University of California at Santa Barbara
Bren School of Environmental Science and Management

ESM 273: Life Cycle Assessment
Winter 2022

M,W: 2:00-3:15pm
Bren Hall 1414

Instructor
Professor Eric Masanet (Bren 3510 or by Zoom at https://ucsb.zoom.us/j/2636222938)
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Course Overview
Life Cycle Assessment (LCA) is a scientific methodology to quantify the environmental impacts of a product or process across its entire life cycle, from raw materials extraction to manufacturing and operation to end-of-life waste management. An LCA provides decision makers with greater visibility into the different environmental impacts associated with their decisions, which enables evidence-based choices that can minimize environmental impacts by design. LCA is increasingly being used across sectors to align decisions with corporate and societal sustainability goals.

In this course, you’ll learn how to construct and execute an ISO 14044 compliant LCA for a product system, including goal and scope definition, life-cycle inventory data collection, environmental impact characterization, results generation and interpretation, and reporting. You’ll learn the process in a highly hands-on way by building a spreadsheet-based LCA model in step-by-step fashion. At the end of the course, your model will enable you to compare the environmental performance of different products. We’ll also apply empirical methods to gather data on energy use and product materials (via disassembly analysis) for real-world product systems.

Most in-class time will be spent on team-based work and in-class discussions related to applying LCA methods to the course project, which is an LCA comparison of different types of coffee makers. Students are expected to watch lecture videos online outside of class, and to come to class prepared to ask questions and to spend productive hands-on project time working in teams.

This syllabus provides a brief summary of the course, assignments, and policies. Consult the course GauchoSpace webpage for more detailed information.

Communications
Instructor announcements and online discussions will be conducted via Slack. In the first week of the course, all registered students will be added to the course Slack channel. Occasionally, important announcements will be made by email.
Textbook
In lieu of a textbook, this course will utilize a series of short topical videos created by the instructor that cover the basics of LCA theory, applications, and relevant ISO standards. A course reader accompanies these videos, which contains transcripts as well as additional content and links to relevant course readings. The course reader is available on GauchoSpace.

Assignments and Grading
The course timeline and homework schedule are provided at the end of this syllabus. The final course grade will be based on homework assignments (32% of the final grade), the course project (58% of the final grade), and participation (10% of the final grade). There is no final exam.

For further information on homework assignments and grading, see GauchoSpace.

Students will be assigned to project teams to develop LCA models of specific coffee maker components during the course. These models will be assembled by the course TA into an integrated model at the end of the course to enable environmental comparisons of different coffee maker models and scenarios. Further information on the course project can be found on GauchoSpace.

The final course project grade will be based on in-class project "report outs," the final project presentation and modeling deliverables, and peer assessments. To receive a high project grade you'll need to show steady progress on your projects and evidence of engagement and effort within both the class and project team environments.

Regular project "report outs" will occur most weeks. These will be brief updates provided by each team to the class on project milestones, which are important for sharing of information and data between project teams. The schedule for reports outs can be found on GauchoSpace.

Students are expected to attend each lecture and to actively participate. To receive a high participation grade you'll need to engage in the in-class discussions, which will often include responding to ad hoc questions and actively participating in in-class exercises. Participation can also be demonstrated by contributing to discussions on the course’s Slack channel.

Academic Integrity
Each student is responsible for his or her own work within the team. Any form of cheating or plagiarism will not be tolerated in this class. Refer to the Student Handbook for guidelines on cheating and plagiarism. These rules will be observed and enforced in this course. Cheating or plagiarism on any assignment will result in a score of zero.

Absences and Extensions
Students are expected to attend each lecture and to attend meetings organized by project teams. Students are encouraged to notify the instructor in advance of any foreseen absences so that accommodations can be made as needed.

If you must miss a due date for an assignment, the instructor will consider granting an extension. Your case will be helped if you have supporting evidence (i.e., doctor’s notice). Do not assume that extensions will be granted automatically.
Course Material Restrictions
All course materials (including class lectures and discussions, handouts, examinations, web materials) and the intellectual content of the course itself are protected by United States Federal Copyright Law, the California Civil Code. The UC Policy 102.23 expressly prohibits students (and all other persons) from recording lectures or discussions and from distributing or selling lectures notes and all other course materials without the prior written permission of the instructor (See http://policy.ucop.edu/doc/2710530/PACAOS-100). Students are permitted to make notes solely for their own private educational use. Exceptions to accommodate students with disabilities may be granted with appropriate documentation. To be clear, in this class students are forbidden from completing study guides and selling them to any person or organization.

