# Catalogue of MILLE Courses


## EIT RawMaterials MILLE

**MI**crocredentials for **L**ifelong **L**earning in **E**ngineering

Università degli Studi di Padova
Scuola di Ingegneria
CONFINDUSTRIA Veneto SIAV S.r.l.
Fraunhofer ISI
FVEM

# EIT RawMaterials MILLE

## MIcrocredentials for Lifelong Learning in Engineering

Project number: 22016

Supported by

eit RawMaterials
Connecting matters

Co-funded by the European Union

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*This communication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.*

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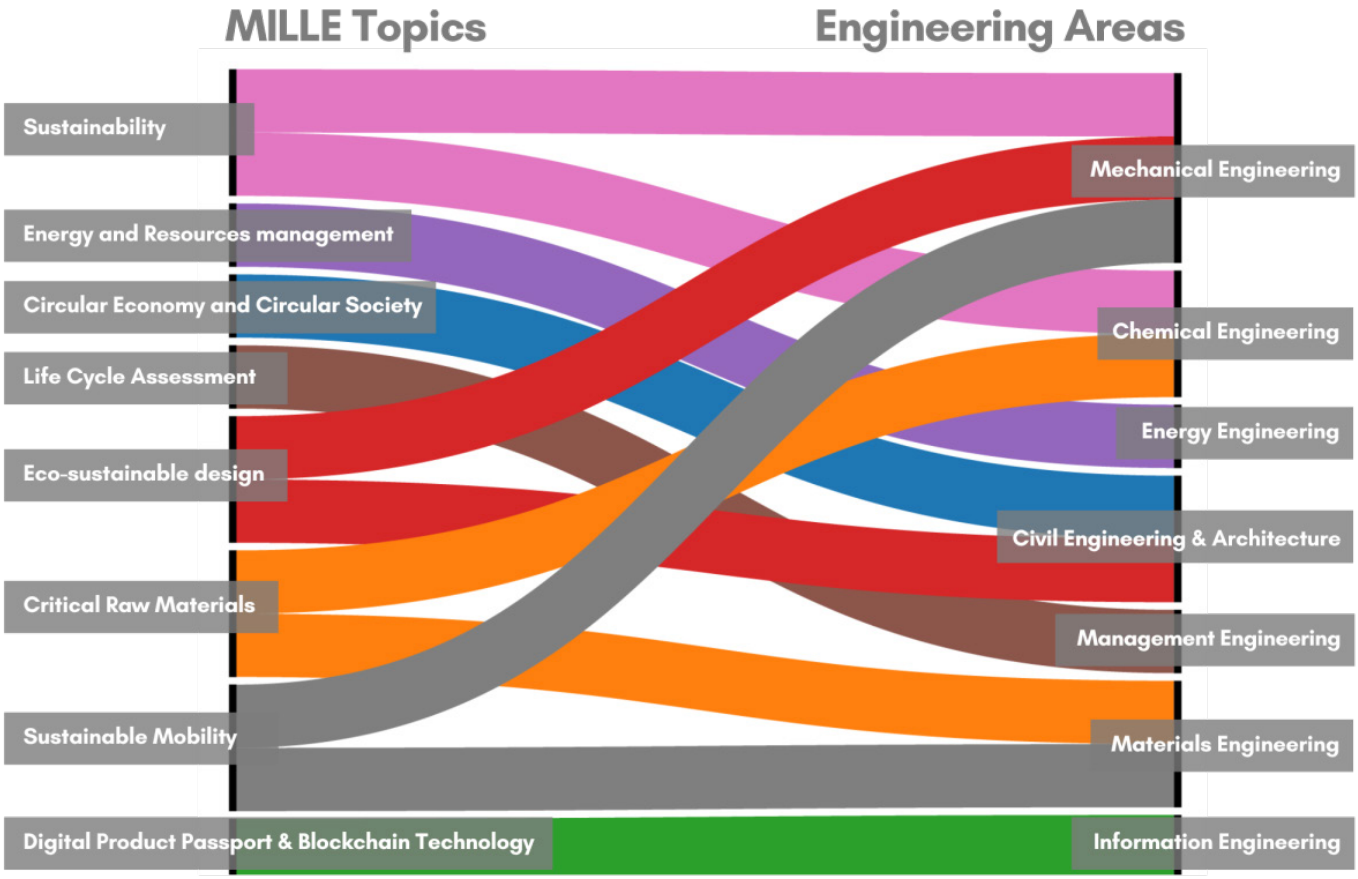
# project description

A continuously growing attention is being paid to innovative ways of Lifelong Learning based on a Human-Centric approach and facing several challenges: learning tailored on the diverse individual needs of each learner, and flexible enough to enable each learner to progress at their own pace; a system in which everyone has access in learning and is therefore inclusive and where everyone continuously improves on existing skills and acquires new ones based on their individual needs. Lifelong Learning, based on innovative training and teaching tools, is becoming a strategic instrument for implementing innovation into SMEs. Empowering workers to up- and re-skill throughout their entire lives is the key-challenge for next years, increasing permeability between different education pathways/systems and improving flexibility, both from person and Company viewpoints, thus fostering more innovative and inclusive approaches and facilitating access to labor market and job transitions. Individuals can accumulate learning outcomes over time and across institutions and sectors, facilitated by e-learning schemes.



