

ESM 273: Life Cycle Assessment (LCA)

Syllabus, Winter 2020

Time & Room: Theory, Jan 7 – Feb 4, 2:00-3:15pm, BH1424
Lab, Feb 6 – March 12, 2:00-3:15pm, BH3035 (GIS Lab)
Final report: Is due on Thursday, March 19, 5pm
Midterm exam: Tuesday, Feb 4, closed-book
Final exam: No final
Instructor: Roland Geyer, BH3426, extension 7234, geyer@bren.ucsb.edu
Office hours: By appointment
TA: Jason Maier, BH3007, jmaier@bren.ucsb.edu
Office hours: By appointment

Books on Life Cycle Assessment (LCA):

- Environmental Life Cycle Assessment (Schenck & White, Eds.)
<https://aclca-shop.lcacenter.org/products/textbook-environmental-lca> (\$45 student price)
- Life Cycle Assessment (Matthews, Hendrickson & Matthews)
<http://www.lcatextbook.com/> (free)
- Environmental Life Cycle Assessment (Jolliet et al.)
<https://www.crcpress.com/engineering-environmental/life-cycle-analysis>

Date	Topics & Readings
Theory Session 1:	
Tue, 1/7	Topics: <ul style="list-style-type: none">• Introduction• History of LCA• LCA terminology• Goal & scope definition
Theory Session 2:	
Thu, 1/9	Topics: <ul style="list-style-type: none">• Inventory analysis• Linear algebra review• Vectors and matrices• Matrix multiplication and inversion
Theory Session 3:	
Tue, 1/14	Topics: <ul style="list-style-type: none">• Inventory analysis• Aluminum bike frame example• Computational structure of process-based inventory analysis Reading: <ul style="list-style-type: none">• Koffler, Geyer, Volz (2014) Life Cycle Inventory, Chapter 5 in Environmental Life Cycle Assessment, Schenck & White (Eds.), ACLCA, Vashon Island, WA.

Theory Session 4:	
Thu, 1/16	<p>Topics:</p> <ul style="list-style-type: none"> • Allocation • Dealing with co-production in attributional LCA <p>Reading:</p> <ul style="list-style-type: none"> • Ekvall & Finnveden (2001) Allocation in ISO 14041 – a critical review, Journal of Cleaner Production, 9(2001) 197-208.
Theory Session 5:	
Tue, 1/21	<p>Topics:</p> <ul style="list-style-type: none"> • Recycling in LCA • Recycled content, avoided burden, and other methods <p>Reading:</p> <ul style="list-style-type: none"> • Atherton (2007) Declaration by the Metals Industry on Recycling Principles, Int. Journal of LCA 12(1) 59-60.
Theory Session 6:	
Thu, 1/23	<p>Topics:</p> <ul style="list-style-type: none"> • Life cycle impact assessment (LCIA) • Characterization factors • Computational structure of LCIA <p>Reading:</p> <ul style="list-style-type: none"> • Jolliet et al. (2016) Pages 105-121 of Life Cycle Impact Assessment, Chapter 5 in Environmental LCA, CRC Press, Boca Raton, FL.
Theory Session 7:	
Tue, 1/28	<p>Topics:</p> <ul style="list-style-type: none"> • Economic input-output (EIO) LCA <p>Reading:</p> <ul style="list-style-type: none"> • Hawkins & Weber (2014) Input-Output Models for Life Cycle Assessment, Chapter 7 in Environmental Life Cycle Assessment, Schenck & White (Eds.), ACLCA, Vashon Island, WA.
Theory Session 8:	
Thu, 1/30	<p>Topics:</p> <ul style="list-style-type: none"> • Attributional versus consequential LCA • Future developments in LCA <p>Reading:</p> <ul style="list-style-type: none"> • 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	<p>Topics:</p> <ul style="list-style-type: none"> • Midterm • Review of LCA theory <p>Reading:</p> <ul style="list-style-type: none"> • All material up to now.
Lab Session 1:	
Thu, 2/6	<p>Topics:</p> <ul style="list-style-type: none"> • Plans, processes, flows • Scaling unit processes

Lab Session 2:	
Tue, 2/11	Topics: <ul style="list-style-type: none"> • Parameterized processes • Free and fixed parameters • Modeling a PET blow molding process
Lab Session 3:	
Thu, 2/13	Topics: <ul style="list-style-type: none"> • 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:	
Tue, 2/18	<ul style="list-style-type: none"> • Cradle-to-gate vs. gate-to-gate processes • Material production processes • Material forming processes
Lab Session 5:	
Thu, 2/20	Topics: <ul style="list-style-type: none"> • Using transportation processes • Building and using dummy processes • Advanced use of parameters • Model transportation of your beverage containers
Lab Session 6:	
Tue, 2/25	Topics: <ul style="list-style-type: none"> • Build PET recycling processes • Use of avoided burned method • Model beverage container end-of-life management
Lab Session 7:	
Thu, 2/27	Topics: <ul style="list-style-type: none"> • GaBi inventory modeling Q & A • Review beverage container plans
Lab Session 8:	
Tue, 3/3	Topics: <ul style="list-style-type: none"> • Quantities in GaBi • Balancing GaBi plans • Selecting impact categories and performing impact assessment
Lab Session 9:	
Thu, 3/5	Topics: <ul style="list-style-type: none"> • How to use the parameter explorer in GaBi • Perform scenario analysis
Lab Session 10:	
Tue, 3/10	Topics: <ul style="list-style-type: none"> • Finalizing all LCA modeling
Lab Session 11:	
Thu, 3/12	Topics: <ul style="list-style-type: none"> • LCA class and project wrap-up and review