

Course Memo
LIFE CYCLE ASSESSMENT

Credits: 7.5 hp
Course code: AL2608
Year: 2020

Welcome to the course in Life Cycle Assessment!

This course memo contains important information about the course.

Please take your time to read it carefully!

Then read parts of it again before every lecture, computer lab, supervision meeting, or seminar.

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ADMINISTRATIVE INFORMATION

Any questions related to course organisation, lectures, seminars etc., should primarily be directed to the course assistant.

Course assistant	Karin Lagercrantz klager@kth.se
Contact for questions about Canvas, schedule, signing up for seminars and computer labs.	
Lecturers	Anna Björklund annab@abe.kth.se Göran Finnveden goran.finnveden@abe.kth.se Miguel Brandão miguel.brandao@abe.kth.se Elisabeth Ekener elisabeth.ekener@abe.kth.se
Project supervisors	Anna Björklund, annab@abe.kth.se
Contact for project specific questions.	Asterios Papageorgiou asterios@kth.se Elias Sebastian Azzi eazzi@kth.se
Course coordinator and examiner	Anna Björklund annab@abe.kth.se
Overall responsible for course content and examination	
Dept. course administration	Marie Larsson kursadmin.seed@abe.kth.se
Contact for questions about admission and registration.	

Teaching unit: Dept. of Sustainable development, Environmental science and Engineering (SEED).

Visiting address: Teknikringen 10B

Web site: <https://www.seed.abe.kth.se/en/>

COURSE CONTENT AND INTENDED LEARNING OUTCOMES

Intended learning outcomes

The general aim of the course is to develop the student's ability to assess environmental impact of complex systems in technology and urban planning based on a life-cycle perspective by giving theoretical and practical skills in Life Cycle Assessment (LCA).

After passing the course, the students should be able to:

1. Give an account of the aim applications of the LCA method.
2. Explain the analytical phases and central concepts of the LCA method.
3. Apply the analytical phases and central concepts of the LCA method on complex systems in technology and urban planning.
4. Identify uncertainties in LCA method and data and evaluate how these influence the results.
5. Report in writing the completed LCA study according to ISO's standard for LCA.
6. Use LCA software.
7. Give an account of the results orally of the completed LCA the study.
8. Work in a collaborative project setting
9. Report in writing and give an account of a critical review orally of an LCA report.

Course main content

The course covers:

- LCA methodology
- LCA tools and – databases
- Specialisation of life cycle impact in a specific field that the students choose independently
- Lecture from industry with examples of use of LCA for decision making

Groups of 5 students perform LCA using the software SimaPro. Projects are presented in a report and at a seminar. Each group will also make a critical review of the LCA of another group.

SCHEDULE, SUBMISSION DEADLINES, SIGN UP FOR ACTIVITIES

The schedule with lectures, seminars, and computer labs is available in TimeEdit:
<https://cloud.timeedit.net/kth/web/public01/>

Deadlines for assignments, as well as deadlines to sign up for seminars, computer labs, and supervision appointments is available in the Course Syllabus in Canvas.

NOTE: You need to add the course AL2608 to your Canvas Calendar in order to see calendar events and use Scheduler to sign up for supervision.

WORK LOAD

The course covers 7.5 credits, corresponding to 5 weeks of full time work. You should expect to spend roughly the following amount of time on different parts of the course:

Note: week 47 (Nov 16 – Nov 20) will be especially intense, with pre-seminar and home exam! Take this into account when you plan your work.

Scheduled studies (~1 week)

- Lectures: 20 h
- Computer labs: 12 h
- Supervision meetings: 4 h

Own studies (~4 weeks)

- Reading course literature: 1 week
- Completing home exam: 6-8 hrs (if you have done the reading before the exam!)
- Project work: 2.5 weeks
- Critical review and final revision of report: 0.5 week

COURSE REGISTRATION

Registration is possible when you have been admitted to the course. Register on-line during the first week of the course through your personal menu at kth.se. You must register to have access to Canvas.

If you encounter problems when registering, please contact the department's course administrator (kursadmin.seed@abe.kth.se).

COMPENSATORY SUPPORT FOR STUDENTS WITH DISABILITIES (FUNKA)

Students with a disability may get support from KTH

<https://www.kth.se/en/student/studentliv/funktionsnedsattning/funka-stod-for-studenter-med-funktionsnedsattningar-1.953214>

LECTURES (L1 – L10)

Digital teaching in fall 2020: During fall term 2020, lectures will be held interactively on Zoom at scheduled hours, but will also be recorded and posted in Canvas.