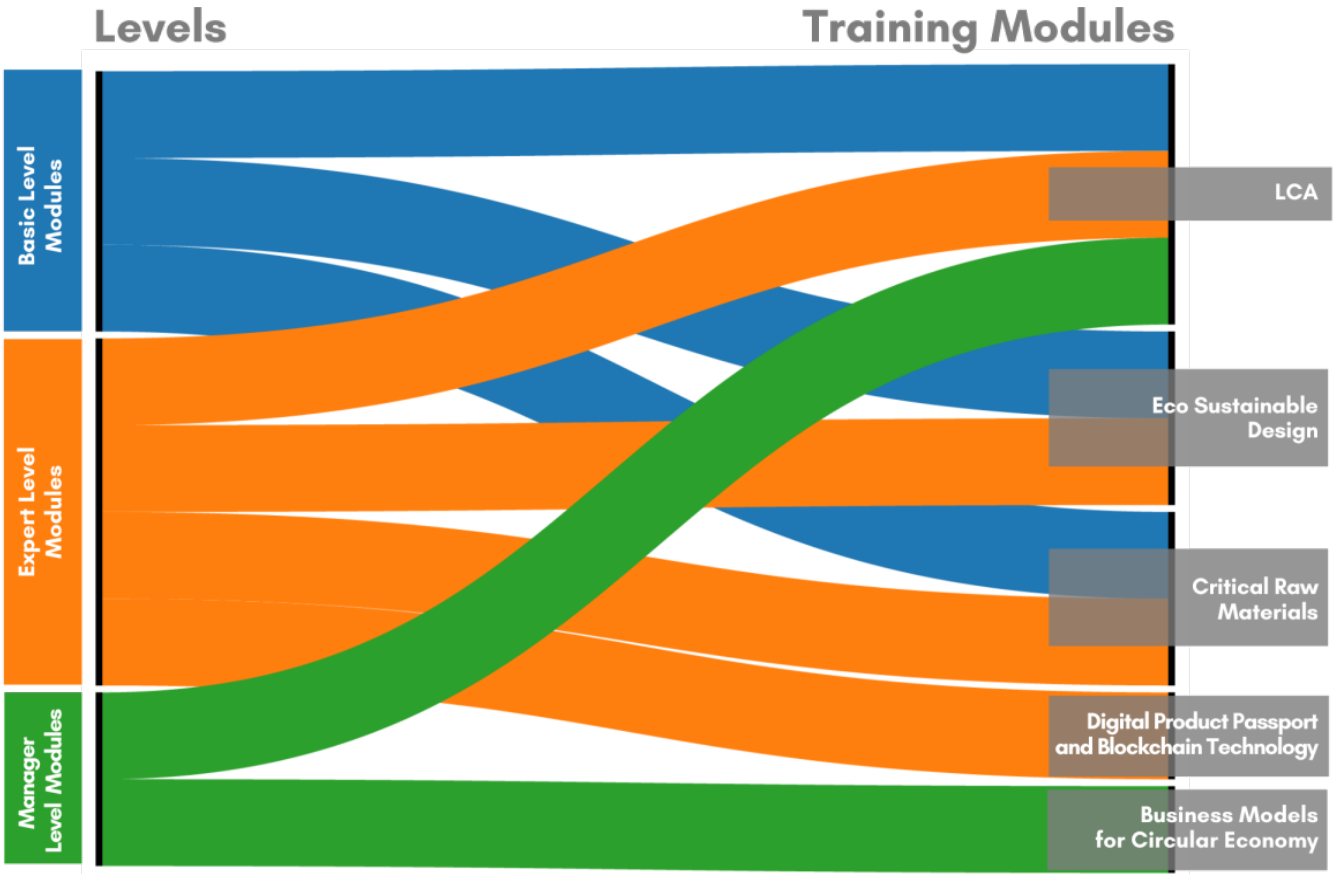

MILLE Project will highly contribute to this scenario, in the Area of Raw Materials, Sustainability, Design for Circularity, Traceability methodologies, by means of the multi-disciplinary micro-credential programs, associated to Digital certifications (e.g. European Digital Skills Certificate, Open Digital Badges, see Digital Education Action Plan 2021-2027) and addressed to professionals and workers in several engineering areas, as shown in the above figure.

This Catalogue displays the organization of MILLE Training modules, jointly developed by Padova University and Fraunhofer Institute, in cooperation with SIAV – Confindustria Veneto and FVEM (Federación Vizcaína de Empresas del Metal), under the financial support of EIT – Raw Materials.

The MILLE training modules are based on:

