

**Pro-Green Diploma  
Life Cycle Assessment – Fall/2016**

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### **Overview of the Course**

This module introduces the principles and methods of life cycle thinking and life-cycle assessment (LCA) with specific reference to agricultural and energy systems using attributional LCA.

The module will be based around the ISO 14040 methodology and the concepts of Carbon, Water and Energy Footprints. The module will focus on the four common stages of LCA: (i) definition of the Goal and Scope; (ii) Life Cycle Inventory Analysis; (iii) Life Cycle Impact Assessment and (iv) interpretation and tools for calculating carbon footprint, water footprint and energy audit. Case studies will consider LCA studies of engineering, agricultural and energy systems.

### **Credit Hours**

2 credit hours

### **Delivery Format**

This course is an online course. The method of delivery includes:

- 1) Explanation videos of the course content by the instructor
- 2) Presentations
- 3) Documentary videos from different sources
- 4) Problem based learning projects

### **Course Prerequisites**

- PRGR 601
- PRGR 611 (May be taken as a co-requisite)
- Prior knowledge in a specific field

## **Course Goals**

The main goals of the course are to understand the fundamentals of LCA and apply it in different systems.

## **Course Objectives**

The objectives of this course are:

- 1) Define and describe the concept of Attributional Life Cycle Assessment, summarize and assess the strengths and limitation of life cycle thinking as a decision support methodology for agricultural, energy or industrial systems;
- 2) Organize and manipulate data sources in order to undertake an LCA to calculate the carbon footprint, water footprint and energy audit of a product or process;
- 3) Convey the findings of the LCA in written format including critique of methodology, data, uncertainty and interpretation.

## **Topics Covered**

- 1: ISO Compliant LIFE CYCLE ASSESMENT Overview Modules (week1)
  - Introduction to Life Cycle Assessment and ISO 14040
  - LIFE CYCLE ASSESMENT Requirements and Guidelines: ISO 14044
- 2: ISO Compliant LIFE CYCLE ASSESMENT Detailed Modules (week2,3,4)
  - Goal, Function, and Functional Unit
  - System, System Boundary, and Allocation
  - Life Cycle Stages
  - LCIA Optional Elements: Grouping, Weighing, and Normalization
  - Data Types and Sources
  - Environmental Product Declarations (EPDs)
- 3: Environmental Impact Categories Overview Modules (week5)
  - Introduction to Impact Categories
  - Common Air Emissions Impact Categories
  - Other Common Emissions Impact Categories
- 4: Environmental Impact Categories Detailed Modules (week6,7,8)
  - Global Warming Potential
  - Acidification Potential
  - Ozone Depletion Potential
  - Smog Creation Potential
  - Eutrophication Potential
  - Human Toxicity and Ecotoxicity Potential
  - Human Health Particulate Matter
  - Impact Assessment Methodologies

5: General LIFE CYCLE ASSESMENT Tools Overview Modules (week9)

- General Paid LIFE CYCLE ASSESMENT Software Tools
- General Free LIFE CYCLE ASSESMENT Software Tools
- Engineering LIFE CYCLE ASSESMENT Software Tools

6: General LIFE CYCLE ASSESMENT Tools Detailed Modules (week10, 11)

- EIO-LIFE CYCLE ASSESMENT Tutorial and Links to GaBi Tutorials
- Building LIFE CYCLE ASSESMENT Software Tutorial

7: Engineering-Related LIFE CYCLE ASSESMENT Overview Modules (week12)

- Introduction to Engineering LIFE CYCLE ASSESMENT and Literature Review

8: Engineering-Related LIFE CYCLE ASSESMENT Detailed Modules (week13, 14)

- GREET Tutorial
- Athena Impact Estimator for Highways

### **Texts and Supplementary Materials**

#### *Optional Text*

- Life cycle assessment – Introduction and overview, A. Russel, T. Evkall, Henrikke Baumann, Journal of cleaner production, 2005
- Life cycle impact assessment (LCIA) of paper making process in Iran, Sotoodehnia Poopak & P. Agamuthu, Institute of Biological Sciences, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia, 2011
- Life Cycle Assessment of Hand Drying Systems, Trisha Montalbo, Jeremy Gregory, Randolph Kirchain, Materials Systems Laboratory, Massachusetts Institute of Technology, 2011

#### *Technical Requirements*

- o Familiar with the Learning Management System (Moodle)
- o Intermediate computer skills
- o Free LCA software

