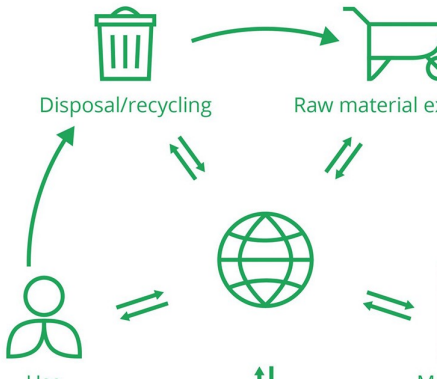
A Practical Introduction to Life Cycle Assessment



EVPP 692 (1 Credit)
EVPP 991 (2 Credits)
Fall 2024

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Classroom: Aquia Building, Room 219.

Class Meetings: Wednesdays, 4:30 PM to 6:20 PM.

Office Hours: By appointment.

Course Description and Goals

This seminar will introduce students to the Life Cycle Assessment (LCA) methodology, which has emerged in recent years as the tool of choice to assess the environmental impacts associated with the entire life cycle of a particular product or service. In this context, the life cycle includes the acquisition of raw materials, production, use, and post-use phases for the product or service. The assessment process involves gathering and measuring all environmental inputs and outputs associated with the product's life cycle, such as energy used, raw materials consumed, and emissions released into the air, water, and land.

The LCA analyst role is expected to see remarkable growth and create thousands of job opportunities across the U.S. by 2030. The high demand for more sustainable brands could make this projection even larger.

Course Learning Outcomes

By the end of this course, students should be able to:

- demonstrate an understanding of LCA as a tool for evaluating the environmental impact of a product or service.
- explain notions in LCA-terminology such as 'functional unit', 'system boundaries', ‘End-of-Life’, ‘allocation’, ‘system expansion’, etc.
- demonstrate a basic mastery of the openLCA software and inventory databases such as ecoinvent and LCA Commons.
- develop simple case studies comparing the relative environmental performance of a related set of products or services.

Learning Management System:

This course will be hosted on Blackboard for the Fall 2024 semester. Please ensure you are familiar with accessing and navigating this platform. Resources and support are available at: https://lms.gmu.edu/getting-started-students/ to help you get started.

Course Content, Instructional Methods and Evaluation of Student Performance

The Class Schedule shown below is tentative but it serves as a guide of the topics to be covered throughout the semester. Most lectures are based on training materials developed by GreenDelta, an engineering and consultancy firm specializing in the development of software and databases for LCAs and sustainability. In 2006, GreenDelta developed the concept of openLCA as a freely available (open-source) software for life cycle assessments. Students are therefore required to download the latest version of openLCA from https://www.openlca.org/download/. Further instructions for operating the software will be provided in class.

Students are also required to conduct a total of eight exercises throughout the semester, which are to be completed during the class sessions. Grades for students enrolled in EVPP 692 will be based on the successful completion of the exercises. Students enrolled in EVPP 991 are also required to develop and present an LCA case study based on the concepts learned in class (further details will be provided as the semester progresses). For these students, the exercises and the case study will each account for 50% of the course grade.

TENTATIVE CLASS SCHEDULE: Subject to changes.

Date	Topic	Exercise
Aug 28	Introduction to Life Cycle Assessment.	1: Get openLCA running.
Sept 4	Introduction to openLCA. LCA data import & elements in the database. Creating flows and processes.	2: Create a new database. 3a: Import a dataset. 3b: Import a database. 3c: Import impact assessment methods. 4: Flow information 5a: Battery production phase – Process creation.
Sept 11	Product systems creation and calculation. Results analysis and interpretation.	5b: Production phase of the battery – Modeling and calculation. 5c: Production phase of the battery – LCIA. 5d: Use phase of the battery – Create process.
Sept 18	Results analysis and interpretation (continued). Comparative LCA studies – Creation of projects. Data export. Sensitivity analysis – Working with parameters.	5e: Use phase of the battery – LCIA. 5f: Production + use phases – LCIA. 5g: e-car vs. diesel powered car. 5h: Battery production phase – Process creation with parameters 5i: e-car in different regions. 5j: Sensitivity analysis with parameters.
Sept 25	Modeling the End-of-Life. Allocation.	6a: Waste modelling (process producing waste). 6b: Waste treatment modelling (process treating waste). 6c: Comparison EoL modelling approaches. 7a: Physical allocation. 7b: Economic allocation. 7c: Causal allocation. 7d: Comparing allocation methods.
Oct 2	No Classes This Week (Search Committee Meeting)	
Oct 9	System Expansion.	8a: System expansion. 8b: System expansion vs. allocation – Model graphs. 8c: System expansion vs. allocation – Analysis. 8d: System expansion.

Date	Topic	Exercise
Oct 16	System Expansion (Continued). Uncertainty Analysis.	8d: System expansion (continued – additional exercise with Excel).
Oct 23	Class Practice: LCA of PC Bottles	
Oct 30	Class Practice: LCA of PC Bottles (continued) Class Practice: Kelp Farming Model by Ayala et al. (2023)	
Nov 6	Class Practice: Kelp Farming Model by Ayala et al. (2023) – Continued Case studies for student presentations are assigned. Introduce Federal LCA Commons	
Nov 13	No Classes This Week – Students work on their case studies.	
Nov 20	Class Practice: LCA model for the U.S. kelp aquaculture industry (using Federal LCA Commons)	
Nov 27	No Classes: **THANKSGIVING BREAK**	
Dec 4	Presentation of case studies by EVPP 991 students.	