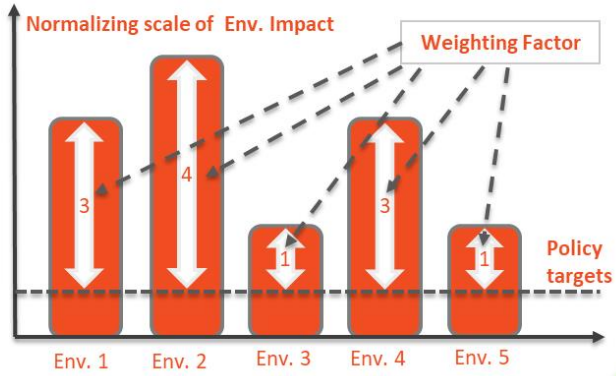
Life Cycle Sustainability Indicators: Policy-Based Methodology for Thailand

Dr. Naruetep Lecksiwilai from JGSEE, King Mongkut's University of Technology Thonburi

Environmental status and policies

Based on 5 ASEAN countries

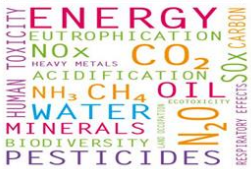
Policy distance-to-target appoach



Policy-based Weighting Factors

Life cycle consideration

Life cycle inventory

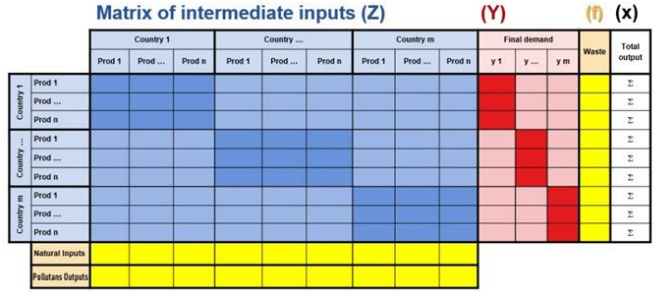


Impact category

- Global Warming
- Water depletion
- Ecosystem
- Mineral depletion
- Human health

Integrating impact indicator

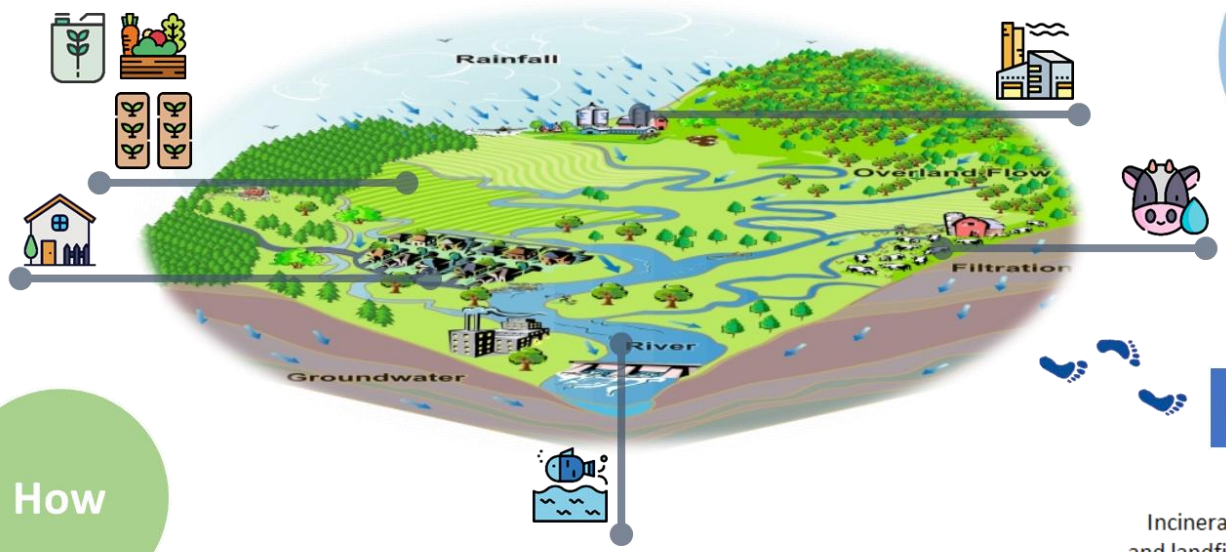
Environmental Extended I/O table



- Using I/O table to define key environmental impact due to consumption and production domains (domestic consumption / import / export).
- Recommendation to policy makers to supporting the **S**ustainable **C**onsumption and **P**roduction target.

