D10.2 Benchmark report on existing available Open Education Resources

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Author: Cristiano Vieira (ISQ)

Contributing Partners: All partners

Reviewers: Carmela Navarro (REVOLVE); Fracisco Verdugo (CARTIF)

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List of Acronyms

AI	Artificial Intelligence
AI/ML	Artificial Intelligence / Machine Learning
CBAM	Carbon Border Adjustment Mechanism
CE	Circular Economy
CIRPASS	European Project
CNC	Computer Numerical Control
CORDIS	EU Project Repository
CSRD	Corporate Sustainability Reporting Directive
D10.1	Deliverable 10.1
D10.2	Deliverable 10.2
DOI	Digital Object Identifier
DPP	Digital Product Passport
EAF	Electric Arc Furnace
ECESP	European Circular Economy Stakeholder Platform
EIP	Eco-Industrial Parks
EoW	End-of-Waste Statute / End-of-Waste
EQF	European Qualifications Framework
ESPR	Eco-design for Sustainable Products Regulation
GLP	Good Laboratory Practices
HADEA	European Health and Digital Executive Agency
HOP	Human and Organisational Performance
I4.0	Industry 4.0
IIC	Industrial Internet Consortium
IoT	Internet of Things
IS	Industrial Symbiosis
LCA	Life Cycle Assessment
LCCA	Life Cycle Cost Analysis
ML	Machine Learning
MNEs	Multinational Enterprises
MOOCs	Massive Open Online Courses
MSPs	Multi-Stakeholder Partnerships
NCA	National Competent Authorities
NMIS	National Manufacturing Institute Scotland
OER(s)	Open Educational Resource(s)
OEM	Original Equipment Manufacturing
SRM	Secondary Raw Materials
TP1	Training Pack 1
TP2	Training Pack 2

TP3	Training Pack 3
TP4	Training Pack 4
UL	Université de Lorraine
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organisation
VET	Vocational Education and Training
VDEh	Steel Institute VDEh
WRF	World Resources Forum

List of Tables

Keywords list

- 1. Skills Gaps
- 2. Open Educational Resources (OER)
- 3. Circular Economy,
- 4. Digital Product Passport
- 5. European Qualifications Framework

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Table of Contents

1. Executive summary

Deliverable 10.2 (D10.2) – Benchmark Report on existing Open Educational Resources (OER) is the main result of Task 10.2 of Work Package 10 (WP10) and aims to systematically identify, map and analyse the training resources already available and relevant to the needs of the ICARUS project. This deliverable plays a strategic role in WP10, ensuring that the subsequent development of the modular training packages in Task 10.3 is efficient, coherent and sustainable, avoiding duplication of efforts and consolidating the state of the art of existing knowledge.

The identification and selection of Open Educational Resources (OERs) was directly guided by the results of D10.1, which highlighted critical skills gaps, namely in the application of products in paving and hydraulic uses (74% perceived gap), in the regulatory framework of the End-of-Waste Statute (EoW, 63%) and in the Digital Product Passport (DPP) (53%). These domains constituted the main thematic axes of the analysis carried out.

The methodology adopted was based on desk research, covering online courses and MOOCs, specialised platforms (such as Steeluniversity and UNIDO Training Academy), scientific and technical publications (focusing on EQF levels 6–8) and the capitalisation of projects funded by the European Commission (e.g. SPIRE-SAIS, CIRPASS). The selection criteria ensured alignment with the gaps identified in T10.1 and coverage of all levels of the European Qualifications Framework (EQF 3–8).

The final inventory resulted in the identification of 490 Open Educational Resources, distributed across 45 online courses, 195 scientific and technical publications, 164 videos and multimedia resources and 86 platforms and repositories. The results demonstrate strong coverage in areas such as Digital Twin, AI/ML for industrial process optimisation and European Union regulation. In parallel, some limitations were identified, namely a predominant sectoral focus on the steel industry and construction materials, which may require additional adaptation and contextualization efforts in T10.3.

In summary, D10.2 establishes a robust evidence base that supports the targeted development of new ICARUS training resources, ensuring complementarity, relevance and alignment with the strategic priorities of the project and the European Union.

1.1. Objective of D10.2

The main objective of Deliverable D10.2 – Benchmark Report on existing OERs is to identify, map and analyse already available training resources that are relevant to the training needs defined within the scope of the ICARUS project.

This deliverable results from Task 10.2, led by ISQ, and constitutes a structuring element for the subsequent development of the project's modular training packages, ensuring an informed, coherent and efficient approach to the design of training content.

For the purposes of presentation and inclusion in the deliverable, the purpose of D10.2 covers the following central activities:

- Identification and compilation of existing resources - Gather and systematise a comprehensive inventory of existing training resources, capable of responding to ICARUS' training needs and supporting the development of the set of planned training packages.
- Review of internal and external sources - Conduct desk research aimed at analysing resources already existing in partner organisations, in line with their areas of expertise, as well as identifying and evaluating open educational resources available on external platforms, including, among others, MOOCs and public repositories of audiovisual content (for example, YouTube).
- Valuing relevant European projects - Give special focus to the capitalisation of projects financed by the European Commission, namely relevant initiatives in the context of ICARUS, through the collection of good practices, methodologies and lessons learned applicable to the development of training content.
- Support for the development of Training resources - Ensure that the inventory and analysis carried out within the scope of D10.2 directly feed Task 10.3, responsible for the design and development of modular online training resources, ensuring alignment with real needs and the existing state of the art.

