Advancing the Transition to Bioeconomy: A Systems Approach

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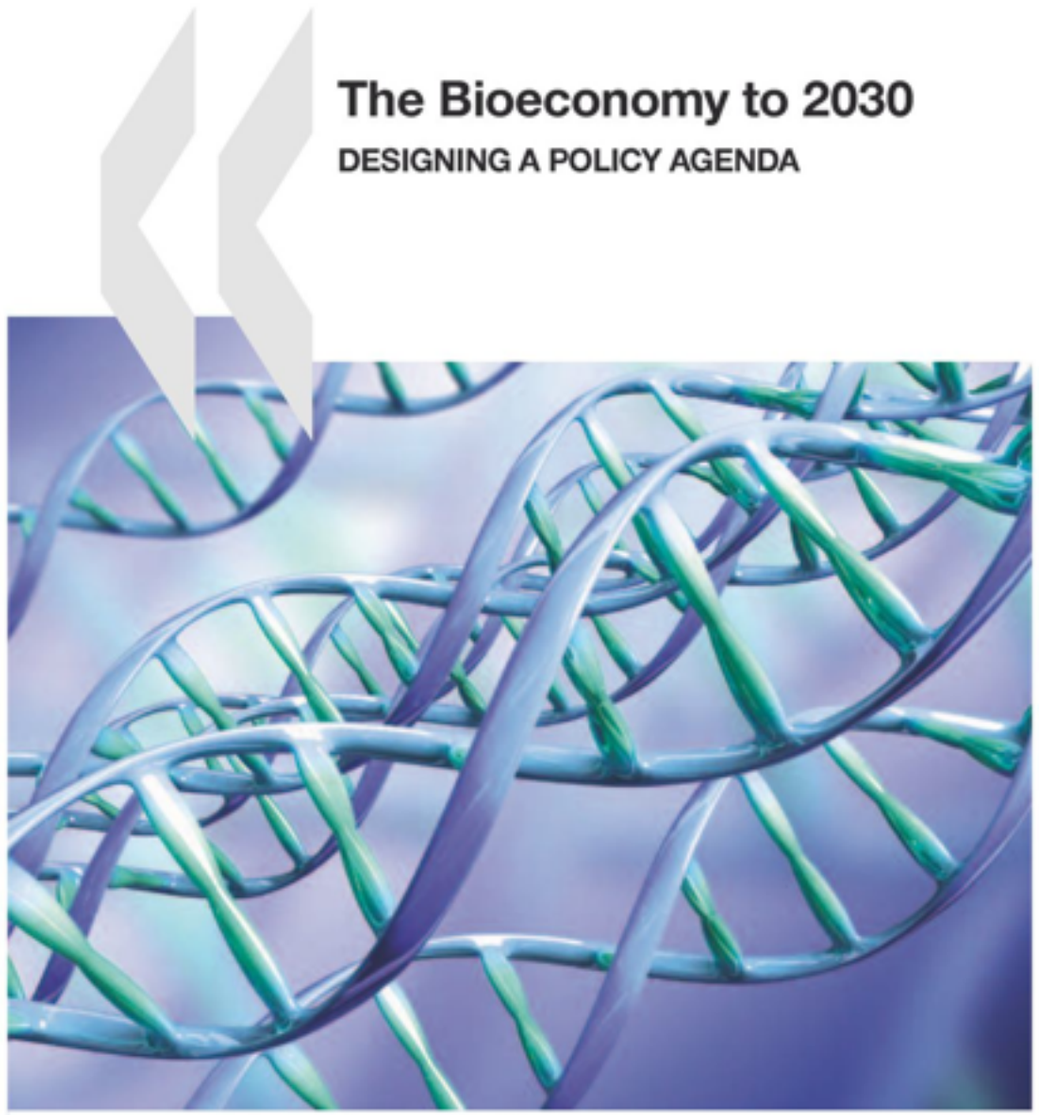
Layout

- Background (What is bioeconomy? Do we all have a common vision?)
- Benefits and challenges of bioeconomy
- What is needed for the transition to a sustainable bioeconomy?
- BIOECONOMY Graduate Research School
- Conclusions