Water Scarcity Weighting in LCA: Implication of Water Footprint for Sustainable Bio-Energy Production

Dr. Pariyapat Nilsalab from JGSEE, KMUTT



Water resources

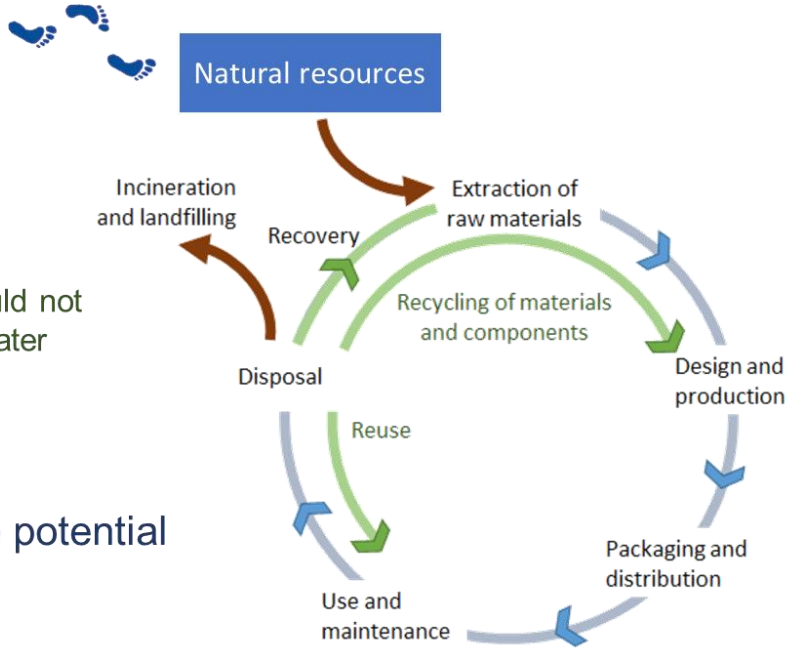
"If water demands increase but water availability cannot support, **more water requirement will possibly cause impacts on freshwater resources**"

How

to assess the impact of freshwater use in LCA

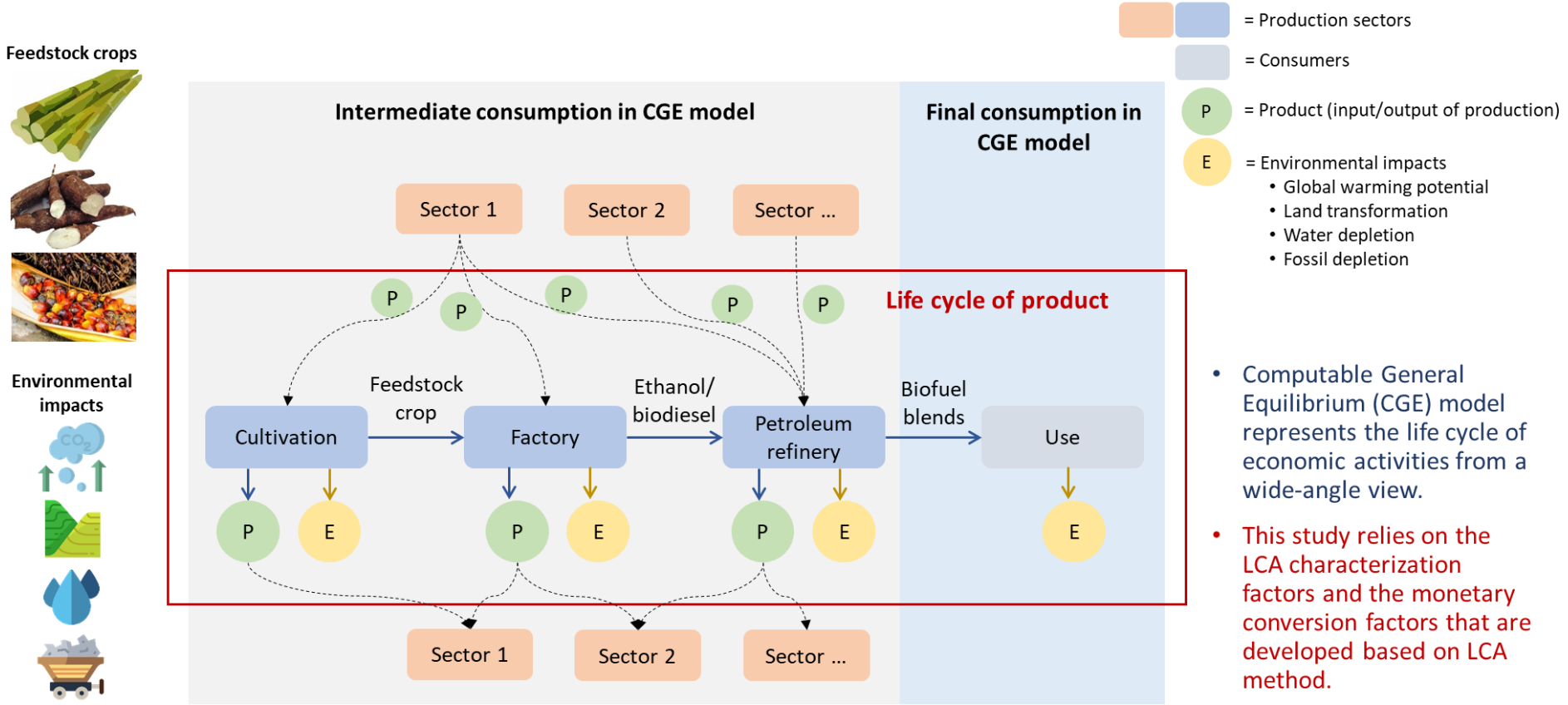
"The impact of water use in areas with abundant freshwater resources should not be the same as areas with limited resources. This impact is quantified as water scarcity footprint"

Water scarcity indicator, characterizing the potential impact of water use on water resources.