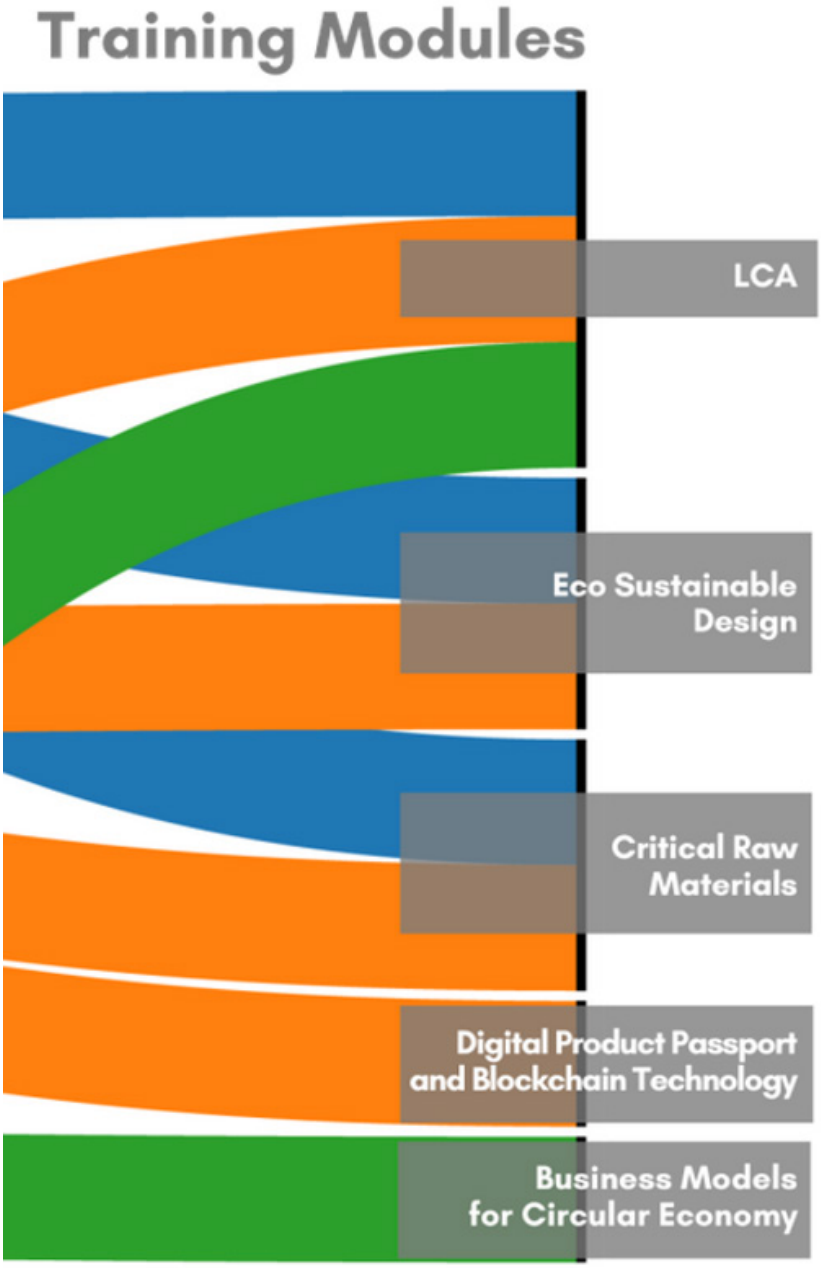
- three levels of development of contents (Basic, Expert, Manager),
- five key-topics (Life Cylce Assessment, Eco-sustainable design, Critical Raw Materials, Digital Product Passport, Business Models for Circular Economy),

as summarised in the figure below.




In the next pages, all the training modules are described in terms of Preliminary requirements, Knowledge & abilities to be achieved, Contents Teaching Methodologies and References.

# lecturers




Sabine Langkau, Anna Mazzi, Anna Stoppato

Ronja Scholz, Paolo Ferro

Michaela Schicho, Silvia Gross, Alessandra Lorenzetti

Yvonne Beck, Antonia Loibl, Laura Macchion

Yvonne Beck, Antonia Loibl, Robin Barkhausen, Eleonora Di Maria

# BASIC-LEVEL MODULES

Università degli Studi di Padova
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FVEM

# Basic-level Module 1
# Key-descriptors

**BM1**

## Title

## Life Cycle Assessment (LCA)

**LECTURERS**

**Sabine Langkau, Anna Mazzi, Anna Stoppato**

**TAGS**

**Life cycle assessment, Sustainability, Product Carbon Footprint, Product Environmental labels**

## Details

**Preliminary requirements**

The module content requires students to have a basic understanding of environmental aspects and impacts, environmental input-output analysis, international standardisation.

**Module description, including Knowledge & abilities to be achieved**

The module is organized into 5 sections:

1. introduction to life cycle approach;
2. LCA principles and framework;
3. LCA to support Environmental Labels;
4. relevance of inventory in LCA studies;
5. LCA for circular economy and for energy transition.

Upon completion of the course, the students will acquire knowledge on:

- principles to evaluate environmental impacts from a life cycle and circular economy perspective;
- general requirements to conduct consistent LCA studies;
- summary of the Contents of ISO 14040 and ISO 14044;
- areas of application of LCA results in the industrial field;
- main environmental labels that use the life cycle approach.

They will be able to:

- understand LCA reports and identify potential environmental improvements on the basis of LCA results;
- set up the data collection needed for an LCA;
- select consistent information to cooperate in carrying out LCA studies;
- contribute to the interpretation of LCA results.

## Contents of the course

The course will cover the following topics:

**Introduction to the life cycle approach**

1. Life cycle thinking and LCA
2. Need and benefits of the LCA approach for companies, the market, and the public sector
3. Definition of sustainability, life cycle approach, and environmental impact assessment
4. Origins of LCA and standards to support LCA

**LCA principles and framework**

5. Goal & scope of LCA study
6. Life Cycle Inventory
7. Life Cycle Impact Assessment
8. Interpretation
9. Examples of LCA studies in specific industrial sectors
10. Strengths and weaknesses/advantages and disadvantages/limitations of LCA

**LCA in Environmental Labels**

11. LCA in EU policies and in ecodesign
12. Carbon footprint (climate change)
13. Ecological backpack/rucksack (resource consumption) and Ecological footprint (land use)
14. Water footprint (water demand in overall production process)
15. EPD and PEF
16. Examples and case history

**Relevance of inventory in LCA studies**

17. Quality of data in LCA
18. Life cycle model and data sheets
19. Datasets and databases in LCA
20. Examples and case history

**LCA for circular economy and energy transition**

21. LCA in renewable energies
22. LCA to support technology innovation
23. LCA to support CE and ecodesign
24. Examples and case history

## Teaching Methodologies

Asynchronous on-line lectures, 4 nominal hours a week, 2 synchronous meetings with teachers. The course will offer:

- asynchronous online teaching lectures;
- individual learning activities (I.e. case study analysis);
- synchronous online meeting with teachers.