Lectures cover LCA methodology as a complement to the course literature. The following overview indicates what parts of the course literature relates to the topic of each lecture. Use this as a help to plan your studies.

Lectures are not compulsory, but it is important to attend lectures and read the corresponding literature to be able to work efficiently in your project. We will not go through the literature specifically in lectures, but lectures and literature complement each other. You are encouraged to do the exercises in the course book, ideally together with fellow students in the course, but we do not work on these together in class.

NOTE: By the time of the home exam, you need to have already studied the literature and lecture notes. Experience from students earlier years tells that it will otherwise be a very stressful exam.

L1 - What is LCA? & Course overview

Lecturer: Anna Björklund

Content: Introduction to key features of LCA to give an overview of course content and a possibility to start reflecting over how LCA can be used in various fields of industry and society. Throughout the remainder of lectures, LCA methodology will be covered in depth.

We will also go through practical issues and course design in this lecture.

Literature for L1:

- Curran, M. A. (2015) *Life Cycle Assessment Student Handbook*. Preface and Chapter 1.
- PRÉ Consultants (2016) *Introduction to LCA with SimaPro*. Chapter 1.

L2 – Forming project groups & Goal and scope definition

Lecturer: Anna Björklund

Content 1st hour: How to set up and design a LCA study. Understanding this phase (Goal definition and scoping) of LCA is important for you to make an adequate and meaningful formulation for the topic of your project. This is necessary as background for the first project supervision meeting (PS1).

Content 2nd hour: We will brain storm about project ideas and form project groups (4 members per group). Please prepare before Lecture 2 by thinking of topics that you would like to work with in your projects.

NOTE: If you miss this lecture, you need to contact the course coordinator ASAP in order to make sure that you join a project group!!! Project groups start working already during the first week of the course.

Literature for L2:

- Curran, M. A. (2015) *Life Cycle Assessment Student Handbook*. Chapter 2.
- PRÉ Consultants (2016) *Introduction to LCA with SimaPro*. Chapter 2.

L3 –Goal and scope definition continued.

Lecturer: Anna Björklund

Content: Goal definition and scoping continued (2h).

Literature for L3:

- Curran, M. A. (2015) Life Cycle Assessment Student Handbook. Chapter 2.
- PRé Consultants (2016) *Introduction to LCA with SimaPro*. Chapter 2.

L4 - Inventory analysis. The Ecoinvent database

Lecturer: Anna Björklund

Content: Constructing a flow model and collecting data of the technical system. Understanding this phase of LCA is important for you to make a detailed description of the technical system of your project, and to start collecting relevant data. This is necessary as background for the 2nd project supervision meeting (PS2). A few words about the Ecoinvent database.

Literature for L4:

- Curran, M. A. (2015) Life Cycle Assessment Student Handbook. Chapter 3.
- PRé Consultants (2016) *Introduction to LCA with SimaPro*, chapter 3.
- Finnveden, G., Hauschild, M., Ekvall, T., Guinée, J., Heijungs, R., Hellweg, S., Koehler, A., Pennington, D., and Suh, S. (2009) Recent developments in Life Cycle Assessment. *Journal of Environmental Management* 91, 1–21.

Videos to complement lecture 4:

- Ecoinvent in a nutshell: <https://www.youtube.com/watch?v=xOdZcWNplso>
- Ecoinvent webinars: https://www.youtube.com/channel/UC4Ma__pX9r1-DoNi2D2Fd6g

L5 – Impact assessment

Lecturer: Göran Finnveden

Content: Principles and methods for impact assessment in LCA. Understanding this phase is important when you start interpreting the results of your project. This is necessary as background for the 3rd project supervision meeting (PS3).

Literature for L5:

- Curran, M. A. (2015) Life Cycle Assessment Student Handbook. Chapter 4.
- PRé Consultants (2016) *Introduction to LCA with SimaPro*. Chapter 4.1 - 4.4.
- Finnveden, G., Hauschild, M., Ekvall, T., Guinée, J., Heijungs, R., Hellweg, S., Koehler, A., Pennington, D., and Suh, S. (2009) Recent developments in Life Cycle Assessment. *Journal of Environmental Management* 91, 1–21.
- Huijbregts et al. (2017) ReCiPe2016: a harmonised life cycle impact assessment method at midpoint and endpoint level. *Int J Life Cycle Assessment*, 22:138, 138-147.

L6 – Weighting, normalisation and interpretation

Lecturer: Göran Finnveden

Content: Methods for further aggregation results, as an aid to interpret the impact assessment results. This is necessary as background for the 4th supervision meeting (PS4).