First time widely-used definition of bioeconomy



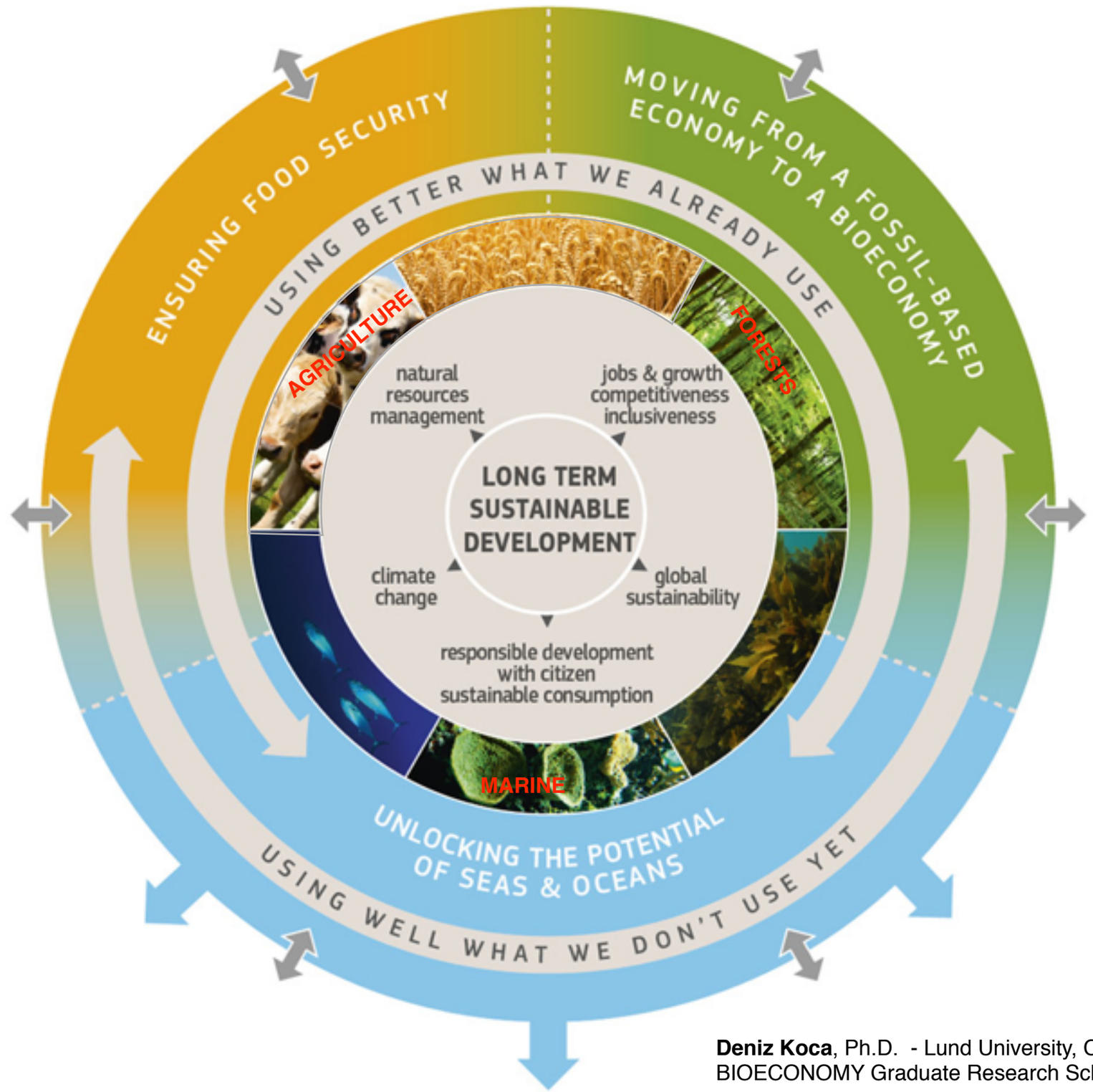
"biotechnology offers technological solutions for many of the health and resource-based problems facing the world. The *application of* ***biotechnology*** *to primary production, health and industry could result in an emerging* ***bioeconomy*** where biotechnology contributes to a significant share of economic output""

OECD The Bioeconomy to 2030 Designing a Policy Agenda, 2009

The EU Bioeconomy Definition

" …. encompasses the **production of renewable biological resources** and the **conversion of these resources** and **waste streams** into **value added products**, such as food, bio-materials, bio-energy and bio-products."

