Course Catalogue Entry

LCA Learning Lab for Energy Technologies

Registration Link:
https://docs.google.com/forms/d/e/1FAIpQLSd48H0fRJm6xJ4bnQRV7OeWVpBXF9AeAt1kEIQ0kj02IGUH2g/viewform?usp=publish-editor

Course Calendar:

Week 1	Week 2	Week 3
March 25 (online)	April 1 (in person)	April 8 (in person)

Instructors: Prof. Dr. M. Özgür Kayalıca, Dr. Denizhan Güven
TA: Dr. Berker Yurtseven
Credits: 0 (Non-credit Learning Lab)
Quota: Minimum 16 – Maximum 50 students
Delivery: In-person (Learning Lab format)
Schedule: Three Weekdays, 4 hours each (4 × 50-minute blocks)

Classroom:

Course Title: LCA Learning Lab for Energy Technologies

Course Description:

This Learning Lab introduces students to **Life Cycle Assessment (LCA)** with a specific focus on mobile and temporary power generation technologies used during the first days after major natural disasters. The course is structured around an **experiential, team-based learning model**. Students acquire theoretical fundamentals during the first week, build inventory datasets in the second week, and conduct LCA modelling in the third week using tools such as **GREET**. The course culminates in team presentations and a cross-team synthesis evaluating the environmental performance of selected technologies.

Course Objectives:

By the end of this Learning Lab, students will be able to:

1. Understand the principles and scope of Life Cycle Assessment.
2. Conduct inventory collection for selected energy technologies.
3. Perform LCA modelling using GREET or similar tools.
4. Interpret LCA results and compare alternative technologies.
5. Communicate analytical findings through structured presentations.
6. Collaborate in multidisciplinary teams in a simulated real-world assessment environment.

Format and Learning Approach:

This course is delivered as a **Learning Lab**, emphasizing active participation and experiential learning. Students work in teams of **5–6** around dedicated tables, using laptops and LCA software to generate real analysis.

Weekly Breakdown:

Week 1 — Introduction to LCA & Sample Applications (ONLINE)

(4 hours)

- Course introduction and expectations
- Overview of temporary/mobile power technologies used in disaster resilience
- Fundamentals of Life Cycle Assessment
- Introduction to GREET software (installation, features, walkthrough)
- Demonstration of a sample technology LCA
- Preparation for Week 2 assigned tasks

Week 2 — Inventory Development Workshop

(4 hours)

- Team formation (5–6 students per table)
- Technology assignments to each group
- Desktop research and dataset building
- Instructor and TA consultations
- Completion of LCA inventory sheets for Week 3 modelling

Week 3 — LCA Modelling & Final Presentations

(4 hours)

- Hands-on LCA modelling with GREET
- Interpretation of results within and across teams
- Group presentations (10–12 minutes per team)
- Final synthesis session:
    - Team representatives evaluate selected technologies
    - Development of a comparative ranking
    - Final 1–2-slide cross-group summary presentations
- Course wrap-up and reflections

Assessment:

Grades are based solely on:

- **Team Presentation (70%)**
- **Attendance (30%)**

Active participation is expected from all students.

Software Requirement:

Students **MUST** bring their laptops to class and install **GREET** before Week 2.

Additional Out-of-Class Workload (18 Hours)

1. Pre-Class Readings on LCA Fundamentals (5 hours)

Students are required to complete guided readings covering:

- Core principles of Life Cycle Assessment (goal & scope definition, functional unit, system boundaries),
- Life cycle thinking in energy systems,
- Environmental impact categories relevant to energy technologies.

2. Reading Module: Natural Disasters, Energy Systems, and Electricity Continuity (5 hours)

To contextualize LCA results within real-world applications, students complete a focused reading module on:

- Impacts of natural disasters (earthquakes, floods, hurricanes) on electricity systems,
- Concepts of electricity continuity, resilience, and recovery in post-disaster environments,
- The role of temporary and mobile power generation technologies in early response phases.

This module strengthens the link between LCA methodology and disaster-resilient energy planning.

3. Inventory Data Collection and Pre-Modelling Work (8 hours)

Between Week 1 and Week 2, student teams conduct structured desktop research to:

- Collect life cycle inventory data for their assigned technology,
- Identify data sources, assumptions, and data gaps,
- Prepare draft inventory tables for GREET-based modelling.

This work forms the analytical backbone of the in-class inventory workshop.

Total Out-of-Class Workload: 18 hours

Selected References

IPCC. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. Cambridge University Press.

ISO. (2006). *ISO 14040: Environmental management—Life cycle assessment—Principles and framework*. International Organization for Standardization.

ISO. (2006). *ISO 14044: Environmental management—Life cycle assessment—Requirements and guidelines*. International Organization for Standardization.

Kwasinski, A., Weaver, W. W., Chapman, P. L., & Krein, P. T. (2010). *Telecommunications power plant damage assessment for hurricane Katrina*. IEEE Power and Energy Magazine, 8(6), 70–78.

Panteli, M., & Mancarella, P. (2015). *The grid: Stronger, bigger, smarter? Presenting a conceptual framework of power system resilience*. IEEE Power & Energy Magazine, 13(3), 58–66.

Wang, Y., Chen, C., Wang, J., & Baldick, R. (2016). *Research on resilience of power systems under natural disasters—A review*. IEEE Transactions on Power Systems, 31(2), 1604–1613.

Wernet, G., et al. (2016). *The ecoinvent database version 3 (part I): Overview and methodology*. The International Journal of Life Cycle Assessment, 21, 1218–1230.