### **Grading Policy**

The grades in this class break down as follows:

Goal and scope definition for LCA of chosen system	15 pts
Carbon and water footprints assessment	25 pts
Ecological assessment	25 pts
Completed LCA presentation including critical analysis	35 pts
<b>Total Points</b>	<b>100 pts</b>

## **Description of Course Requirements (assessments)**

### *Goal and scopes definition for LCA of Chosen System (Discussion forum)*

The instructor will propose three different systems, which cover different industrial, agricultural and energy sectors. The students have to engage in discussions on the module forum to identify the goals and scopes definitions for Life Cycle Assessment of these proposed systems. The students have to interact with each other's posts as well as pay attention to the instructor's updated remarks.

### *Carbon and water foot prints assessment (Individual assignment)*

Each student will assess both carbon and water footprints values and trends of a system or activity of his/her own choice. The final product should be a minimum of two infographic posters, which contain the data they collected, as well as their discussion.

### *Ecological assessment (Group Project)*

A group of 3 to 5 students have to assess two different activities or systems from the same field. The two projects will be compared regarding their sustainability and Environmental Impact. The submission project will contain a "brief" of both cases, and relating their positives and negatives to the module topics. It will also include final recommendations to reduce the negative environmental impact. Your submission should be typed, single-spaced, with 1-inch margins and a 12-pt. font (no more than six pages).

### *Completed LCA presentation including critical analysis (Presentation and Skype discussion)*

Each student will propose opening a new business in a specific field. The proposal will be submitted in a PowerPoint presentation, which includes a brief of the idea, the different methods for doing complete LCA of this business, a step-by-step analysis of one of these methods, results and recommendations. After the submission, a Skype discussion of maximum 20 minutes will be held online to cover the main key elements of the analysis.

## **Internet Etiquette**

Netiquette (short for "network etiquette" or "Internet etiquette") is a set of social conventions that facilitate interaction over networks.

### *General Rules*

1. Make your messages easier to read by making your paragraphs short and to the point.
2. TYPING IN ALL CAPS IS CONSIDERED SHOUTING ON THE INTERNET.
3. Messages in all lowercase letters can be difficult to read, instead, use normal capitalization.
4. \*Asterisks\* surrounding a word can be used to make a stronger point.
5. Be careful when using sarcasm and humor. Without face-to-face communications your joke may be viewed as criticism. When being humorous, use emoticons to express humor. (Tilt your head to the left to see the emoticon smile) :- ) = happy face for humor
6. Never give your user ID or password to another person. System administrators that need to access your account for maintenance or to correct problems will have full privileges to your account.

## Make-up Policy

- First activity does not have a make-up option, as it has to be made within a specific time range to follow up the posts of the other students.
- All other activities' grade will be reduced by 20% if submitted late by 1 week, and 40% if submitted later than 1 week.

## Tentative Schedule

<b>Day/Week</b>	<b>Topic</b>	<b>Activity</b>	<b>Due Date</b>
1	ISO Compliant LIFE CYCLE ASSESMENT Overview Modules	Ice breaking (Introducing yourself)	25th of September 2016
2	ISO Compliant LIFE CYCLE ASSESMENT Detailed Modules (Part1)	Ice breaking (LCA King/Queen)	2nd of October 2016
3	ISO Compliant LIFE CYCLE ASSESMENT Detailed Modules (Part2)		
4	ISO Compliant LIFE CYCLE ASSESMENT Detailed Modules (Part3)	Goal and scope definition for LCA of chosen system	From 10th of October till 30th of October 2016
5	Environmental Impact Categories Overview Modules		
6	Environmental Impact Categories Detailed Modules (Part1)		
7	Environmental Impact Categories Detailed Modules (Part2)		
8	Environmental Impact Categories Detailed Modules (Part3)	Carbon and water footprints assessment	27th of November 2016
9	General LIFE CYCLE ASSESMENT Tools Overview Modules		
10	General LIFE CYCLE ASSESMENT Tools Detailed Modules (Part1)	Ecological assessment	11th of December 2016

11	General LIFE CYCLE ASSESMENT Tools Detailed Modules (Part2)		
12	Engineering-Related LIFE CYCLE ASSESMENT Overview Modules	Completed LCA presentation including critical analysis	25th of December 2016
13	Engineering-Related LIFE CYCLE ASSESMENT Detailed Modules (Part1)		
14	Engineering-Related LIFE CYCLE ASSESMENT Detailed Modules (Part2)		