EU bioeconomy strategy, 2012



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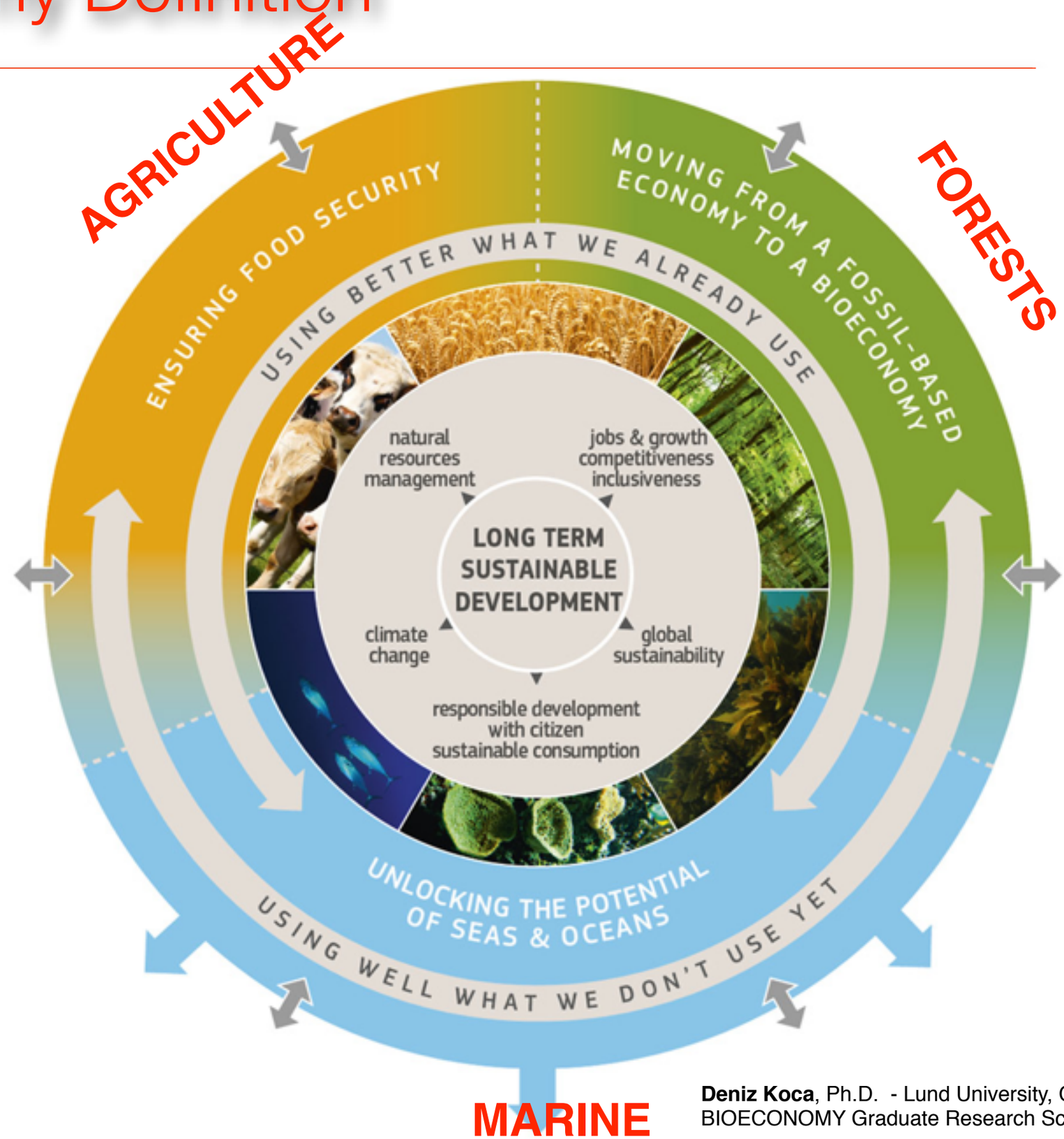

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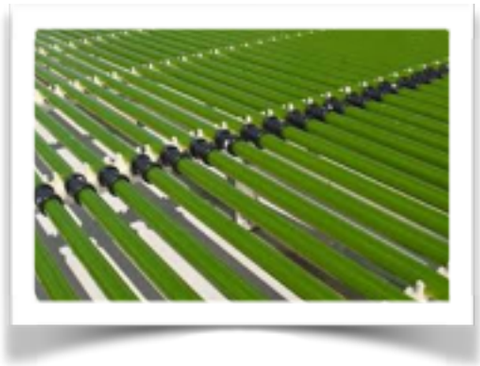
some examples of bio-products and energy

