

Course guide

330804 - SACV - Sustainability and Life Cycle Analysis

Last modified: 24/05/2026

Unit in charge:	Manresa School of Engineering	
Teaching unit:	750 - EMIT - Department of Mining, Industrial and ICT Engineering.	
Degree:	MASTER'S DEGREE IN INDUSTRIAL FACILITY DESIGN AND MANAGEMENT (Syllabus 2026). (Compulsory subject).	
Academic year: 2026	ECTS Credits: 5.0	Languages: Catalan

LECTURER

Coordinating lecturer: Guimerà Villalba, Xavier
Lladó Valero, Jordi

Others: Guimerà Villalba, Xavier
Lladó Valero, Jordi

TEACHING METHODOLOGY

Theoretical-Practical Classes
Presentation of concepts through examples and group discussion.

LCA Software Workshops
Hands-on sessions using OpenLCA for modelling and assessment.

Real Case Studies
Study of real industrial applications of LCA, IPMVP, and management systems.

Final Project
Group development of a simplified LCA for a hypothetical industrial facility, integrating:
Goal and scope definition, Modelling using OpenLCA, Economic evaluation (LCC), Improvement proposal based on IPMVP, Communication through an executive report.

LEARNING OBJECTIVES OF THE SUBJECT

Knowledge
M2.K1: Identify the main causes, consequences, and proposed solutions to sustainability and industrial safety issues in the context of industrial facilities, as well as the relevant regulations and legislation.
M2.K2: Describe continuous improvement processes.
M2.K3: Identify the main environmental and safety risks and impacts relevant to the most common industrial facilities.
M2.RAT_UPC_1.1: Define approaches that promote sustainable development (e.g., the circular economy) and their influence on the design of industrial facilities.

Skills
M2.S1: Determine the requirements of an industrial facility according to environmental control, waste generation, quality, and safety needs.
M2.S2: Assess the condition of different environmental media/vectors (air, water, etc.), as well as their direct and indirect effects on people's health and safety.
M2.RAT_UPC_1.2: Assess the environmental and social impact of a facility through a comprehensive life cycle assessment, as well as its economic viability.



STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	100.00

Total learning time: 45 h

CONTENTS

Chapter 1. Conceptual framework of industrial sustainability

Description:

- 1.1. The concept of sustainability: evolution, dimensions (environmental, social, and economic)
- 1.2. Main environmental and social challenges in industrial environments
- 1.3. Strategic approaches: Circular Economy and Sustainable Design
- 1.4. Key regulations and legislation (IPPC Directive, REACH, SDGs 2030)
- 1.5. Corporate Social Responsibility and integration into business strategy

Specific objectives:

M2.K1
M2.RAT_UPC_1.1

Full-or-part-time: 6h

Theory classes: 5h

Laboratory classes: 1h

Chapter 2. Management systems and sustainability indicators

Description:

- 2.1. Environmental management systems (ISO 14001, EMAS)
- 2.2. Energy management systems (ISO 50001)
- Sustainability indicators and environmental assessment (environmental KPIs, Carbon Footprint, Water Footprint, Ecological Footprint, Human Development Index)
- 2.4. Introduction to the IPMVP measurement and verification protocol

Specific objectives:

M2.K2
M2.S1

Full-or-part-time: 3h

Theory classes: 3h

Chapter 3. Environmental assessment tools

Description:

- 3.1. Environmental assessment of projects and risk management
 - 3.1.1. Environmental Impact Assessment (EIA) in industrial projects
 - 3.1.2. Chemical risk management and REACH regulation
- 3.2. Introduction to Life Cycle Assessment (LCA)
 - 3.2.1. Concept, industrial applications and relationship with environmental indicators
 - 3.2.2. ISO 14040 and ISO 14044 standards
 - 3.2.3. LCA and environmental footprints (carbon, water, etc.)
- 3.3. LCA methodology according to ISO
 - 3.3.1. Goal and scope definition
 - 3.3.2. Life Cycle Inventory analysis (LCI)
 - 3.3.3. Life Cycle Impact Assessment (LCIA)
 - 3.3.4. Interpretation of results
- 3.4. LCA applications in industry
 - 3.4.1. Ecodesign and product improvement
 - 3.4.2. Environmental Product Declarations (EPD)
 - 3.4.3. Eco-labels and environmental communication

Specific objectives:

M2.K3
M2.S2
M2.RAT_UPC_1.1
M2.RAT_UPC_1.2

Full-or-part-time: 12h

Theory classes: 6h

Laboratory classes: 6h

Chapter 4. Practical LCA tools: modelling, data and quality

Description:

- 4.1. LCA modelling with software (OpenLCA or equivalent)
 - Definition of scope and inventory
 - Impact assessment and interpretation
- 4.2. Environmental data sources (primary and secondary)
- 4.3. Data quality and uncertainty
- 4.4. Sensitivity analysis and scenarios
- 4.5. Multifunctionality and methodological limitations