## References


- Hauschild M.Z., Rosenbaum R.K., Olsen S.I. (eds), Life Cycle Assessment. Theory and Practice. Springer, 2018. ISBN 978-3-319-56474-6.


## Link with Agenda 2030

# Basic-level Module 2
# Key-descriptors

**BM2**

## Title

## Eco-sustainable design

**LECTURERS**

**Ronja Scholz, Paolo Ferro**

**TAGS**

**Eco-design, Circular Economy Design, European sustainable product initiative**

## Details

**Preliminary requirements**

LCA Module, Understanding of Lifecycle phases, basics of material properties (preferably basic understanding of design process).

**Module description, including Knowledge & abilities to be achieved**

The module introduces to a system understanding of Eco-sustainable design, the concept of a Circular Economy and Design requirements from a systemic perspective as well as a material related design. At the end of the course, the participants:

- understand the Circular design concepts, design strategies and how to apply them to individual products;
- have an understanding of strategies, methods and tools to implement Eco-sustainable Design;
- can prioritize ways to improve the circularity of a product from a systemic life cycle perspective, including materials selection in a CRM scenario;
- are aware of CRM related issues with material selection process;
- are able to understand the limits of design intervention and indicate potential for the integration of Eco-design strategies in the organization strategy;
- have knowledge of various different examples of specific cases.

**Contents of the course**

**Eco-sustainability from a system perspective**

1. Ecodesign and the Circular Economy
   Inroduction to Both concepts, circularity strategies, circular vision & society.
   Limits and feasibility, target conflicts on the example of electronics.
2. Ecodesign in the design process, what skills and focus when?
   How to decide on the right strategy, involvement of producers and up- and downstream stakeholders.

3. Ecodesign in EU-Regulation
   (ESP, ESG, RoHs & REACH, Energylabel, French Repairability Index)
4. Circular business models
   Value creation and design requirements; Examples & Strategies
5. Product/Service/System-Design - a new leverage for sustainability
   Reversed logisitics, industrial symbiosis and other synergies, limits and side-effects
6. A basic introduction to reliability in electronic systems

**Product material related design**

7. Energy related design aspects
8. Deep dive Electronics - Understanding impacts and design
9. Materials in design and related issues (CRM) (1h)
10. The design process: concept, embodiment, details
11. A materials selection systematic approach (1h)
12. Co-selection material and shape to serve for material use improved efficiency (1h)
13. How to face multi-objectives design problem in material selection (1h)
14. Eco-design driven material choice (1h)

Potential Cases: a parking lot sensor, a modular Smartphone, Lighting management system, a router that fits a letterbox, CitizienSensors for circular cities.

## Teaching Methodologies

Asyncronous on-line lectures, 4 nominal hours a week, 2 syncronous meetings with teachers.

## References


- EcoDesign Circle (www.ecodesigncircle.eu, www.circulardesign.tools).
- https://www.fairphone.com/wp-content/uploads/2022/07/Fairphone-4-Life-Cycle-Assessment-22.pdf.
- https://greenict.de/nachhaltige-halbleiterfertigung/.
- Jaeger-Erben, Melanie & Hofmann, Florian & Marwede, Max & Winzer, Janis & Proske, Marina & Wagner, Eduard & Poppe, Erik. (2019). From Take-Make-Dispose to a Circular Society: Introduction of a new vision in six propositions.
- Proske, Marina. (2022). How to address obsolescence in LCA studies – Perspectives on product use-time for a smartphone case study. Journal of Cleaner Production.
- Shevchenko, Tetiana & Yannou, Bernard & Saidani, Michael & Cluzel, François & Ranjbari, Meisam & Shams Esfandabadi, Zahra & Danko, Yuriy & Leroy, Yann. (2022). Product-level circularity metrics based on the "Closing-Slowing Future-Past" quadrant model. Sustainable Production and Consumption.
- P. Ferro, F. Bonollo. Materials selection in a critical raw materials perspective. Materials and Design 177 (2019) 107848.
- P. Ferro, F. Bonollo. Design for Recycling in a Critical Raw Materials Perspective. Recycling 2019, 4, 44; doi:10.3390/recycling4040044.

- P. Ferro, F. Bonollo & S.A. Cruz. Alloy Substitution in a Critical Raw Materials Perspective. Frattura ed Integrità Strutturale, 51 (2020) 81-91.
- P. Ferro, F. Bonollo. How to apply mitigating actions against critical raw materials issues in mechanical design. Integrity Procedia 26 (2020) 28-34.
- Ferro P. Raw materials criticalities in material selection & design. Int J Phys Res Appl. 2020; 3: 017-019. DOI: 10.29328/journal.ijpra.1001020.
- P. Ferro, F. Bonollo & S.A. Cruz. Product design from an environmental and critical raw materials perspective, International Journal of Sustainable Engineering, 2021, 14(1), pp. 1-11 DOI: 10.1080/19397038.2020.1719445.
- Ferro, P., Bonollo, F., Lightweight design versus raw materials criticalities. Sustainable Materials and Technologies. Vol. 35 April 2023 Article number e00543.
- Sustainable Materials - With Both Eyes Open.
- Future Buildings, Vehicles, Products And Equipment - Made Efficiently And Made With Less New Material, by Julian Allwood, Jonathan Cullen (ISBN: 1906860076).
- Materials and the Environment. Eco-Informed Material Choice. Michael F. Ashby. Book, Third Edition, 2021, ISBN 978-0-12-821521-0.