corn

wood



algae

organic waste

Pharmaceuticals

Bioplastics

textile

Construction material

Bio fuel & energy

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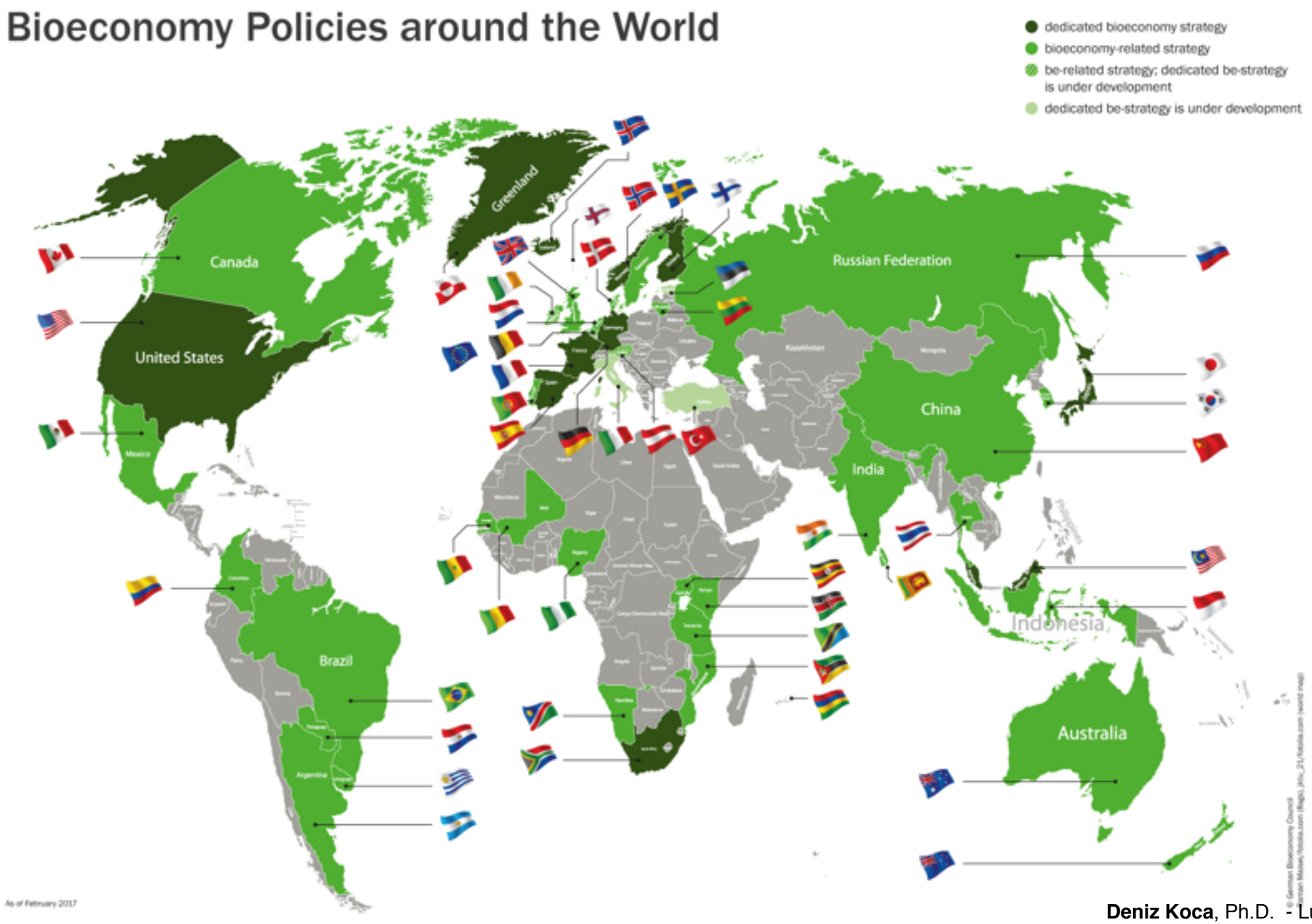
Bioeconomy policies around the world



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Different visions of bioeconomy

sustainability MDPI
Review
What Is the Bioeconomy? A Review of the Literature
Markus M. Bugge [1], Teis Hansen [1,2,3,*] and Antje Klitkou [1]

Bibliometric analysis of 453 scientific articles to identify the key interpretations of the bioeconomy concept

1. *A bio-technology vision* emphasises the importance of **bio-technology research and application** and commercialization of bio-technology in different sectors. **Economic growth and job creation**. Global clusters and central regions
2. *A bio-resource vision* focuses on the role of R&D related to **biological raw materials**, as well as on the **establishment of new value chains**. **Economic growth and sustainability**. Rural and peripheral regions - importance of external linkages
3. *A bio-ecology vision* highlights the importance of **ecological processes** that optimise the use of energy and nutrients, promote biodiversity and avoids monocultures and soil degradation. **Sustainability, conservation of eco-systems**. Rural and peripheral regions - development of locally embedded economies

Bioeconomy has tremendous potential for growth and substantial benefits. It may:

- address key environmental challenges;
  - reduce use of fossil based raw materials —> reduced GHG emissions

  - replace non-degradable with deg

- biofuel vs fossil fuel
- bio chemicals vs petrochemicals
- bioplastics vs oil based plastic
- wood fiber vs polyester fiber in textile

- diversify energy sources —> imp
- provide healthier and longer lives;

- create new “biomass” businesses—> increase the multifunctionality and scope of the processing, manufacturing of new etc.

In the EU:

- 13% increase in bioplastic production
- With this rate the production quadriples by 2030.
- 300 new refineries, 47 Bil. EUR investment