Specific objectives:

M2.S2
M2.RAT_UPC_1.2

Full-or-part-time: 9h

Theory classes: 2h

Laboratory classes: 7h

Topic 5. Extended LCA: economic and social dimensions

Description:

- 5.1. Life Cycle Costing (LCC) and Total Cost of Ownership (TCO)
- 5.2. Social Life Cycle Assessment (S-LCA)
- 5.3. Environmental-economic-social integration (triple bottom line)
- 5.4. Applications in industrial supply chains
- 5.5. Case studies in industry and services

Specific objectives:

M2.S2
M2.RAT_UPC_1.2

Full-or-part-time: 6h

Theory classes: 2h

Laboratory classes: 4h

Topic 6. LCA applied to energy, processes and circular economy

Description:

- 6.1. LCA in energy systems (renewable and fossil)
- 6.2. Energy efficiency and auditing (IPMVP)
- 6.3. Waste management and circular economy strategies
- 6.4. Comparison of industrial scenarios (recycling, reuse, design)
- 6.5. Application to plastics, metals and WEEE (waste electrical and electronic equipment)

Specific objectives:

M2.S2
M2.RAT_UPC_1.2

Full-or-part-time: 6h

Theory classes: 2h

Laboratory classes: 4h

Topic 7. LCA in strategy and industrial decision-making

Description:

- 7.1. LCA in eco-design and product improvement
- 7.2. Integration into environmental management systems (ISO and similar standards)
- 7.3. Sustainability indicators and corporate reporting
- 7.4. Decision support: multi-criteria tools
- 7.5. Integrative case: from design to strategic decision-making

Specific objectives:

M2.C1
M2.K2
M2.S1

Full-or-part-time: 3h

Theory classes: 1h

Laboratory classes: 2h

ACTIVITIES

name english

Full-or-part-time: 30h

Self study: 30h

Assignments, reports and exercises

Description:

Completion of different individual activities throughout the course, including problem-solving, application exercises, practical case analysis, and the preparation of technical reports related to the course contents.

Specific objectives:

These activities aim to consolidate the concepts addressed in class and develop students' ability to analyse and interpret results and communicate technical information.

Apply the concepts and methodologies developed throughout the course.

Solve conceptual and quantitative exercises related to sustainability and life cycle assessment.

Develop critical analysis and result interpretation skills.

Prepare technical reports with an appropriate structure and sound reasoning.

Material:

Activity statements.

Course notes and documentation.

Software and tools used throughout the course.

Full-or-part-time: 20h

Guided activities: 20h

Written examination

Description:

Individual assessment aimed at evaluating the achievement of the course learning outcomes. The examination will include conceptual questions on the theoretical contents, as well as problem-solving and calculation exercises related to the methodologies, tools, and applications developed throughout the course.

Specific objectives:

Demonstrate an understanding of the fundamental concepts of the course.

Apply the knowledge acquired to the resolution of exercises and practical cases.

Justify and interpret the results obtained in calculation-based problems.

Integrate the different course contents when solving technical problems and situations.

Full-or-part-time: 3h

Theory classes: 3h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the [Action Framework for Academic Integrity in Assessment at the UPC](#).

ACT ☐ Tasks, reports and/or exercises (30%) – Problem solving and individual assignments.

PR ☐ LCA project (40%) – Practical application of the methodology in a real case.

EF ☐ Final exam (30%) – Assessment of theoretical and practical knowledge.

Overall grade = ACT * 0.3 + PR * 0.4 + EF * 0.3

BIBLIOGRAPHY

Basic:

- Hunkeler, David; Lichtenwort, Kerstin; Rebitzer, Gerald. Environmental life cycle costing [on line]. First edition. Pensacola, Fla.: SETAC ; CRC Press, 2008 [Consultation: 11/06/2026]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=570462>. ISBN 9781420054736.

- Dinçer, Ibrahim; Rosen, Marc. Exergy : energy, environment, and sustainable development [on line]. Amsterdam ; Boston: Elsevier, 2007 [Consultation: 11/06/2026]. Available on: <https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/monograph/9780080445298/exergy>. ISBN 9780080531359.

- Castaldi, Marco J; Klinghoffer, Naomi B. Waste to energy conversion technology [on line]. First edition. Oxford: Elsevier Science & Technology, 2013 [Consultation: 11/06/2026]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=1574937>. ISBN 9780124051904.

- Klöpffer, Walter; Grahl, Birgit. Life cycle assessment : a guide to best practice [on line]. 1st ed. Wiley, 2014 [Consultation: 15/06/2026]. Available on: <https://onlinelibrary-wiley-com.recursos.biblioteca.upc.edu/doi/book/10.1002/9783527655625>. ISBN 9781523115464.