

## **Course Name**

“Transition to a Bio-based Economy – A Systems Approach”

## **Course Description**

Introduction: Transition to a bio-based economy ensures a shift from finite fossil based raw materials to sustainable biomass based feedstock and a reduction in the total CO<sub>2</sub> footprint. A prerequisite for such a transition to be sustainable is a systems level redesign of the existing economic system and the socio-ecological regime in such a way that it sustains, not reduces the life support mechanism of the Earth. A redesign like this requires new technology, products, and legal frameworks; changes in consumption preferences; and new institutional arrangements that can interlink independently addressed policies from a wide range of areas/sectors in the whole biomass value chain. However, 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 in the production, processing and consumption phases of the entire biomass value chain. Consequently, the radical changes necessary for a genuinely sustainable bio-based economy imply a strong need for a systems approach and broad stakeholder involvement.

Objective: The overall aim of the course is to develop competencies necessary for Ph.D students to i) adopt systems approach for identifying and assessing the full range of challenges and opportunities in transition to a bio-based economy; and ii) lead the way in innovative transdisciplinary research for a bio-based economy.

Course Details and Content: The course consists of four themes covering the entire biomass value chain. With these themes the students will be introduced into:

- 1) what bio-based economy is all about with its advantages and disadvantages, and why we need a transition to a bio-based economy;
- 2) a good understanding of the whole biomass value chain:
  - i. sustainable production of biomass feedstock from agriculture, forestry, waste and marine ecosystem;
  - ii. processing of different biomass feedstock with alternative ways and technologies to produce bio-based products, biofuel and bioenergy;
  - iii. consumption of bio based products, biofuel and bioenergy.
- 3) the research and development initiatives, innovation incentives, policy frameworks needed to support the transition to a bio-based economy, as well as the effective governance and coordination of this transition;
- 4) a systems science based indicator framework for developing bio-based economy indicators.

With themes 1 and 2, the students will develop a good understanding of, firstly, how a society with bio-based economy has tremendous potential for growth and substantial public benefits. For instance, how it can reduce dependency on fossil based raw materials; diversify energy sources; provide healthier and longer lives; address key environmental challenges; increase the sustainable production, multifunctionality and scope of the agricultural sector; improve manufacturing processes; introduce innovative new bio-based products to the market; and increase employment, stimulating the regional development, etc. Secondly, how, without a proper analysis and sustainable long-term planning, such a transition may also generate severe negative impacts on the environment and society, such as: conversion of ecologically fragile and valuable lands to agriculture to supply the increased demand for feedstock; possible CO<sub>2</sub> emissions from such conversions; depleted and contaminated water resources; loss of biodiversity; and decreased soil quality, etc.

Theme 3 will focus on how to build a strong research and innovation base, and assess cross-cutting policy instruments in production, processing and consumption phases of the whole biomass value chain to optimally support the bio-based economy. Effective governance and coordination between relevant bio-based economy sectors and policies will also be introduced in this theme.

In theme 4, the students will be introduced to a systems science based and stakeholder participative indicator framework, which can be used to develop bio-based economy indicators through a series of group modeling workshops.

Course Design: The course is one full week and consists of lectures, short assignments and discussions. Course literature includes a compilation of research and policy material.

Learning outcomes: Upon successful completion of this course the students will have;

- a good understanding and knowledge of bio-based economy, its origins, key definitions and concepts, as well as its pros and cons;
- an extensive, detailed and critical understanding and knowledge of the major parts of the production, processing and consumption phases of whole biomass value chain;
- a holistic understanding of the transition to bio-based economy with respect to systems approach, systems thinking and sustainability science;
- the ability to use their knowledge and understanding in identifying what actions are needed for building a strong research and innovation base, as well as for fostering effective governance and involvement of the society in transition to bio-based economy;
- the skills to identify and develop bio-based economy indicators

Dates: to be decided later (late Autumn 2015 or early Spring 2016)

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