COVID Safety Protocols
Per university policy, students and instructors are required to wear masks during indoor instruction. In the classroom, instructors will direct any student who is not masked to don their mask immediately, or leave the classroom. If a student still does not comply, the instructor may cancel the class meeting and leave.
- Student non-compliance with COVID-19 health and safety requirements or with related directions from the instructor is a violation of the UCSB Standards of Conduct and will be adjudicated accordingly.
- All students of this course, as a condition of physical presence in this classroom (including for exams or tests in this classroom or other location on the UCSB campus), must be compliant with the UC SARS-CoV-2 (COVID-19) Vaccination Program at all times.

Non-compliant students can be reported to the Office of Student Conduct for disciplinary measures.

Accommodation of Special Circumstances
Please see the instructor for accommodation of religious beliefs, disabilities, and other special circumstances.
<table>
<thead>
<tr>
<th>Week</th>
<th>Class</th>
<th>Date</th>
<th>Topics</th>
<th>Videos*</th>
<th>HW**</th>
<th>Soft drink LCA model***</th>
<th>Project team report out</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>3-Jan</td>
<td>Introduction and overview</td>
<td></td>
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<tr>
<td>2</td>
<td>5-Jan</td>
<td>5-Jan</td>
<td>Unit processes, project team breakouts</td>
<td>1, 2, 2S, 3, 3S</td>
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<td>2</td>
<td>3</td>
<td>10-Jan</td>
<td>Unit processes, scaling, and data sources</td>
<td>4, 4S</td>
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<td>4</td>
<td>12-Jan</td>
<td>12-Jan</td>
<td>Impacts and elementary flows</td>
<td>5, 5S, 6, 6S</td>
<td>HW1 due</td>
<td>Bill of materials</td>
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<td>3</td>
<td>17-Jan</td>
<td>19-Jan</td>
<td>No class – Martin Luther King Jr. Day</td>
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<td>4</td>
<td>6</td>
<td>24-Jan</td>
<td>Goal and scope definition: functional units</td>
<td>7, 8, 8S, 9</td>
<td>HW2 due</td>
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<td>7</td>
<td>26-Jan</td>
<td>31-Jan</td>
<td>Goal and scope definition: system boundaries</td>
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<td>5</td>
<td>8</td>
<td>31-Jan</td>
<td>Life cycle inventories and data requirements</td>
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<td>9</td>
<td>2-Feb</td>
<td>2-Feb</td>
<td>Multi-functionality and allocation, part I</td>
<td>13, 14</td>
<td>HW3 due</td>
<td>Week 3 due</td>
<td>Systems diagrams</td>
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<tr>
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<td>10</td>
<td>7-Feb</td>
<td>Input-output methods, part I</td>
<td>16, 17</td>
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<td>11</td>
<td>9-Feb</td>
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<td>Input-output methods, part II</td>
<td>18</td>
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<td>7</td>
<td>12</td>
<td>14-Feb</td>
<td>Data quality assessment, sensitivity analysis</td>
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<td>13</td>
<td>16-Feb</td>
<td>16-Feb</td>
<td>Life cycle impact assessment, part I</td>
<td>21</td>
<td>HW4 due</td>
<td>Week 4 due</td>
<td>Goal and scope definition</td>
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<td>8</td>
<td>21-Feb</td>
<td>23-Feb</td>
<td>Life cycle impact assessment, part II</td>
<td>22, 23, 24</td>
<td>HW5 due</td>
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<td>9</td>
<td>15</td>
<td>28-Feb</td>
<td>Reporting and visualization</td>
<td>25, 26</td>
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<td>16</td>
<td>2-Mar</td>
<td>2-Mar</td>
<td>Consequential LCA</td>
<td>27</td>
<td>HW6 due</td>
<td>Week 6 due</td>
<td>Initial LCI results</td>
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<tr>
<td>10</td>
<td>17</td>
<td>7-Mar</td>
<td>Team project presentations</td>
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<td>18</td>
<td>9-Mar</td>
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<td>Team project presentations and coffee maker</td>
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* assigned videos should be viewed prior to lecture on the indicated day
** all HW is due by 2pm Pacific time on the indicated day
*** date by which self-study bottled soft drink LCA modeling assignment should be completed