

Theory & Practice of Life Cycle Assessment

<u>Instructor:</u>	Christoph J Meinrenken
<u>Office hours:</u>	tba
<u>Prerequisites:</u>	No specific pre-requisites, familiarity with spreadsheet software and quantitative, data-driven analyses strongly recommended

1 CONTENT OVERVIEW

Life Cycle Assessment (LCA), a methodology to assess the environmental impact of products, services, and industrial processes is an increasingly important tool in corporate sustainability management. This course teaches both the theoretical framework as well as step-by-step practical guidelines of conducting LCAs in companies and organizations. Particular emphasis is placed on separating the more academic, but less practically relevant aspects of LCA (which will receive less focus) from the actual practical challenges of LCA (which will be covered in detail, including case studies). The course also covers the application of LCA metrics in a companies' management and discusses the methodological weaknesses that make such application difficult, including how these can be overcome. Product carbon footprinting (as one form of LCA) receives particular focus, owing to its widespread practical use in recent and future sustainability management.

2 LEARNING OBJECTIVES

The overall learning objective of this course is for students to be able to speak intelligently about the management benefits, strengths, and weaknesses of LCA, when to apply this tool, knowing the basic steps and processes of how to conduct one, and having detailed knowledge of where and when to find additional resources such as software packages, databases, and (government) standards and protocols.

Particular learning objectives are:

- Mastery of the LCA project management roadmap, from data collection to report writing (focus on hands on expertise to be able to "hit the ground running" if tasked with conducting an LCA)
- Basic understanding and mastery of LCA software and tools
- Familiarity with concepts and procedures for quality management of LCA data
- Difference of LCA on one hand and related approaches on the other (such as corporate footprinting and economic input/output analysis); understanding of the relative merits and when to use them
- Ability to critically interpret LCAs carried out by third parties or competitors
- Benefits and perils of applying LCA metrics in corporate management and product design

- Role of standards and how government, NGOs, and the private sector can affect their evolution

3 WEEKLY SYLLABUS & READINGS

The week-by-week syllabus will be shared at the beginning of the semester and may be updated during the course of the semester in order to include current news and events as well as to accommodate practitioners as guest lecturers. Selected readings will be assigned each week, and the instructor will give detailed guidance how to use the readings and which part of the readings to focus on.

4 GUEST LECTURERS

An important element of this course are invited guest lecturers. These will typically be drawn from companies and government or NGO-type organization. The goal is to reveal to students the challenges and constraints that practitioners face when carrying out LCAs – and when incorporating the LCA results into their product development and management decisions. Examples for guest lecturers are:

- World Resources Institute; ERM; PepsiCo; Siemens; Levy Strauss; Ernst & Young; Carbon Disclosure Project, Colgate Palmolive, Tom's of Maine, Ben & Jerrys, The Sustainable Consortium, Zady, etc.

5 METHOD OF INSTRUCTION AND EVALUATION

This section provides an overview of instruction methods and assignments (above and beyond the lectures themselves) as well as the respective weights attributed for the final grade. Details of students' assignments and respective expectations are laid out in section 6.

- **Assignments [40%]**
 - Homework will be assigned each week, to be turned in a week later. Assignments will be of qualitative and quantitative nature, focusing on practical examples and challenges of conducting and interpreting LCAs in business settings. Typical are e.g. LCA exercises using real (but sanitized) company data
- **Midterm quiz [20%]**
 - Quiz with part essay and part multiple choice questions
- **Class participation [10%]**
 - Attendance and active participation in classroom discussions is required. In addition, students can engage in topic-specific discussions on *Canvas*, e.g. to exchange hints and advice on particular homework sets and additional sources
- **Collaborative final project and in-class presentation [30%]**
 - The final group project will be a complete, a-z LCA conducted of a product or service of the group's choice. A comprehensive report of the LCA, compliant with ISO and other respective

standards, is part of this assignment. The grade (A+ ... F) will be assessed based on (i) accuracy of analyses and (ii) completeness of the report (vis-à-vis the respective reporting requirements).

5.1 Letter grade system and final grades

Unless indicated otherwise by the instructor during the course, each individual assignment (a specific homework, midterm, class participation, etc.) will be assigned letter grades (A+ ... F) across students, based on a curve centered around B+. The final grade for each student will be the weighted average (weights see above) of the four grades, using the standard GPA metric (i.e., A+ = 4.33, A = 4.0, A- = 3.67, B+ = 3.33, etc.).

5.2 Policies for late assignments, incompletes, missed lectures, etc.

Towards the beginning of the course, the instructor will communicate clearly respective policies.

6 COURSE ASSIGNMENTS AND EXPECTATIONS OF STUDENTS

Homework assignments will be assigned each week, to be turned in a week later. Assignments will be of qualitative and quantitative nature, focusing on practical examples and challenges of conducting and interpreting LCAs in business settings.

