

# ESM 273: Life Cycle Assessment (LCA)

## Syllabus, Winter 2023

Theory Sessions:	Mon & Wed, Jan 9 – Feb 8, 2:00-3:15pm, BH 1414 No classes on Jan 16 (MLK Day) & Feb 20 (Presidents' Day) Make-up classes Thu, 1/19, BH 1424 & TBD
Lab Sessions	Mon & Fri, Feb 13 – March 17, 2:00-3:15pm, BH 3035 and BH 3022
Final report:	Is due on Thursday, March 23, 11:59pm
Midterm exam:	Wednesday, Feb 8, closed book
Final exam:	No final
Instructor:	Roland Geyer, BH 3426, <a href="mailto:geyer@bren.ucsb.edu">geyer@bren.ucsb.edu</a>
Office hours:	By appointment
TA:	Jaenna Wessling, BH 3007, <a href="mailto:jaenna@ucsb.edu">jaenna@ucsb.edu</a>
Office hours:	By appointment

Course Book (freely available from me):

Environmental Life Cycle Assessment – Measuring the Environmental Performance of Products, Schenck & White, Editors (2014) American Center for Life Cycle Assessment.

All additional reading will be posted on Canvas.

Date	Topics & Readings
Theory Session 1:	
Mon, 1/9	Topics: <ul style="list-style-type: none"><li>• Introduction</li><li>• History of LCA</li><li>• LCA terminology</li><li>• Goal &amp; scope definition</li></ul>
Theory Session 2:	
Wed, 1/11	Topics: <ul style="list-style-type: none"><li>• Unit processes</li><li>• Inventory data</li><li>• Intermediate vs. elementary flows</li><li>• Primary vs. secondary data</li></ul> Reading: <ul style="list-style-type: none"><li>• Course Book, Chapter 1</li></ul>
Theory Session 3:	
Wed, 1/18	Topics: <ul style="list-style-type: none"><li>• Inventory modeling</li><li>• Activity levels (scaling factors)</li><li>• Examples</li><li>• Computational structure of process-based inventory analysis</li></ul> Reading: <ul style="list-style-type: none"><li>• Course Book, Chapter 5</li></ul>

Theory Session 4:	
Thu, 1/19 8–9:15 am	<p>Topics:</p> <ul style="list-style-type: none"> <li>• Allocation</li> <li>• Dealing with co-production in attributional LCA</li> </ul> <p>Reading:</p> <ul style="list-style-type: none"> <li>• Ekvall &amp; Finnveden (2001) Allocation in ISO 14041 – a critical review, Journal of Cleaner Production, 9(2001) 197-208.</li> </ul>
Theory Session 5:	
Mon, 1/23	<p>Topics:</p> <ul style="list-style-type: none"> <li>• Recycling in LCA</li> <li>• Recycled content, avoided burden, and other methods</li> </ul> <p>Reading:</p> <ul style="list-style-type: none"> <li>• Atherton (2007) Declaration by the Metals Industry on Recycling Principles, Int. Journal of LCA 12(1) 59-60.</li> </ul>
Theory Session 6:	
Wed, 1/25	<p>Topics:</p> <ul style="list-style-type: none"> <li>• Life cycle impact assessment (LCIA)</li> <li>• Characterization factors</li> <li>• Computational structure of LCIA</li> </ul> <p>Reading:</p> <ul style="list-style-type: none"> <li>• Jolliet et al. (2016) Pages 105-121 of Life Cycle Impact Assessment, Chapter 5 in Environmental LCA, CRC Press, Boca Raton, FL.</li> </ul>
Theory Session 7:	
Mon, 1/30	<p>Topics:</p> <ul style="list-style-type: none"> <li>• Economic input-output (EIO) LCA</li> </ul> <p>Reading:</p> <ul style="list-style-type: none"> <li>• Course Book, Chapter 7</li> </ul>
Theory Session 8:	
Wed, 2/1	<p>Topics:</p> <ul style="list-style-type: none"> <li>• Attributional versus consequential LCA</li> <li>• Future developments in LCA</li> </ul> <p>Reading:</p> <ul style="list-style-type: none"> <li>• Ekvall &amp; Weidema (2004) System boundaries and input data in consequential life cycle inventory analysis, Int. Journal of LCA 9(3) 161-171.</li> </ul>
Theory Session 9:	
Mon, 2/6	<p>Topics:</p> <ul style="list-style-type: none"> <li>• LCA Case study</li> <li>• Interpretation</li> <li>• Contribution analysis</li> <li>• Uncertainty and scenario analysis</li> </ul> <p>Reading:</p> <ul style="list-style-type: none"> <li>• TBD</li> </ul>
Theory Session 10:	
Wed, 2/8	<p>Topics:</p> <ul style="list-style-type: none"> <li>• Midterm (review all reading and lecture slides)</li> <li>• Review of LCA theory</li> </ul>

Lab Session 1:	
Mon, 2/13	Topics: <ul style="list-style-type: none"> <li>• Plans, processes, flows</li> <li>• Scaling unit processes</li> </ul>
Lab Session 2:	
Fri, 2/17	Topics: <ul style="list-style-type: none"> <li>• Parameterized processes</li> <li>• Free and fixed parameters</li> <li>• Modeling a PET blow molding process</li> </ul>
Lab Session 3:	
Mon, 2/20	Topics: <ul style="list-style-type: none"> <li>• Lab project kick-off: Functional unit (FU) and reference flows (RF)</li> <li>• Inventory modeling: Cradle-to-gate beverage container production</li> <li>• Plan and global parameters</li> </ul>
Lab Session 4:	
Fri, 2/24	<ul style="list-style-type: none"> <li>• Cradle-to-gate vs. gate-to-gate processes</li> <li>• Material production processes</li> <li>• Material forming processes</li> </ul>
Lab Session 5:	
Mon, 2/27	Topics: <ul style="list-style-type: none"> <li>• Using transportation processes</li> <li>• Building and using dummy processes</li> <li>• Model transportation of your beverage containers</li> </ul>
Lab Session 6:	
Fri, 3/3	Topics: <ul style="list-style-type: none"> <li>• Build PET recycling processes</li> <li>• Use of avoided burden method</li> <li>• Model beverage container end-of-life management</li> </ul>
Lab Session 7:	
Mon, 3/6	Topics: <ul style="list-style-type: none"> <li>• GaBi inventory modeling Q &amp; A</li> <li>• Review beverage container plans</li> </ul>
Lab Session 8:	
Fri, 3/10	Topics: <ul style="list-style-type: none"> <li>• Quantities in GaBi</li> <li>• Balancing GaBi plans</li> <li>• Selecting impact categories and performing impact assessment</li> </ul>
Lab Session 9:	
Mon, 3/13	Topics: <ul style="list-style-type: none"> <li>• How to use the parameter explorer in GaBi</li> <li>• Perform scenario analysis</li> </ul>
Lab Session 10:	
Fri, 3/17	Topics: <ul style="list-style-type: none"> <li>• Finalize all LCA modeling</li> </ul>