Literature for L6:

- Curran, M. A. (2015) Life Cycle Assessment Student Handbook. Chapter 5.
- PRé Consultants (2016) *Introduction to LCA with SimaPro*. Chapter 4.5 – 4.6.
- Hellweg, S. and i Canals, L. M. (2014) Emerging approaches, challenges and opportunities in life cycle assessment. *Science*, 344, 1109-1113.

Lecture 7 – Data quality, uncertainty, representativity

Lecturer: Anna Björklund

Content: Sources of uncertainty in LCA and examples of approaches to handle uncertainty

Literature for L7:

- Curran, M. A. (2015) Life Cycle Assessment Student Handbook. Chapter 6.3.

Lecture 8 – Modelling bio-based systems in LCA

Lecturer: Miguel Brandão

Content: Modeling of biogenic carbon cycles in LCA.

Literature for L9:

- Curran, M. A. (2015) Life Cycle Assessment Student Handbook. Chapter 3.3.6.
- Schmidt et al. (2015). A framework for modelling indirect land use changes in life cycle assessment. *Journal of Cleaner Production*, 99, 230-238.
- Brandão, M. et al (2013) Key issues and options in accounting for carbon sequestration and temporary storage in life cycle assessment and carbon footprinting. *Int J of Life Cycle Assessment*, 18, 230-240.

Lecture 9 – Social LCA

Lecturer: Elisabeth Ekener

Content: Overview of Social LCA, its main characteristics, methodology and guidelines.

Literature for L8:

- Curran, M. A. (2015) Life Cycle Assessment Student Handbook. Chapter 7.4.
- Wu, R. Yang, D., and ChenWu, J. (2014) Social Life Cycle Assessment Revisited. *Sustainability*, 6, 4200-4226.

Lecture 10 – LCA in Practice

Lecturers:

- TBD

Content: Invited speakers from industry, authority, or academia present examples of using LCA in practice in their organisations.

Literature for L10:

- Curran, M. A. (2015) Life Cycle Assessment Student Handbook. Chapter 6.8. (*Comment: EPD is a good example of LCA being used in practice in business-to-business communication*)

Videos to complement lecture 10:

- The Life Cycle Perspective at the Swedish Environmental Protection Agency:
<https://www.youtube.com/watch?v=pbEg54Wegh4>
- The Life Cycle Perspective at Vattenfall:
<https://www.youtube.com/watch?v=MbM4IKklrQc&t=38s>
- The Life Cycle Perspective at Chalmers University of Technology:
<https://www.youtube.com/watch?v=7ZPLwM0XHjc&t=50s>

COMPUTER LAB MEETINGS (C1 – C6)

Digital teaching in fall 2020: Please see information in Canvas for details on remote access to computer labs, scheduled computer lab meetings with supervision in Zoom, and the on-line queueing system “Stay a While”.

Simapro access: Throughout the course, SimaPro is available in the computers labs at Drottning Kristinas väg 30 (Bure, MacLean*, Faggot) and Teknikringen 76 (Christopher, Nils*, Baltzar*). * = remote access only.

There are six scheduled meetings to work on SimaPro, with teachers present to help you out with exercises and working on your projects. You can choose to work on-site or remote, but supervisors will only attend via zoom.

You need to work on your own at other times in the computer lab with exercises and projects! Learning to use SimaPro early on in the course is important to be able to complete a successful project.

C1-C2 instructions: Run the SimaPro demo, tutorial, and do exercises

- Work with your project group, but split in two small groups when working on demo, tutorial, and exercises.
- Do the assignments outlined in “*Instructions to SimaPro demo and exercises in AL2608*” available in Canvas/Modules/SimaPro and computer exercises.
- **NOTE:** This part should be completed before you come to the third meeting (C3) in the computer lab. You will probably need to meet with group outside the scheduled meetings in order to have time to finish.

Literature for C1-C2:

- Instructions to SimaPro demo and exercises in AL2608 (instructions to C1-C2)
- PRé Consultants (2016) Introduction to LCA with SimaPro.
- PRé Consultants (2014) *SimaPro Tutorial*

C3 – C6 Own project modelling in SimaPro

From the third meeting in the computer lab (C3) you should work with your entire project group to build your project model in SimaPro.

Only one computer at a time can be logged into a specific project model, hence you need to plan well how you share the time working on your model.

C3-C6 are scheduled to make sure you have time to meet a teacher to ask questions about modelling in SimaPro. No joint exercises are planned for C3-C6- You also need to schedule own time with your project group in the lab, since time during scheduled computer labs will not be enough.

Course requirement – Computer exercises

Minimum attendance at 5 (out of 6) meetings in the computer lab is required. Inform your group if you are not able to attend and make agreements on how to catch up.