Economic LCA: Integrating the economic Analysis to LCA of Bio-energy

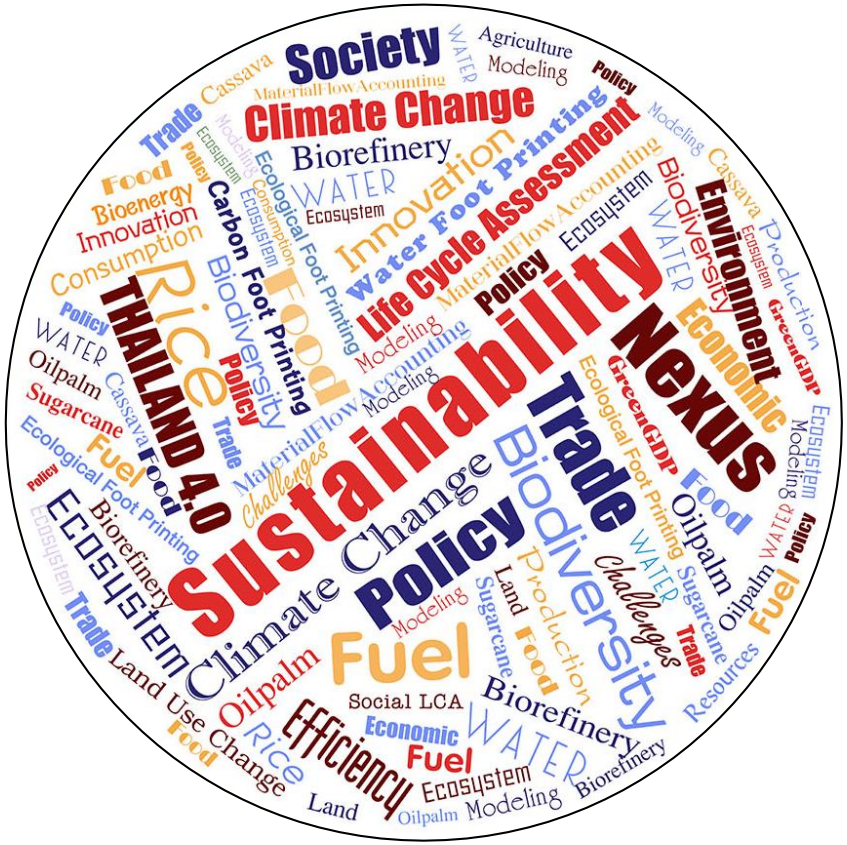
Dr. Piyanon Haputta from Thammasat University



- Computable General Equilibrium (CGE) model represents the life cycle of economic activities from a wide-angle view.
- This study relies on the LCA characterization factors and the monetary conversion factors that are developed based on LCA method.

Tools for Sustainability Assessment

Green GDP
CGE Analysis



Carbon Footprint
Water Footprint
Ecological Footprint
Material Flow Analysis
Life Cycle Impact Assessment

Network for Research and Innovation

International Collaboration

- UNEP
- AIST and NARO, Japan
- CIRAD and INRA, France
- ETH Zurich, Switzerland
- CML, Leiden U., Netherlands
- KIT, IINAS, TUHH, Germany
- UNC, USA
- University of Surrey, England
- Aalborg University, Denmark
- USC, Spain
- SIRIM and UKM, Malaysia
- UNILA and IPB, Indonesia
- UPD, Philippines
- UQ and UTS, Australia

Network for Research and Innovation

National Research Partners

Government Agencies

LCA Networks

- Thai LCA Network
- LCA Agri Food Asia
- LCA Food international conference

Private Partnerships

- Charoen Pokphand Group
- Bangchak Petroleum PCL
- Thai Sugar Millers Corporation Limited
- Thai Ethanol Manufacturing Association
- Thai Tapioca Starch Association
- Thai Oil Palm and Palm Oil Association
- Thai Confederation of Tapioca Farmers
- Federation of Thai Sugarcane Farmers
- Thai National Farmers Federation
- Thai Rice Mills Association
- Thai Rice Exporters Association


SUSTAINABLE DEVELOPMENT GOALS
17 GOALS TO TRANSFORM OUR WORLD
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS


Society
Agriculture
Modeling
Policy
Cassava
MaterialFlowAccounting
Climate Change
Trade
Biorefinery
Food
Bioenergy
Innovation
Consumption
WATER
Ecosystem
Carbon Foot Printing
Ecological Foot Printing
Water Foot Printing
Life Cycle Assessment
Rice
THAILAND 4.0
Biodiversity
Environment
Sustainability
Nexus
Economic
GreenGDP
Production
Oilpalm
Sugarcane
Fuel
Challenges
Climate Change
Policy
Trade
Biodiversity
Ecosystem
Land Use Change
Social LCA
Efficiency
Economic
Resources
Land

THANK YOU