## Link with Agenda 2030

# Basic-level Module 3
# Key-descriptors

**BM3**

## Title

## Resource Management & Critical Raw Materials

**LECTURERS** **Michaela Schicho, Silvia Gross, Alessandra Lorenzetti**

**TAGS** **Critical Raw Materials, Resources, Recycling, Urban Mining**

## Details

**Preliminary requirements**

Scientific or technical basic education. No further requirements.

**Module description, including Knowledge & abilities to be achieved**

The BM3 module aims at introducing to a general audience the topics of critical raw materials by contextualizing it into the broader framework of natural resources and their scarcity. The module will present the resource topic, along with its regulatory framework, and will then introduce the topic of critical and strategic raw materials along the whole value chain (mining, processing and use, recovery, recycling, End of Life/End of Waste, overall and supply chain). A particular focus will be on mitigation strategy to address criticality (i.e. substitution, recovery, urban mining). A focus on a selection of CRM will be made.
Knowledge & abilities to be achieved: recognize and assess CRM and SRM, understanding their technological and economical relevance and the critical issues related to their supply and recovery. Acquire a basic knowledge of main recovery and recycling processes.

**Contents of the course**

| | |
|---|---|
| 1-3 | Introduction to resources management |
| 4-5 | Introduction to Critical and Strategic Raw Materials |
| 6 | Critical Raw Materials act |
| 7-8 | Relevance of raw materials for strategic technologies |
| 9 | Supply chain of CRM |
| 10 | Mining of CRM and mining charts |
| 11-13 | Mitigation measures |
| 14-15 | Urban Mining |
| 16 | Case Study: Rare earth elements |
| 17 | Case study: Lithium |
| 18 | Case study: Copper |
| 19-20 | Further CRMs |
| 21-24 | Recovery of CRM: pyro, hydrometallurgical approaches and alternative approaches |

## Teaching Methodologies

Asyncronous on-line lectures, 4 nominal hours a week, 2 syncronous meetings with teachers.

## References


- https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en.
- European Commission, COM (2023) 165 final.
- Carrara, S., Bobba, S., Blagoeva, D., Alves Dias, P., Cavalli, A., Georgitzikis, K., Grohol, M., Itul, A., Kuzov, T., Latunussa, C., Lyons, L., Malano, G., Maury, T., Prior Arce, Á., Somers, J., Telsnig, T., Veeh, C., Wittmer, D., Black, C., Pennington, D., Christou, M., Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU - A foresight study, Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/386650, JRC132889.


## Link with Agenda 2030

# EXPERT-LEVEL MODULES

Università degli Studi di Padova
Scuola di Ingegneria
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Fraunhofer ISI
FVEM

# Expert-level Module 1
# Key-descriptors

**EM1**

## Title

## Life Cycle Assessment (LCA)

**LECTURERS**

**Sabine Langkau, Anna Mazzi, Anna Stoppato**

**TAGS**

**Life cycle assessment, Product Carbon Footprint, Product Environmental Labels, Environmental Impact Assessment**

## Details

**Preliminary requirements**

The module content requires students to have a basic understanding of environmental impacts identification, environmental input-output analysis, environmental impacts indicators, goal of LCA methodology and expected results.

**Module description, including Knowledge & abilities to be achieved**

The module is organized into 5 sections:

1. introduction to the life cycle approach;
2. steps of LCA and contents;
3. LCA in practice with softwares and databases;
4. LCA to support environmental labels;
5. LCA in circular economy and energy transition.

Upon completion of the course, the students will acquire knowledge on:

- the relevance of life cycle approach and LCA in CE and ecodesign;
- general and specific requirements to conduct consistent LCA studies;
- detailed information on the content of ISO 14040 and ISO 14044;
- detailed information on the main areas of application of LCA to support environmental strategies, ecodesign, and green marketing;
- main benefits and difficulties in applying the LCA methodology.

They will be able to:

- know the basic elements to conduct LCA studies;
- identify the main characteristics of LCA studies and the relevance of LCA results;
- understand the information reported in LCA results;
- support management in using LCA results in sustainable business strategies, in ecodesign for CE, and in energy transition project.

## Contents of the course

The course will cover the following topics:

**Introduction to the life cycle approach**

1. Need and benefits of life cycle approach approach for companies, market, and the public sector
2. Definition of sustainability, life cycle thinking, and environmental impact assessment
3. LCA in ISO standards

**Steps of LCA and contents**

4. Goal & scope of LCA study: requirements
5. Goal and scope of LCA study: examples
6. Life Cycle inventory: requirements
7. Life Cycle Inventory: examples
8. Life Cycle Impact Assessment
9. Life Cycle impact Assessment: examples
10. Interpretation of results: requirements
11. Interpretation of results: examples

**LCA in practice: softwares and databases**

12. LCA software and databases
13. Examples of LCA using the software SimaPro
14. Examples of LCA using the Database Ecoinvent
15. Strengths and weaknesses/advantages and disadvantages/limitations of LCA

**LCA to support environmental labels**

16. Carbon footprint (climate change)
17. Ecological backpack/rucksack (resource consumption) and Ecological footprint (land use)
18. Water footprint (water demand in the overall production process)
19. EPD and PEF

**LCA for circular economy and energy transition**

20. LCA to compare recycling options
21. LCA to support circular innovation
22. LCA in renewable energies
23. LCA to support technology innovation and CE
24. LCA for CE and energy transition: examples

## Teaching Methodologies

Asynchronous on-line lectures, 4 nominal hours a week, 2 synchronous meetings with teachers. The course will offer:

asynchronous online teaching lectures;
individual learning activities (I.e. case study analysis);
synchronous online meeting with teachers.