NOTE: Attendance is registered automatically when logging in to the main zoom meeting at the beginning of each computer lab meeting. After that we trust you to join your project group in your separate zoom meeting.

If you are absent from more than 1 computer lab, you need to complete a compensation assignment. To compensate:

- *First, talk to your group about what they worked on in the computer lab while you were away. Agree with them what you should do to catch up and contribute your fair share of the work.*
- *Then, submit a file in Canvas (Modules/Assignments/Attendance and compensation assignments/Attendance computer lab “X”) explaining what you agreed with your group on how to compensate for your absence.*

WRITTEN HOME-EXAM

A two-day home-exam is given at mid-term. The purpose of this exam is to ensure that all students learn the basics of LCA methodology that is necessary to actively contribute in a good way to the group projects.

The exam covers Lectures 1-7 and the corresponding literature. You will be tested for knowledge of LCA terminology through:

- multiple choice questions (part A, 15 points),
- ability to apply LCA knowledge to explain or draw conclusions (part B, 15 points)
- ability to apply LCA knowledge to make own LCA calculations (part C, 15 points)

Make sure to study the literature along with the lecture notes in advance. Starting to read when the home exam opens is not a good path to success and will be very stressful!

Maximum points is 45 distributed over parts A-C with 15 points each. In order to pass the exam, you need to have 20 points or more in total on parts A and B. Part C is not graded unless you fulfill this requirement. If you fulfill this requirement, the grading limits are as follows:

A: ≥ 40 p

B: ≥ 35 p

C: ≥ 30 p

D: ≥ 25 p

E: ≥ 20 p

Fx: < 20 p)

If you receive an Fx, you must complement through an oral examination soon after the home exam. An oral examination can only give you an E.

Course requirement – Written exam

To pass the course, you need to acquire the grade E or higher on the exam. Exams graded as Fx (fail with the possibility of supplementing) will require supplementing through an oral exam. After supplementing, the exam will be graded as E.

PROJECTS AND PROJECT REPORTS

The aim of the project is to put theory from lectures and the course literature into practice and to give practical experience of LCA modelling with LCA software.

Project group agreement

Co-operating in projects is sometimes challenging. Group members may have different ambition levels, different communication styles, or different expectations on each other, all of which can be a source of conflicts. One reason to work in projects during your education is to experience this and to learn how to resolve difficulties in a professional way. The project requirements and supervision in this course are designed in part to help you to plan your project in a way so that problems are avoided.

As a way to prevent, as far as possible, misunderstanding or conflicts between project group members, there is a “Project group agreement” form for each group to fill in.

Please contact your group supervisor at an early stage if you experience problems of co-operating in your group that you don’t know how to resolve yourselves, so that we can find a way to help you.

Course requirement – Project contract

Each group must fill in a “Project group agreement” (available in Canvas) and save among its project documents.

Select topics and form project groups

Projects are performed in groups of 5 students. Together with other students you will define your own project topic, on your own area of expertise and interest.

- **Before Lecture 2:** Prepare by thinking of areas/topics/research questions that you would like to work with in your projects. Talk to your class mates before hand or use the discussion forum on Canvas (Discussions/Select topics and form project groups) to find others interested in your idea.
- **Tips for finding a good topic:** We strongly recommend that you choose a topic that you already have some knowledge of. Also, the more narrowly defined your research question is (focusing on very specific details), the more difficult it will be to find relevant data, but with own experience from the field you may be able to overcome these problems.
- **During Lecture 2:** We will brainstorm in class and list your topics of interest to help you to form groups.

Join project groups in Canvas

Once you have formed your project group (during Lecture 2), you will be given a group number. You must then sign up in your group on Canvas.

- Under People/Project groups you find a list of project groups.
- Each student logs in to Canvas and joins the assigned project group number.
- Edit the group name to reflect your topic (for example: “Project Group 1 – electric vehicles”)

Sign up for project supervision (PS) meetings

After lecture 2 you will be assigned a supervisor. His/her name will be listed by the name of your project group in People/Project groups.

- **Sign up for PS1-PS4:** Sign up for PS with your supervisor in Canvas using the Calendar. We advise you to sign up for all supervision meetings at once. On Canvas, there is a guide on how to sign up for supervision.
- **Note:** You need to sign up for PS1 already on Friday the first week of the course.

Prepare for project supervision

Always prepare well before meetings according to instructions in “*Instructions for project supervision meetings in AL2608*” available in Canvas/Modules/Project work.