- ment
-

Global Biomass Demand - by sectors

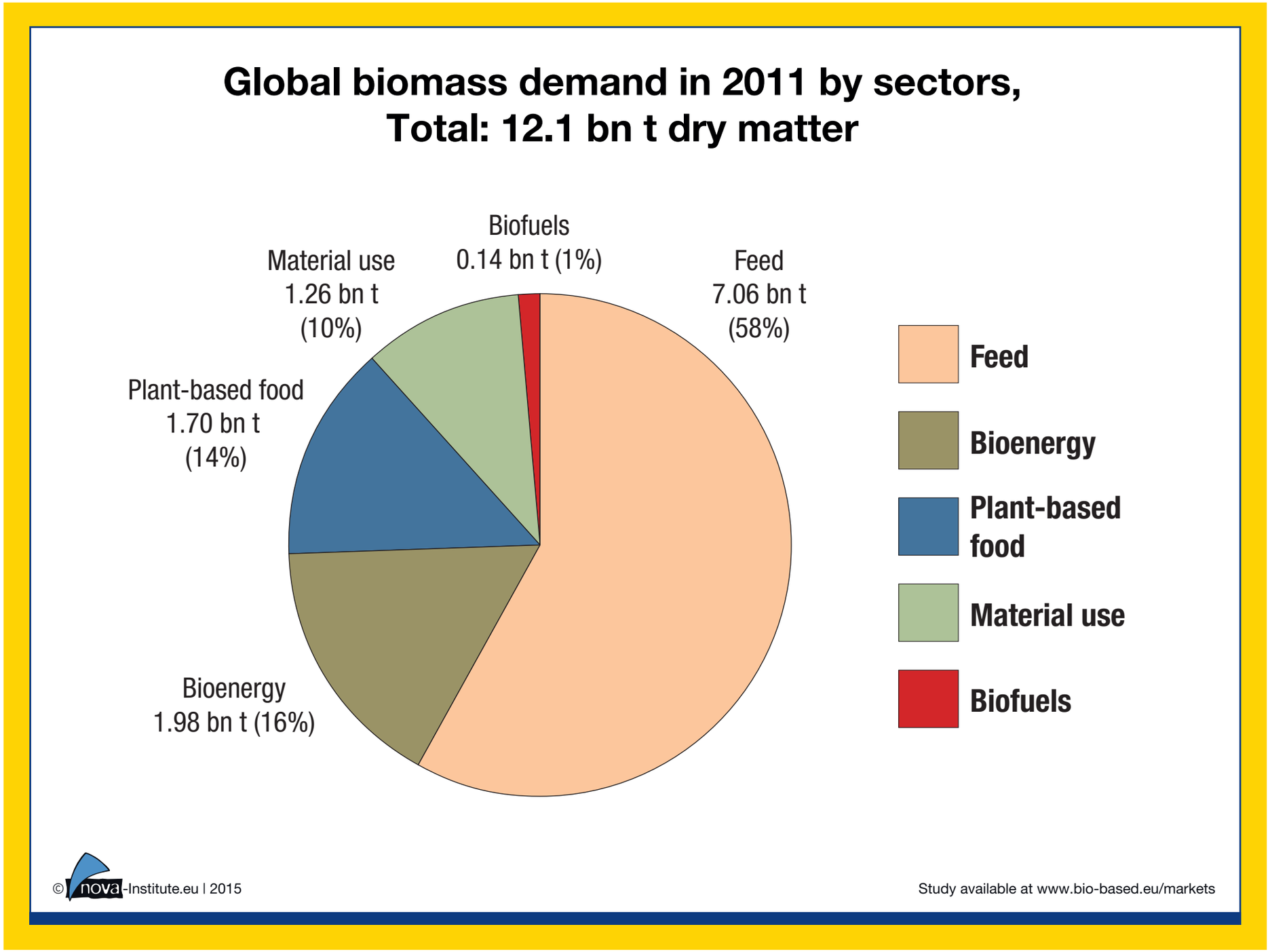


Figure 3: Global biomass demand 2011, by sectors (Source: FAO 2014; own calculations)

from Piotrowski, et. al., 2015

Future Global Biomass Demand ?

- The trend in **increasing demand for biomass** will continue, not only as food and feed, but also as materials and fibres, and feedstock for fuel/energy productio

global production of bioplastics expected to more than triple until 2019, with land requirements increasing from 1.1 to 1.4 Mio. Hectares of cropland

Increasing demand for biofuels

—> production is expected to expand rapidly to 120-180 million hectares of cropland by 2020

- the growi
- changing **consumption patterns**

Bioeconomy may also generate severe negative impacts on the environment and society

- conversion of ecologically fragile and valuable lands to agriculture to supply the increased demand for biomass
  - conflicts for land (land grabbing)
  - possible CO_2 emissions from such conversions
- intensification of production in agriculture and forestry
  - depleted and contaminated water resources,
  - loss of biodiversity —> loss of ecosystem functioning!
  - soil degradation, decreased soil quality
- food security, higher prices for food?
- concerns regarding design and end-of-life management of bioplastics, with little clear standards defining their recyclability, biodegradability or compostability

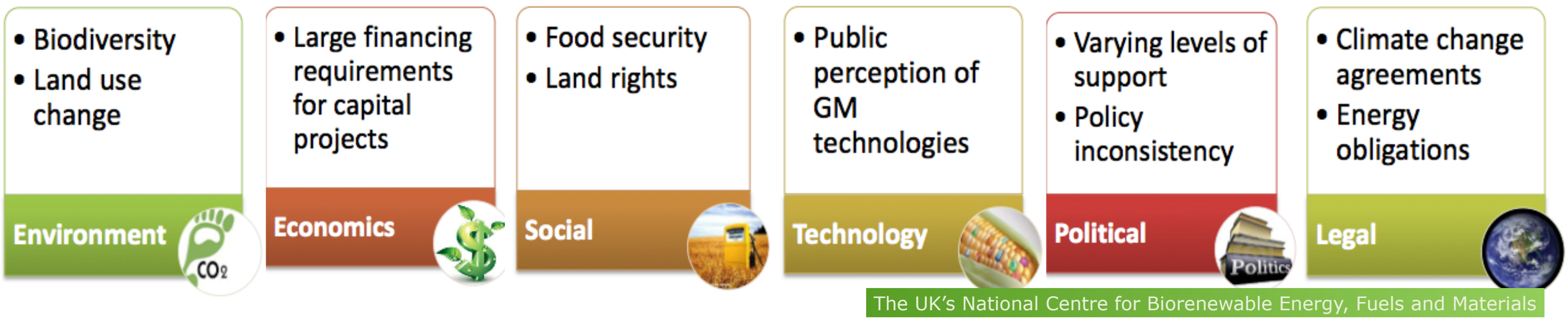
What is needed? (1)