## References


- Hauschild M.Z., Rosenbaum R.K., Olsen S.I. (eds), Life Cycle Assessment. Theory and Practice. Springer, 2018. ISBN 978-3-319-56474-6.


## Link with Agenda 2030

# Expert-level Module 2
# Key-descriptors

**EM2**

## Title

## Eco-sustainable design

**LECTURERS**

**Ronja Scholz, Paolo Ferro**

**TAGS**

**Eco-design, Circular Economy Design, European sustainable product initiative**

## Details

**Preliminary requirements**

LCA Module, Understanding of Lifecycle phases, basics of material properties (preferably basic understanding of design process).

**Module description, including Knowledge & abilities to be achieved**

The module introduces to a system understanding of Eco-sustainable design, the concept of a Circular Economy and Design requirements from a systemic perspective as well as a material related design. At the end of the course, the participants:

- understand the Circular design concepts, design strategies and how to apply them to individual products;
- have an understanding of strategies, methods and tools to implement Eco-sustainable Design;
- can prioritize ways to improve the circularity of a product from a systemic life cycle perspective, including materials selection in a CRM scenario;
- are aware of CRM related issues with material selection process;
- are able to understand the limits of design intervention and indicate potential for the integration of Eco-design strategies in the organization strategy;
- have knowledge of various different examples of specific cases.

**Contents of the course**

**Eco-sustainability from a system perspective**

1. Ecodesign and the Circular Economy
   Inroduction to Both concepts, circularity strategies, circular vision & society
   Limits and feasibility, target conflicts on the example of electronics
2. Ecodesign in the design process, what skills and focus when?
   How to decide on the right strategy, involvement of producers and up- and downstream stakeholders,

3. Ecodesign in EU-Regulation
   (ESP, ESG, RoHs & REACH , Energylabel, French Repairability Index)
4. Circular business models
   Value creation and design requirements; Examples & Strategies
5. NetZero, R-Strategy-Waste management, Scope1-2-3 and other Systems
6. Product/Service/System-Design – a new leverage for sustainability
   Reversed logisitics, industrial symbiosis and other synergies, limits and side-effects
7. A basic introduction to reliability in electronic systems
8. Circular & Ecodesign tools
9. Ecodesign - Measurement, Indicators, Labels

**Product material related design**

10. Energy related design aspects
11. Deep dive Electronics – Understanding impacts and design
12. Materials in design and related issues (CRM) (1h)
13. The design process: concept, embodiment, details
14. A materials selection systematic approach (1h)
15. Co-selection material and shape to serve for material use improved efficiency (1h)
16. How to face multi-objectives design problem in material selection (1h)
17. Eco-design driven material choice (1h)
18. Material selection in a CRM perspective (1h)
19. Design for Recycling in a Critical Raw Materials Perspective (1h)
20. Material Substitution in a Critical Raw Materials Perspective (1h)
21. Product design from an environmental and critical raw materials perspective (1h)
22. Design for and from recycling – principles and limitations
23. Lightweight design versus raw materials criticalities (1h)

Potential Cases: A parking lot sensor, a modular Smartphone, Lighting management system, a router that fits a letterbox, CitizienSensors for circular cities.

## Teaching Methodologies

Asyncronous on-line lectures, 4 nominal hours a week, 2 syncronous meetings with teachers.

## References


- EcoDesign Circle (www.ecodesigncircle.eu, www.circulardesign.tools).
- https://www.fairphone.com/wp-content/uploads/2022/07/Fairphone-4-Life-Cycle-Assessment-22.pdf.
- https://greenict.de/nachhaltige-halbleiterfertigung/.
- Jaeger-Erben, Melanie & Hofmann, Florian & Marwede, Max & Winzer, Janis & Proske, Marina & Wagner, Eduard & Poppe, Erik. (2019). From Take-Make-Dispose to a Circular Society: Introduction of a new vision in six propositions.

- Proske, Marina. (2022). How to address obsolescence in LCA studies - Perspectives on product use-time for a smartphone case study. Journal of Cleaner Production.
- Shevchenko, Tetiana & Yannou, Bernard & Saidani, Michael & Cluzel, François & Ranjbari, Meisam & Shams Esfandabadi, Zahra & Danko, Yuriy & Leroy, Yann. (2022). Product-level circularity metrics based on the "Closing-Slowing Future-Past" quadrant model. Sustainable Production and Consumption. 34.
- P. Ferro, F. Bonollo. Materials selection in a critical raw materials perspective. Materials and Design 177 (2019) 107848.
- P. Ferro, F. Bonollo. Design for Recycling in a Critical Raw Materials Perspective. Recycling 2019, 4, 44; doi:10.3390/recycling4040044.
- P. Ferro, F. Bonollo & S.A. Cruz. Alloy Substitution in a Critical Raw Materials Perspective. Frattura ed Integrità Strutturale, 51 (2020) 81-91.
- P. Ferro, F. Bonollo. How to apply mitigating actions against critical raw materials issues in mechanical design. Integrity Procedia 26 (2020) 28-34.
- Ferro P. Raw materials criticalities in material selection & design. Int J Phys Res Appl. 2020; 3: 017-019. DOI: 10.29328/journal.ijpra.1001020.
- P. Ferro, F. Bonollo & S.A. Cruz. Product design from an environmental and critical raw materials perspective, International Journal of Sustainable Engineering, 2021, 14(1), pp. 1-11 DOI: 10.1080/19397038.2020.1719445.
- Ferro, P., Bonollo, F., Lightweight design versus raw materials criticalities. Sustainable Materials and Technologies. Vol. 35 April 2023 Article number e00543.
- Sustainable Materials - With Both Eyes Open.
- Future Buildings, Vehicles, Products And Equipment - Made Efficiently And Made With Less New Material, by Julian Allwood, Jonathan Cullen (ISBN: 1906860076).
- Materials and the Environment. Eco-Informed Material Choice. Michael F. Ashby. Book, Third Edition, 2021, ISBN 978-0-12-821521-0.


