ESM 273: Life Cycle Assessment (LCA)

Syllabus, Winter 2025

Theory Sessions:	Tue & Thu, Jan 7 – Feb 6, 12:30-1:45pm, BH 1424	
Lab Sessions	Tue & Thu, Feb 11 – March 13, 12:30-1:45pm, BH 3035	
Final Report:	Is due on Thursday, March 17, 11:59pm	
Midterm Exam:	Wednesday, Feb 6, closed book	
Final Exam:	No final	
Brief Quizzes:	8	
Short Assignments:	3	
Grading:	Quizzes	20% (8 x 2.5%)
	Assignments	15% (3 x 5%)
	Midterm Exam	15%
	Final Report	50%
Instructor:	Roland Geyer, BH 3426, rgeyer@ucsb.edu	
Office hours:	By appointment	
TA:	Jaenna Wessling, BH 3007, jaenna@ucsb.edu	
Office hours:	By appointment	

Important notes:

- All readings will be posted on Canvas.
- All quizzes are based on the slide content of the previous class.
- Hand-written assignments will not be accepted.
- The midterm covers the slide content of all 9 theory classes.
- This is an in-person class (maximum of 2 excused absences are allowed).

Date	Topics & Readings
Theory Session 1:	
Tue, 1/7	Topics: • Introduction • History of LCA • LCA terminology • Goal & scope definition Reading: • ISO 14044 (2006), Sections 4.1 to 4.2.3.2

Theory Session 2:	
Thu, 1/9	Topics: • Unit processes • Inventory data • Intermediate vs. elementary flows • Primary vs. secondary data Reading: • ISO 14044 (2006), Section 4.2.3.3 • White & Chester (2014) Chapter 1 in Environmental Life Cycle Assessment, Schenck & White (Eds.), ACLCA, Vashon Island, WA.
Theory Session 3:	
Tue, 1/14	Topics: • Inventory modeling • Activity levels (scaling factors) • Examples • Computational structure of process-based inventory analysis Reading: • Koffler, Geyer, Volz (2014) Chapter 5 in Environmental Life Cycle Assessment, Schenck & White (Eds.), ACLCA, Vashon Island, WA.
Theory Session 4:	
Thu, 1/16	Topics: • Co-production/multi-functionality • Allocation • Allocation procedure/key Reading: • ISO 14044 (2006), Section 4.3.4 • Jolliet et al. (2016) Pages 85-95 (4.5.1 to 4.5.4) of Chapter 4 in Environmental Life Cycle Assessment, CRC Press, Boca Raton, FL.
Theory Session 5:	
Tue, 1/21	Topics: • Life cycle impact assessment (LCIA) • Mandatory elements of LCIA: Classification & characterization Reading: • ISO 14044 (2006), Section 4.4.2 • Jolliet et al. (2016) Pages 105-112 (5.1 to 5.2.3.3) of Chapter 5 in Environmental Life Cycle Assessment, CRC Press, Boca Raton, FL.
Theory Session 6:	
Thu, 1/23	Topics: • Life cycle impact assessment (LCIA) • Optional elements of LCIA: Normalization & weighting Reading: • ISO 14044 (2006), Section 4.4.3 • Jolliet et al. (2016) Pages 112-115 (5.2.3.4 to 5.2.4) of Chapter 5 in Environmental Life Cycle Assessment, CRC Press, Boca Raton, FL.

Theory Session 7:	
Tue, 1/28	Topics: • Computational structure of process-based LCA • Economic input-output (EIO) LCA Reading: • Hawkins & Weber (2014) Chapter 7 in Environmental Life Cycle Assessment, Schenck & White (Eds.), ACLCA, Vashon Island, WA.
Theory Session 8:	
Thu, 1/30	Topics: • Attributional versus consequential LCA • Future developments in LCA Reading: • Ekvall & Weidema (2004) System boundaries and input data in consequential life cycle inventory analysis, Int. Journal of LCA 9(3) 161-171.
Theory Session 9:	
Tue, 2/4	Topics: • Beyond Burger LCA Case study • Structure • Content • Results • Interpretation Reading: • Heller & Keoleian (2018) Beyond Meat's Beyond Burger Life Cycle Assessment, Report No. CSS18-10, University of Michigan, MI.
Theory Session 10:	
Thu, 2/6	Topics: • Midterm (review all reading and lecture slides) • Review of LCA theory
Lab Session 1:	
Tue, 2/11	Topics: • Plans, processes, flows • Scaling unit processes
Lab Session 2:	
Thu, 2/13	Topics: • Parameterized processes • Free and fixed parameters • Modeling a PET blow molding process
Lab Session 3:	
Tue, 2/18	Topics: • Lab project kick-off: Functional unit (FU) and reference flows (RF) • Inventory modeling: Cradle-to-gate beverage container production • Plan and global parameters
Lab Session 4:	
Thu, 2/20	• Cradle-to-gate vs. gate-to-gate processes • Material production processes • Material forming processes

Lab Session 5:	
Tue, 2/25	Topics: • Using transportation processes • Building and using dummy processes • Model transportation of your beverage containers
Lab Session 6:	
Thu, 2/27	Topics: • Build PET recycling processes • Use of avoided burden method • Model beverage container end-of-life management
Lab Session 7:	
Tue, 3/4	Topics: • GaBi inventory modeling Q & A • Review beverage container plans
Lab Session 8:	
Thu, 3/6	Topics: • Quantities in GaBi • Balancing GaBi plans • Selecting impact categories and performing impact assessment
Lab Session 9:	
Tue, 3/11	Topics: • How to use the parameter explorer in GaBi • Perform scenario analysis
Lab Session 10:	
Thu, 3/13	Topics: • Finalize all LCA modeling