- a **systems level redesign** of the existing economic system and the socio-ecological regime
  - sustainable production of biomass. It sustains, not reduces the life support mechanism of the Earth
  - valuation of natural capital and ecosystem services
  - innovation - technology, business systems, product design, legal frameworks
  - new institutional arrangements that can interlink independently addressed policies from a wide range of areas/sectors in the whole biomass value chain
  - changes in consumption preferences
  - societal acceptance, address the SDGs, paradigm shift…

What is needed? (2)

- agreeing on legal frameworks, formulating policies and governmental measures, industrial investments and achieving societal acceptance are extremely **complex issues** in this redesigning process

- the overall system solutions requires:
  - disciplinary, interdisciplinary and, most importantly, **transdisciplinary research** with broad **stakeholder engagement** and **cross-sectoral collaboration** from the whole biomass value chain
  - strong need for a **systems thinking approach** and **innovation**



BIOECONOMY Graduate Research School (BIOECONOMY-GRS)

- Overall aim is to develop the competencies necessary for participating PhD students to
  - adopt **systems approach** in order to identify and assess the full range of technological, economic, social and ecological challenges and opportunities in transition to a circular bioeconomy; and
  - lead the way in **innovative** i**nter/trans-disciplinary research** for a sustainable circular bioeconomy in the international arena.

- BIOECONOMY-GRS will act as a **collaborative learning platform** at Lund University allowing **researchers** and **Ph.Ds**, across faculties/disciplines and research areas, as well as non-academic **stakeholders** to meet with each other in order to identify, carry out and communicate innovative, analytically advanced and yet problem-oriented research for a sustainable future circular bioeconomy covering the whole biomass value chain.

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www.cec.lu.se/bioeconomy

- FORMAS funded, 4 years project

formas

The Swedish Research Council Formas

Committed to excellence in research for sustainable development

- Co-funded by public/private organisations

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- Cross faculty/discipline
  - 3 Faculties (Natural Science - Engineering - Political Science)
  - 4 Centres/Institutes (CEC, IIIEE, CIRCLE, LUCSUS)
  - 5 Departments (Physical Geography & Ecosystem Science, Biology, Chemical Eng., Biotechnology, Sociology, Political Science)
- 20 PhD students each year - education/training/networking activities i.e. courses, seminars, workshops etc.

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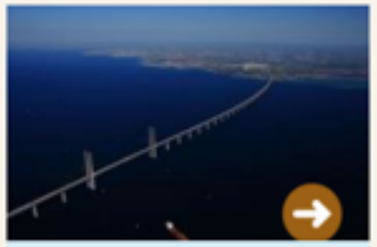