## Link with Agenda 2030

# Expert-level Module 3
# Key-descriptors

**EM3**

## Title

## Resource Management & Critical Raw Materials

**LECTURERS**

**Michaela Schicho, Silvia Gross, Alessandra Lorenzetti**

**TAGS**

**Critical Raw Materials, Strategic Materials, Resources, Recycling, Urban Mining**

## Details

**Preliminary requirements**

Scientific or technical advanced education in the fields of chemistry, geology, materials sciences, chemical engineering, materials engineering, environmental engineering.

**Module description, including Knowledge & abilities to be achieved**

The EM3 module aims at introducing to an expert audience the topics of critical raw materials by contextualizing it into the broader framework of natural resources and their scarcity. The module will present the methodology Material Flow Analysis as a quantitative tool for research management and its applicability to criticality and circularity. Detailed insights in the methodology of the criticality assessment will be provided and mitigation measures to decrease the criticality will be discussed. The module includes case studies from several industrially relevant metals.
Knowledge & abilities to be achieved:
Recognize and assess CRM and SRM, understanding their technological and economical relevance and the critical issues related to their supply and recovery, getting to know mitigation measures. Acquire an advanced knowledge of main recovery and recycling processes.

**Contents of the course**

| | |
|---|---|
| 1-2 | Introduction to resources management |
| 3-4 | Material Flow Analysis as a tool for resource management |
| 5 | MFA case study: Copper |
| 6 | Introduction to Critical Raw Materials |
| 7-8 | CRM Methodology - Supply risk |
| 9 | CRM Methodology - Economic importance |
| 10 | Critical Raw Materials act |
| 11-12 | Mitigation measures: General |
| 13-14 | Mitigation measures: Substitution |
| 15 | Applications of CRM: Relevance |
| 16 | Applications of CRM: Lithium-ion-batteries |
| 17-18 | Applications of CRM: Rare earth elements |

19-21 Recovery of CRM
22 Basics of urban mining
23-24 Social aspects on CRM

## Teaching Methodologies

Asyncronous on-line lectures, 4 nominal hours a week, 2 syncronous meetings with teachers.

## References


- https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en.
- European Commission, COM (2023) 165 final.
- Carrara, S., Bobba, S., Blagoeva, D., Alves Dias, P., Cavalli, A., Georgitzikis, K., Grohol, M., Itul, A., Kuzov, T., Latunussa, C., Lyons, L., Malano, G., Maury, T., Prior Arce, Á., Somers, J., Telsnig, T., Veeh, C., Wittmer, D., Black, C., Pennington, D., Christou, M., Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU - A foresight study, Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/386650, JRC132889.


## Link with Agenda 2030

# Expert-level Module 4
# Key-descriptors

**EM4**

## Title

# Digital Product Passport and Blockchain Technology

**LECTURERS** **Yvonne Beck, Antonia Loibl, Laura Macchion**

**TAGS** **Digital Product Passport, Blockchain, Sustainability**

## Details

**Preliminary requirements**

None

**Module description, including Knowledge & abilities to be achieved**

This module comprises an introduction to Digital Product Passports and Blockchains addressed to management personnel in companies. At the end of the course, participants are able to:

- describe and apply concepts of sustainability, social responsibility and risk management to their individual professional context;
- understand the concepts of sustainable supply chains and their traceability, as well as blockchains (in order to support strategic decisions in their company).

**Contents of the course**

The course is structured in the following sections:

**Introduction**
- Sustainability and corporate social responsibility (CSR)

**CSR and risk management**
- Improvement of Sustainability and Reputational Risk of companies

**Supply chains**
- Sustainability roadmap for supply chains
- Supply chain traceability

**Digital Product Passport**
- Definition and goals of the digital product passport
- Examples and trends in policy and industry

**Digital supply chains**
- New practices to support the traceability of supply chains

**Blockchain**

- Introduction and uses of blockchains
- Blockchain and sustainability

**Insights and conclusions of the course**

- Transfer of concepts to individual contexts

## Teaching Methodologies

Asynchronous online lectures, 4 nominal hours a week, 2 synchronous meetings with teachers.

## References


- Moretto, A., Macchion, L. (2022): Drivers, barriers and supply chain variables influencing the adoption of the blockchain to support traceability along fashion supply chains. In Oper Manag Res 15, 1470-1489. https://doi.org/10.1007/s12063-022-00262-y.
- Macchion, Laura; Moretto, Antonella; Caniato, Federico; Danese, Pamela; Vinelli, Andrea (2020): Static supply chain complexity and sustainability practices: A multitier examination. In Corp Soc Responsibility Env 27 (6), 2679-2691. https://doi.org/10.1002/csr.1992.
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## Link with Agenda 2030

# MANAGER-LEVEL MODULES

Università degli Studi di Padova
Scuola di Ingegneria
CONFINDUSTRIA Veneto SIAV S.r.l.
Fraunhofer ISI
FVEM

# Manager-level Module 1
# Key-descriptors

**MM1**

## Title

## LCA & Life Cycle Thinking

**LECTURERS**

**Sabine Langkau, Anna Mazzi, Anna Stoppato**

**TAGS**

**Life cycle assessment, Life Cycle Thinking, sustainability assessment, circular economy**

## Details

**Preliminary requirements**

The module content requires students to have a basic understanding of environmental sustainability, European policies on the environment, and international standardisation.