- **Attendance:** The entire group must attend each meeting! Should you for some reason absolutely not be able to attend, you must confirm in advance with your group and your supervisor that absence will be OK, and make an agreement how to catch up.
- **Professional attitude:** The work process is also assessed. Therefore it is important to come well-prepared to every meeting and to collaborate in an open and including manner within the project group.

Course requirement – Project supervision meetings

Attendance is compulsory. Failing to show up for supervision, for whatever reason, without having made a sincere effort to contact your group and supervisor to reschedule the meeting, can affect your grade negatively.

Each group member must be prepared to present the work of the group to that date, questions, or any other issues. Failing to take this role seriously can affect your grade negatively.

Each group member must also take responsibility to involve other group members. Project work is not a one man show! Failing to do so can affect your grade negatively.

Project status reports

The day before each supervision meeting, short notes must be submitted according to the instructions in “*Instructions for project supervision meetings in AL2608*”, uploaded to Canvas (Assignments/Status report), and brought to the meeting.

Course requirement – Project status reports

Before each supervision meeting, each group should upload an updated status report in Canvas/Assignments/Project status reports.

Project reports

Each group writes a report (15-20 pages). Detailed instructions on format and content are found in the document “*Instructions for project supervision meetings in AL2608*”.

Course requirement – Project report

Hand in report according to instructions on format and content.

PRE-SEMINAR

Digital teaching in fall 2020: During fall term 2020, seminars will be held interactively on Zoom at scheduled hours. Seminars are not recorded.

Each group will present its draft report at a pre-seminar, attended only by students. The purpose is to give you the opportunity to get feedback on your own project and to learn from the work of other students.

All groups will be responsible for giving peer feedback on another project. You will not prepare any feedback before the seminar, but during the seminar you will take the lead in asking questions and giving feedback. After the seminar each group should write and submit a brief summary and feedback.

Before the pre-seminar

- Sign up for pre-seminar times in Canvas (using the Calendar).
- You must attend the entire pre-seminar (2h) when your own project is presented.
- Prepare a 10 min presentation (no advance submission, just bring your presentation to the seminar) that you can re-use and develop further for the final seminar. The pre-seminar presentation should only cover:
 - Goal & scope,
 - Life cycle inventory analysis, and
 - Brief outline of expected results and interpretation.
 - Questions that you would like feedback on from other students.

During the pre-seminar

A teacher will be present at the beginning of the seminar to get you started, and at the end to answer any remaining questions from the presentations. Therefore, take notes of unresolved questions during the seminar.

- Bring the presentation on your own laptop.
- All group members must participate in the presentation.
- You will be assigned “peer-feedback group” for another project.
- Outline of presentation (total 25 min per group):
 - **10 min** presentation by project group
 - **15 min** discussion. The responsible peer-feedback group starts by giving feedback and asking questions. After this, others can ask questions.

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After the pre-seminar: Written feedback and reflection

After the pre-seminar, each peer-feedback group writes a feedback about the project that you were assigned to give feedback on, as well as a reflection on your own project.

Include the following (about 1 page):

- Summarise in about 10 sentences your understanding of the other group's project (rationale, aim, expected outcome).
- Comment on two (or more) things about the project that was particularly good/inspiring/creative. **Explain and motivate.**
- Suggest two (or more) things that could be improved in the project. **Explain and motivate.**
- Mention two things (or more) that you will improve in your own project, as a result of what you learned from others during the pre-seminar.

Upload your Written feedback and reflection in Canvas after the pre-seminar (Assignments/Pre-seminar reflection). Please check info on deadlines above in this document.

Written feedback and reflection from all groups will be posted on Canvas for everyone to read.

Course requirement – Pre-seminar

You must attend the entire pre-seminar when your project is presented, participate in your own group's presentation and peer feedback on other groups.

Each group must write a feedback and reflection document of the pre-seminar, and upload it in Canvas according to instructions.

In case you were not able to attend the pre-seminar you need to submit the following compensation assignment:

Within three days after the deadline for submission of pre-seminar reflection, you should submit an individual reflection (0.5 - max 1 page), according to the following instructions:

- *Read all pre-seminar reflections. These are uploaded on Canvas (Modules/Pre-seminar) after the submission deadline.*
- *Discuss with your group the written feedback and any additional feedback that they received during the seminar.*
- *Based on this, write your personal assessment of possible improvements:*
 - *Based on the oral and written feedback that your group has received - How can you improve your project?*
 - *What additional ideas for improvement did you get when reading the other reflections?*

Submit your reflection on Canvas/Modules/Assignments/Attendance and compensation assignments.

PEER REVIEW SEMINAR

Digital teaching in fall 2020: During fall term 2020, seminars will be held interactively on Zoom at scheduled hours. Seminars are not recorded.