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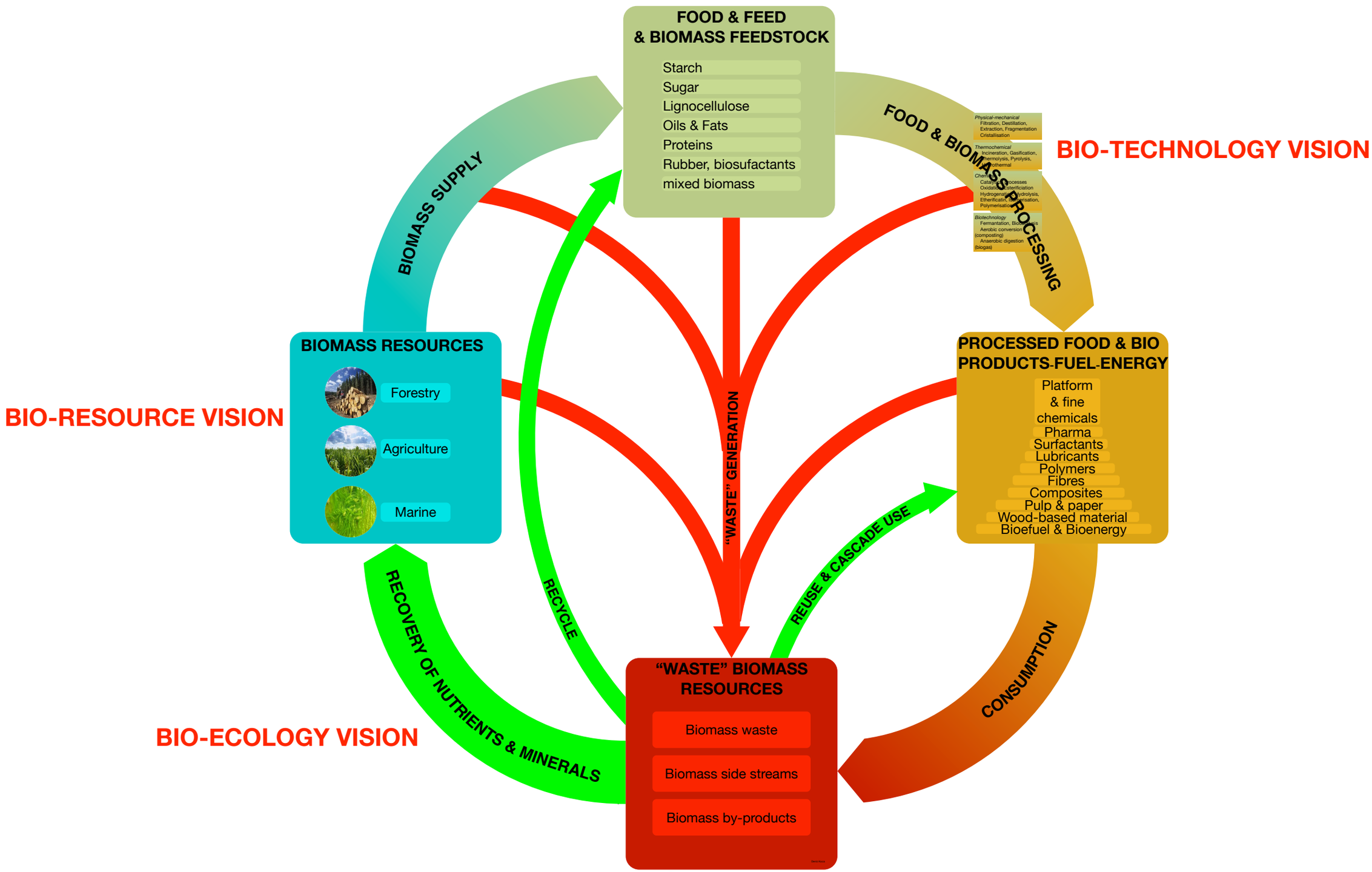
CIRCULAR BIOECONOMY



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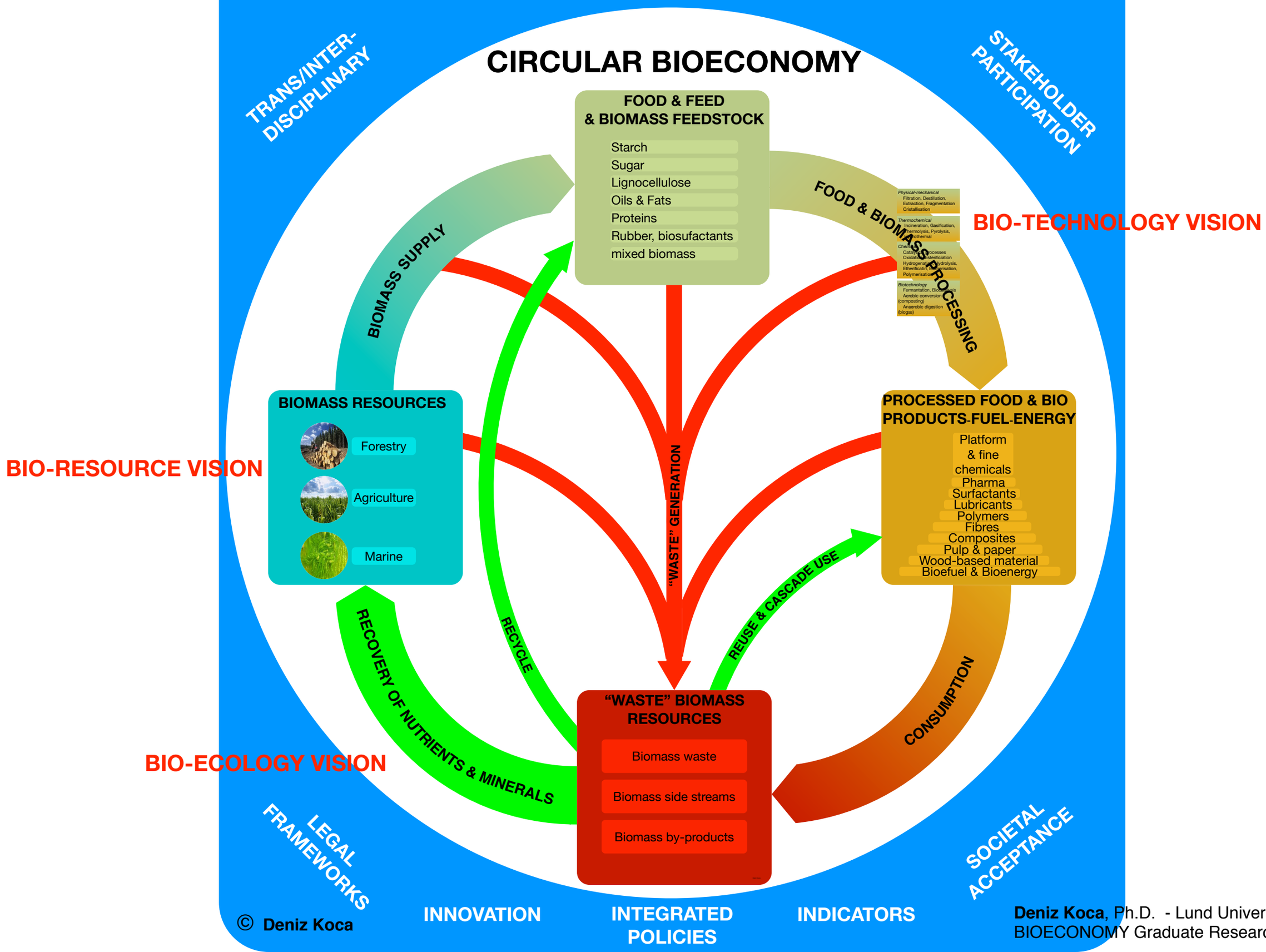
PLANNING-COORDINATION-GOVERNANCE OF THE TRANSITION TO CIRCULAR BIOECONOMY