Students should expect each assignment to take **several hours** of independent work. This time is in addition to students doing the weekly suggested readings which will be the basis for discussion in the lectures.

6.1 Quantitative – simple spreadsheet calculations

Quantitative assignments will be practical exercises to reinforce the learning of LCA's basic mechanics and mathematical steps. These will be set by the instructor, in co-ordination with the case studies in the syllabus and/or based on current events. Typical are e.g. specific portions of complete LCA exercises, using real (but sanitized) company data, and typically performed as (simple) spreadsheet analysis or publicly available LCA calculators.

6.2 Qualitative - short-answer essays

For qualitative assignments, a short answer essay format will be employed. Several short-answer essays will be assigned during the course of the semester. Essays are designed to reinforce the basic concepts presented in class and to ensure that students master the main concepts. These essays will consist of multiple questions. Answers to each question should be no longer than a paragraph (5 to 6 sentences). For example, you may be asked: What are the four basic steps of a proper LCA as laid out by ISO standards? The objective is to gain experience concisely identifying key concepts and arguments. Grading: The 'Short-Answer Essays' component will be graded on a letter grade scale from A+ to F.

6.3 Term paper and in-class presentation

The term paper is a semester-long assignment on a case study in LCA. Students will be expected to form groups (3-6 students per group) and select a topic that is both interesting to them and of interest in

developing their career (e.g., focus on bioplastics or storm water management). The instructor will support student groups in selecting a suitable topic by (i) providing a handout with more examples early in the semester and (ii) discussing data availability and scope of each proposed topic early with each student group before the bulk of the project work begins. The central goal of the group project is to provide students with a hands-on experience of all the steps necessary and challenges faced to perform a life cycle assessment from a-z – and how this can be established in a team (such as one student may have later in their professional careers). The term paper should be 8 to 10 pages in length (double spaced, excluding figures and references). Before handing in the final paper, students will first submit a summary or abstract of their topic as well as a progress report on your paper.

During the last 2 sessions, student groups will present their findings in presentation format to the entire class. Each group should prepare slides or other material to cover about 45min per project, including Q&A by the class. Each presentation will be graded by how well it communicates the main findings. In addition to providing engaging class room discussion and a variety of topics to all students, the goal of the in-class presentations is to train students to present research findings in a clear and succinct manner. Grading: The 'Term-paper and Presentation' component will be graded on a letter grade scale from A+ to F.

7 LOGISTICS AND SOFTWARE

Unless communicated otherwise, Columbia University's platform *Canvas* will be used to distribute reading materials, lecture slides, and to turn in assignments.

8 POLICIES

8.1 Academic Integrity

The School of Continuing Education does not tolerate cheating and/or plagiarism in any form. Those students who violate the Code of Academic and Professional Conduct will be subject to the Dean's Disciplinary Procedures. The Code of Academic and Professional Conduct can be viewed online: <http://ce.columbia.edu/node/217>

Please familiarize yourself with the proper methods of citation and attribution. The School provides some useful resources online; we strongly encourage you to familiarize yourself with these various styles before conducting your research: <http://library.columbia.edu/help/howto/endnote.html>

Violations of the Code of Academic and Professional Conduct will be reported to the Associate Dean for Student Affairs.

8.2 Accessibility Statement

Columbia is committed to providing equal access to qualified students with documented disabilities. A student's disability status and reasonable accommodations are individually determined based upon disability documentation and related information gathered through the intake process. For more

information regarding this service, please visit the University's Health Services website:
<http://health.columbia.edu/services/ods/support>

8.3 Columbia University Information Technology (CUIT) Computer Use Policy

Columbia University requires that all individuals accessing University electronic information resources to abide by the standards of acceptable usage indicated within this policy. The University is not responsible for information or materials residing on non-University systems or available over publicly accessible networks even if accessed via the University's network. Such materials do not necessarily reflect the attitudes, opinions, or values of the University, its trustees, faculty, staff, or students. Columbia University's network and computing technology provides information, data, and communication services. Responsible use of electronic information resources is necessary to create and maintain an open community of responsible users based on mutual respect and cooperation, commitment to the integrity of resources and data, and compliance with all University policies and federal, state, and local statutes.

APPENDIX A

Student Information Page

SUMA KTBD DECISION MODELS & MANAGEMENT

Please complete this information page and return it to me at the next class meeting. I will use this information to plan the semester, to get to know you, and to contact you by email or phone if the need arises. I will not share this information with anyone without your consent.

Name _____ Student ID# _____

Contact me by phone at: Home: _____

Work: _____

Other: _____

My UNI email address: _____

Backup email address: _____

Identify the degree program or certificate program you are in:

Explain why you are you taking this course and how it fits into your degree or certificate program.

What are your expectations for the course?

Briefly describe related experiences or courses that are relevant to this course:

If you require special accommodations, please indicate that below and be sure to discuss them with me soon.