At this seminar, we will go through the template for grading of project reports. Each group will be assigned one report of another group to assess.

Assessments should be submitted in Canvas (Assignments) the day after the seminar and will be shared with all groups (Modules).

NOTE: The assessment of another group is NOT a formal basis for grad. The purpose of this exercise is for all groups to better understand the grading criteria, to reflect on one's own writing by reading the report of another group, and to provide helpful feedback to that group to be used when finalising the reports.

Before the Peer review seminar

Before the seminar you must submit your Draft project report on Canvas (Assignments). Please check info on deadlines above in this document.

After the Peer review seminar

After the seminar you must submit your assessment on Canvas (Assignments). Please check info on deadlines above in this document.

Course requirement – Peer review seminar

Submit the Draft project reports according to instructions.

Attendance is compulsory. You must attend the entire peer review seminar, but also spend more time on the exercise after the seminar since it will be difficult to finish within the scheduled time.

Submit the assessment of another group's report according to instructions.

If you did not attend the peer review seminar you need to compensate for this according to the instructions below:

- *Read the grading template (available in Canvas/Modules/Peer review seminar) and the assessment done by another group of your group's report (available in Canvas/Modules/Peer review seminar/Assessments soon after the seminar).*
- *For each comment that you received (of lower grade than A), write a short comment on how you can revise the report for a higher grade.*
- *Share with your group.*
- *Submit a document with your comments on Canvas/Modules/Assignments/Attendance and compensation assignments.*

Deadline for submission is within three days after the peer review feedback has been posted in Canvas.

CRITICAL REVIEW OF PROJECTS BEFORE FINAL SEMINAR

Each project group shall prepare a written critical review of the project report of another group. Critical review is an important procedure for quality assurance of LCA, and an important part of scientific methodology in general.

Instructions

- When project reports have been submitted before the final seminar, they will be uploaded in Canvas for all students to see (Modules/Project reports for review). You will be informed about what report to review, and you should download it from Canvas.
- The critical review should be prepared and presented according to the instructions in “*Instructions for report & critical review in AL2608*”.
- Submit your critical review in Canvas (Assignment/Critical review of project report). Please check “Schedule, submission deadlines” above in this document.
- At the final seminar, all groups members should make an oral presentation of the critical review and discuss their feedback with the group that they have been reviewing.
- After the final seminar, the written critical reviews will also be shared on Canvas (Modules/Critical reviews of projects).

Literature for critical review:

- Instructions for report & critical review in AL2608
- Curran, M. A. (2015) Life Cycle Assessment Student Handbook. Chapter 6.7

Course requirement – Critical review

Each group shall prepare and present a written critical review of the project report of another group. Submit according to instructions.

FINAL SEMINAR AND REPORT SUBMISSION

Digital teaching in fall 2020: During fall term 2020, seminars will be held interactively on Zoom at scheduled hours. Seminars are not recorded.

Project reports are presented at a final seminar. This is the final examination of the course. Comments on your report will be presented at the seminar by a critical review group.

NOTE: The report that you submit before the final seminar is the one that is graded. Revisions after the seminar are only to complement if any aspects are not yet assessed as complete.

Before the final seminar

- Sign up for final seminar times on Canvas (on Canvas/Syllabus or using the calendar).
- Submit your report in Canvas (Assignments/Project report, before final seminar). Please check info on deadlines above in this document.
- See separate instructions on report format (“*Instructions for report & critical review in AL2608*”). It will be automatically checked for plagiarism.
- Prepare a critical review of the project report of another group. See separate section in course memo (“*Instructions for report & critical review in AL2608*”).

At the seminar

- Each seminar (3 h) includes 3-4 presentations.
- Each group has 30 min at its disposal, including:
 - 15 min presentation (beware that this is short and requires careful planning!)
 - 10 min critical review
 - 5 min comments and questions from the rest of the audience
- All group members must participate in the preparation and presentation and be able to answer questions related to the entire project.
- Bring your own laptop for the presentation.

After the final seminar

- After the seminar you will receive written feedback from your supervisor with grade and required amendments. The grade will be your final grade if you manage to make the required amendments. Otherwise you may receive a lower grade.
- Final revised reports shall be handed in at Canvas (Assignments/Revised project report, after final seminar).
- Please check info on deadlines above in this document.

Course requirement – Final seminar

Submit report according to instructions.

Attendance is compulsory.

Participate actively in the entire final seminar when your project is presented.

Submit final revised report according to instructions.