SYSTEMS APPROACH



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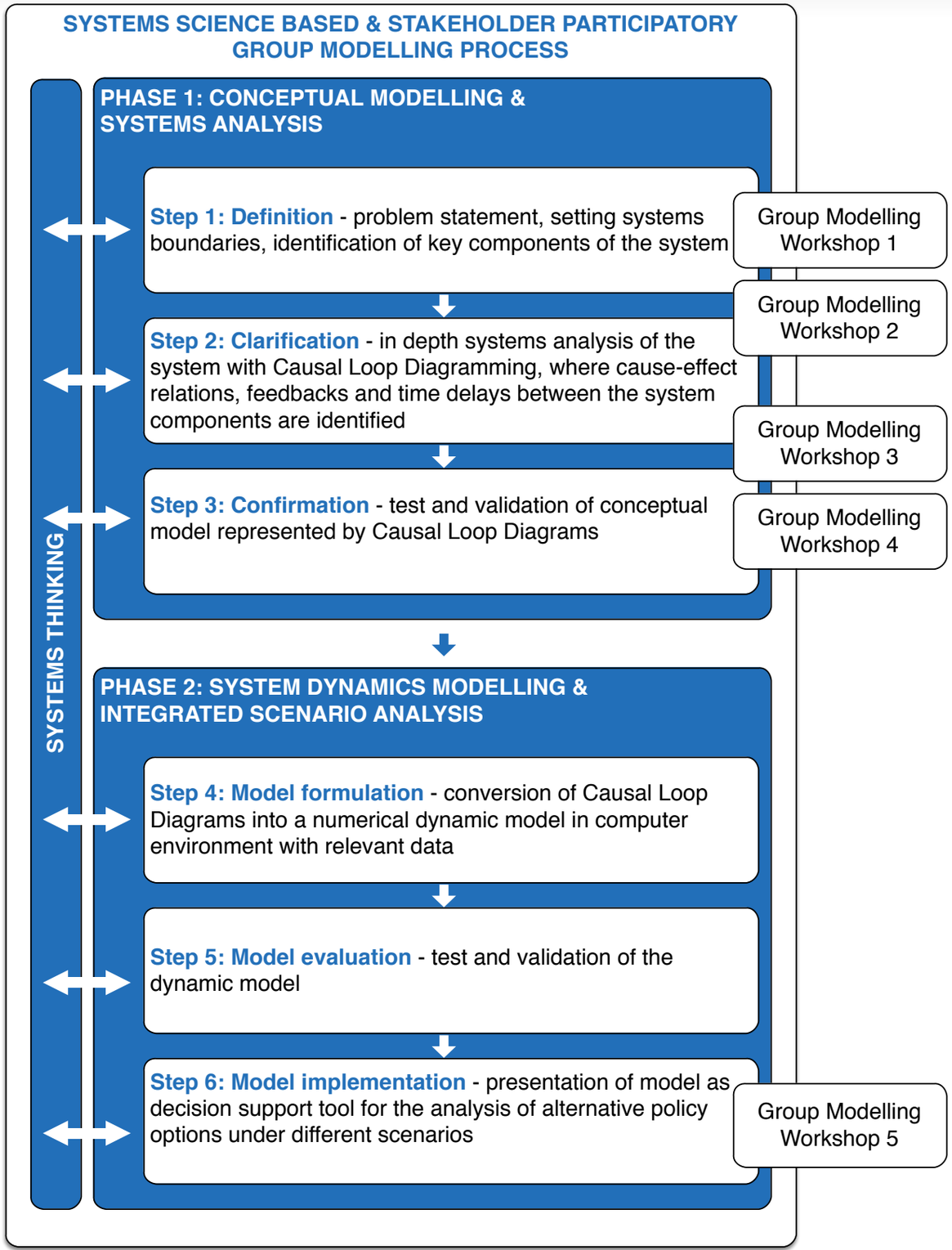
Working methodology for an effective/efficient communication and deeper understanding



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Thank you for your attention!

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