**Module description, including Knowledge & abilities to be achieved**

The module is organized into 5 sections:

1. introduction to LCT and LCA;
2. LCA principles and framework;
3. LCA to support environmental labels;
4. Life Cycle approach for sustainability assessment;
5. LCA for circular economy and for energy transition.

Upon completion of the course, the students will acquire knowledge on:

- Life Cycle Thinking approach;
- principles and models to evaluate environmental impacts from the life cycle and circular perspective;
- international requirements for LCA studies: ISO 14040-14044 standards;
- areas of application of LCA studies in the industrial field and its main results;
- goal, scope and contents of Life Cycle Costing, Social LCA and Life Cycle Sustainability Assessment;
- international and European policies to support environmental impact assessment and life cycle approach.

They will be able to:

- understand the results of an LCA study, their usefulness and limits;
- evaluate the opportunity to perform an LCA to support business strategy and marketing;

- understand the complexity of LCA results as environmental profile with several environmental impact categories;
- know the benefits and the limits of LCA in general and in case of circular economy;
- understand the importance of life cycle approach in case of sustainability assessment.

## Contents of the course

The course will cover the following topics:

**Introduction to LCT and LCA**

1. Introduction to Life Cycle Thinking (LCT) and Life Cycle Assessment (LCA)
2. History of LCA and LCT
3. Need and benefits of an LCT approach for companies
4. Need and benefits of an LCT approach for the market
5. Need and benefits of an LCT approach for the public sector
6. Definition and approaches to sustainability
7. Examples: 17 Sustainable Development Goals, three pillars of sustainability
8. European policies related to Sustainability

**LCA principles and framework**

9. ISO standards for LCA: ISO 14040 and ISO 14044
10. Goal & scope of LCA
11. Life cycle Inventory and Life Cycle Impact Assessment
12. Interpretation of results and Critical Review process
13. Strengths and weaknesses/advantages and disadvantages/limitations of LCA

**LCA to support Environmental Labels**

14. Carbon footprint (climate change) and Water Footprint (water scarcity)
15. Ecological footprint (land use) and Ecological backpack / backpack (resource consumption)
16. EPD and PEF

**Life Cycle approach for sustainability assessment**

17. Social LCA (S-LCA)
18. Life Cycle Costing (LCC)
19. Life Cycle Sustainability Assessment (LCSA)
20. Examples of S-LCA, LCC, SLCA

**LCA for circular economy and for energy transition**

21. LCA to compare recycling options
22. LCA to support circular innovation
23. LCA in renewable energies
24. LCA to support technology innovation and CE

## Teaching Methodologies

Asynchronous on-line lectures, 4 nominal hours a week, 2 synchronous meetings with teachers. The course will offer:

- asynchronous online teaching lectures;
- individual learning activities (I.e. case study analysis);
- synchronous online meeting with teachers.

## References


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## Link with Agenda 2030

# Manager-level Module 2
# Key-descriptors

**MM2**

## Title

# Circular Economy (Business Models, Regulatory Framework, Certification)

**LECTURERS**

**Yvonne Beck, Antonia Loibl, Robin Barkhausen, Eleonora Di Maria**

**TAGS**

**Business models, strategy, regulation, certification**

## Details

**Preliminary requirements**

The module content requires participants to have a basic understanding of business organization and business strategies.

**Module description, including Knowledge & abilities to be achieved**

The module is organized into 4 sections:

1. an introduction to circular economy and sustainability;
2. business model description of the main characteristics and components;
3. business models in the circular economy framework focused on presenting and knowing the different circular business models a firm can adopt;
4. regulatory framework and certification to present the different regulations related to circular economy in terms of design and product management and certification schemes available.

Upon completion of the course, students will be able to:

- understand the importance of CE implementation for a sustainable development;
- identify the main characteristics of circular business models;
- use tools to write and analyze a business model
- know the basic elements of business model analysis and its application in different competitive contexts
- understand the basics of EU product regulatory frameworks and certification schemes.

## Contents of the course

The course will cover the following topics:

**Introduction**

- Introduction to Circular Economy and sustainability
- Basic strategies of a Circular Economy
- Motivations for a Circular Economy adoption: reduction of carbon emissions and overall ecological and social sustainability
- Circularity and material supply security

**Business models**

- General introduction to business models
- Business model canvas: characteristics and components
- Summary & reflection on sustainability, Circular Economy and business models

**Circular Business Models**

- Circular Business models (CBM) and innovation: introduction
- CBM and innovation: the role of collaboration
- Circular business model and circular suppliers
- CBM and circular suppliers: value chain analysis
- Circular business model and eco-efficiency
- CBM and eco-efficiency: measurements and technologies
- Circular business model: reuse
- Circular business model and servitization
- Circular business model: applications

**Regulatory framework and Certification**

- Ecodesign Directive and its evolution towards Circular Economy
- Ecodesign for Sustainable Products
- EU Battery Regulation as a frontrunner towards a Circular Economy
- Certification schemes
- Summary and reflection on regulatory framework and certification

**Summary of key concepts**

- Transfer of concepts to individual contexts

## Teaching Methodologies

Asynchronous on-line lectures, 4 nominal hours a week, 2 synchronous meetings with teachers. The course will offer:

- asynchronous online teaching lectures;
- individual learning activities (I.e. case study analysis);
- synchronous online meeting with teachers.

## References


- Peter Lacy, Jacob Rutqvist, Waste to Wealth: The Circular Economy Advantage. London: Palgrave Macmillan, 2015.
- https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/examples.
- https://ec.europa.eu/eurostat/web/circular-economy.
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