EXAMINATION AND GRADING

The course examination consists of the following parts:

- Written exam (2,5 hp), grade scale: A, B, C, D, E, FX, F
- Project report (4.5 hp), grade scale: A, B, C, D, E, FX, F
- Critical review (0.5 hp), grade scale: P, F

The final grade (A-F) is a weighted average of the written exam and the group project assignment, with the project weighted slightly less than its corresponding credits (Exam = weight 2.5; Project = weight 4).

In order to receive a final grade, the requirements for an “E” for the written exam and project assignment must be fulfilled, and "Pass" grade on the critical review is required.

Fx represents a failing grade which lies on the boundary between pass/fail, and can be complemented to reach the grade E.

Failing to meet course requirements related to project work (attendance and active participation at seminars and supervision, deadlines) is considered a badly handled working process and will affect your grade negatively.

Written mid-term home exam (2.5 hp, A-F)

- The written exam covers intended learning outcomes 1-2.
- The written exam is graded A-F.
- Fx denotes a failed grade, but with the possibility to pass the written exam by oral examination. After oral examination, the student can only receive the grade E.

Critical review (1 hp, P/F)

- This examination item examines intended learning outcome 9.
- This examination item consists of two exercises; the “Peer review and assessment seminar” and the critical review done in advance of the final seminar.
- The Critical review is assessed as pass/fail (P/F). To pass this assignment, it should be prepared and presented according to the instructions.

Group project assignment (4 hp, A-F)

- The group project examines intended learning outcomes 3-8.
- The project assignment is graded A-F (see grading criteria below). The grade of the project assignment is based on the following factors:
 - o *Report content* (your understanding of LCA methodology, and ability to design and perform an LCA study)
 - o *Report formal qualities* (outline, clarity, language, referencing).
 - o *Performance* (group and individual student) at supervision meetings and at final seminar.
 - o *Course requirement fulfillment*, regarding attendance at supervision, computer labs and seminars and meeting deadlines.

Opportunity to raise an approved grade via renewed examination (upping)

Upping is not allowed in this course.

Evaluation criteria for group project assignment

Aspects and assessment criteria	A	C	E	Fx
A. Report content				
LCA methodology	LCA methodological aspects are correctly defined and used wherever necessary.	LCA methodological aspects are for the most part correctly defined and used wherever necessary.	Some important errors in documentation and use of LCA methodological aspects, but that did not entirely mess up the project design and results.	Severe mistakes or gaps in LCA methodology that cannot be easily corrected or explained in revision of final report.
Clarity and completeness	Content is clear, precise, and complete, so that the reader gets a good understanding of background, methodological choices, scope of the project etc.	Content is for the most part clear, precise, and complete, so that the reader gets a fairly good understanding of the project.	Content mirrors aim of the project, but with some serious unclarity in content.	Because of lacking or unclear information the content does not give the reader a good understanding of the project.
Relevance and conciseness	Content is well delimited, including only relevant content with regard to the goal of the LCA.	Content is for the most part well delimited, including only relevant content with regard to the goal of the LCA.	The report is readable with regard to relevance of content.	The report is difficult to read because of too much irrelevant content.
Documentation of data	Data documentation is complete and transparent, so that the reader easily understands how the project was modelled.	Data documentation is for the most part complete and transparent.	Documentation of data is not complete and transparent, but gives the reader some basic understanding of how the project was modelled.	It is not possible from the documented data to get a general understanding of what was modelled and how.

Aspects and assessment criteria	A	C	E	Fx
Response to research question	Clear connection problem-goal - results - discussion - conclusions.	For the most part clear connection problem- goal - results - discussion - conclusions. Some aspects missing.	There is some connection problem- goal - results - discussion - conclusions, but in general it is not well organised.	Problem and goal of study are not mirrored in results, discussion, conclusions.
B. Written presentation, language and format				
Language	Excellent language throughout report, both in terms of spelling and grammar, and reader friendliness of the text.	Mostly good language, both in terms of spelling and grammar, and reader friendliness of the text.	Report is readable.	Bad language, so that the content is difficult to understand.
Disposition and coherence	Content is well-disposed, coherently and logically structured, follows outline in report instructions, and easy to follow.	Content is mostly well-disposed, follows outline in report instructions, and mostly easy to follow.	The report outline for the most part follows the report instructions, but is not easy to follow.	Many deviations from report instructions, without apparent reason.
Figures and tables	All figures and tables are relevant and contribute to the content, have legends using consistent format, are consistently numbered, and are referred to and explained in the text.	Most figures and tables are relevant to the content, have legends, are numbered, and are referred to in the text. Explanations are missing or are incomplete.	Figures and tables have legends and are mentioned in the text, but either are not explained in the text or are not relevant.	Figures and tables are not included in a way that contributes to the understanding of the text. Legends missing. Not explained in the text.

Aspects and assessment criteria	A	C	E	Fx
References	References are included wherever necessary, in a way that would be acceptable in a scientific context (complete and consistent).	References are included in a mostly complete and consistent way.	References are used so that it is mostly clear when information comes from other sources, but are not complete and consistent.	Many important references are missing. References not used in a consistent way.
C. Oral presentation				
Final seminar, group	Very well disposed presentation, with regard to content of slides and presentation, that gives a good understanding of the project. Content presented within time limits.	Mostly well disposed presentation, with regard to content of slides and presentation, Time limits not severely surpassed.	Presentation and slides cover most relevant parts of the project. Time limits not severely surpassed.	Presentation does not communicate content of project. Severe surpassing of time limits. Very unbalanced contribution by group members.
Final seminar, group	All group members actively and equally involved in presentation and discussion.	All group members contribute, but with some unbalance of contribution.	All group members contribute, but with very uneven contribution.	Very unbalanced contribution from project members, so that some totally dominate alternatively are not given room to contribute.
Final seminar, individual	The student shows very good ability to meet the opposition at the final seminar, with clear argumentation and reflection based on the course	The student is able to meet the opposition at the final seminar, and to discuss the project in a way that shows basic understanding of LCA methodology.	The student shows basic understanding of own project, and is able to answer questions directly related to own subject.	Student is not able to answer basic questions related to own project at the final seminar.

Aspects and assessment criteria	A	C	E	Fx
	literature and other literature used in the project.			
Supervision meetings, individual	The student participates actively in the discussion at supervision meetings, showing good understanding of LCA methodology and own project topic.	The student participates in the discussion at supervision meetings, mostly showing understanding of LCA methodology and own project topic.	Student is mostly able to answer basic questions directly related to LCA methodology and own project topic.	Student is not able to answer basic questions related to LCA methodology and own project during supervision.
D. Group process				
Professional project management	The group comes well-prepared and on time to supervision. It is clear that the group actively includes all group members in the project. Problems are communicated at an early stage to supervisor.	The group comes prepared and on time to supervision. All group members make some contribution during supervision.	The group mostly comes prepared and on time to supervision.	Group repeatedly does not show up on time. Group fails to communicate problems in time so that the project work does not proceed.
Independence	The group is able to independently and in a creative manner manage the research, including identify and delimit research question, data needs, assessment, and	The group is sometimes able to independently manage the research, including identify and delimit research question, data needs, assessment, and interpretation. The supervisor	The group is able to complete the project assignment, but with no or little independence in relation to the supervisor.	The group work does not proceed without repeated interference by the supervisor.

Aspects and assessment criteria	A	C	E	Fx
	interpretation. The supervisor is consulted for feedback.	often has to interfere to point out necessary next steps in the project.		
Log book and deadlines	The group uses the log book in a good way to plan and show progress of the project, according to instructions. Submissions of log book and other project deliverables meet deadlines.	The group uses the log book in a way that shows progress of the project. Submissions of log book and other project deliverables mostly meet deadlines.	The group uses the log book, but not in a good way to plan and show progress of the project. Project deliverables are submitted, but often fail to meet deadlines.	Group repeatedly fails to use log book and/or repeatedly fails to meet deadlines for project deliverables.
E. Individual process				
Student shows understanding of project and LCA methodology during supervision and seminar. Does this without interfering with a positive work	Much better than average in the group	Average in the group.	Much below average in the group.	Failing to meet requirement for Pass, without communicating and resolving issues with course responsible.

Aspects and assessment criteria	A	C	E	Fx
environment and dynamics in the project group.				
Meets requirements of attendance, or otherwise handles motivated absence in a professional way in dialogue with supervisor and rest of the group.	Much better than average in the group	Average in the group.	Much below average in the group.	Failing to meet requirements, in a way that interferes negatively with the project work.

LITERATURE

All course material, except the course book, are available in Canvas/Modules/Course literature.

Book

Curran, M. A. (ed) (2015) Life Cycle Assessment Student Handbook. Wiley.

You can order this book from for instance AdLibris (www.adlibris.se) or Bokus (www.bokus.se). It will not be available at the student book store, simply because it would be much more expensive.

Scientific papers

As listed under each lecture above in this document.

SimaPro manuals

- PRé Consultants (2016) *Introduction to LCA with SimaPro*
- PRé Consultants (2014) *SimaPro Tutorial*

Other

- *Instructions for project supervision meetings in AL2608*
- *List of usefull LCA data sources in AL2608*
- *Instructions for report & critical review in AL2608*
- *Instructions to SimaPro demo and exercises in AL2608*