In summary, Deliverable D10.2 helps the ICARUS project avoid duplication of efforts by identifying, organising and critically evaluating the training materials already available, promoting the efficiency, relevance and sustainability of new training packages to be developed within the scope of the project.

1.2. Framework of D10.2 and its strategic role for Task 10.3

D10.2 is one of the main results of WP10, whose overall objective is to design learning paths and skills development aligned with new processes, technologies and solutions developed within the scope of the ICARUS project, as well as providing modular online training packages adapted to different user profiles.

D10.2 results directly from Task 10.2, included in the design and preparation phase of the WP10 training content, and is linked sequentially with the remaining tasks of the work package:

- T10.1 (previous): Identification and characterisation of user groups, analysis of skills gaps and definition of learning paths, culminating in Deliverable D10.1.
- T10.2: Conducting desk research to identify, compile and analyse OER and other existing training materials relevant to ICARUS training needs.

- T10.3 (subsequent): Design, development and adaptation of modular online training resources, based on the results obtained in previous tasks, in D10.2.

The benchmark carried out within the scope of D10.2 plays a strategic role as a bridge between the identification of training needs (T10.1) and the effective development of training packages (T10.3). Its main contribution is to guarantee the relevance, efficiency and sustainability of the training resources to be developed, avoiding duplication of efforts and promoting the reuse of existing knowledge. In particular, D10.2 ensures:

- Systematic inventory and analysis of existing resources - The deliverable provides a structured inventory of existing training resources, aligned with ICARUS' training needs. This survey includes materials from partner organisations, analysed according to their areas of expertise, as well as open educational resources available on external platforms, such as MOOCs and public repositories of audiovisual content (e.g. YouTube).
- Capitalisation of relevant European projects - The benchmark pays special attention to the valorisation of projects financed by the European Commission, to identify good practices, methodological approaches and lessons learned that can be integrated into ICARUS. In this context, the experience of ISQ, leader of WP10, in previous European projects in the area of skills development stands out.
- Structuring basis for the development of modular content - The resources identified and analysed in D10.2 constitute the reference basis for Task 10.3, led by the Université de Lorraine (UL), responsible for the creation, adaptation and development of modular online training packages. The benchmark ensures that T10.3 starts from a consolidated state-of-the-art, incorporating and complementing previously validated materials, instead of developing content from scratch.
- Contribution to alignment with the EQF and user profiles - Although the framework in the European Qualifications Framework (EQF) is defined in T10.1, D10.2 contributes to mapping existing resources to qualification levels and different professional profiles (namely blue-collar and white-collar), supporting the modularisation of content and a learner-centred approach in T10.3.

In summary, Deliverable D10.2 constitutes the research and analysis step that establishes the basis for the development and implementation step of training resources in WP10. By providing a structured mapping of the state of the art in open educational resources, D10.2 allows the ICARUS project to build a training portfolio of high quality, relevance and impact, aligned with the objectives of the green and digital transition.

1.3. Relationship between D10.1 and D10.2

The relationship between the Deliverable D10.1 – Report on Skills Gaps of User Groups and Training Paths, the Deliverable D10.2 – Benchmark Report on existing Open Educational Resources, and the training needs identified within the scope of the ICARUS project is sequential, complementary and structured for the training strategy developed in WP10 – Skills Development and Standardisation.

D10.1 constitutes the analytical, pedagogical and strategic foundation of WP10 training activities. Its central objective is to identify, characterise and analyse target user groups and assess their skills gaps, establishing clear priorities for training intervention.

In particular, D10.1 identifies priority training needs, based on the application of a skills mapping questionnaire, to identify critical areas where there are significant deficits in knowledge and skills. Among the most relevant gaps are the application of products in paving and hydraulics, the End-of-Waste (EoW) status and the Digital Product Passport (DPP). D10.1 also seeks to define the architecture of the formations based on the gaps identified; the deliverable also establishes learning paths structured in modular training packages, differentiated by user profile and aligned with the European Qualifications Framework (EQF). In this way, D10.1 defines the contents, learning objectives and levels of complexity that the training resources must meet.

D10.2, the result of Task 10.2, focuses on the identification, compilation and analysis of existing training resources that can respond to the needs and training structure defined in D10.1, in such a way that it is directly dependent and aligned with the results of D10.1, which guide the research and selection criteria for resources.

D10.2 fulfils the function of benchmarking and mapping, with the main objective of carrying out a systematic benchmark and bringing together a structured inventory of existing training resources, capable of being reused, adapted or integrated into ICARUS training packages; as well as the review of relevant resources and capitalisation of European projects. The research conducted in D10.2 covers OER, including MOOCs and other materials available on public platforms, as well as the valorisation of projects funded by the European Commission, particularly relevant to the critical domains identified in D10.1, such as the Circular Economy and Industrial Symbiosis.

In summary, D10.1 and D10.2 operate in a relationship of functional interdependence in the ICARUS project training development cycle:

- D10.1 - Training Needs - D10.1 diagnoses skills gaps and defines the architecture and objectives of training packages (TP1 to TP4), establishing clear training priorities.
- Training Needs - D10.2 - The needs and Training Packs defined in D10.1 constitute the guiding basis for the identification, selection and analysis of existing resources carried out in D10.2.
- D10.2 thus provides the inventory of reference materials that will be used in Task 10.3 – Development of Modular Training Resources, ensuring that the online training resources to be developed respond in a direct, efficient and aligned way to the strategic priorities established by D10.1.

1.4. Main results of D10.1

Within the scope of T10.1, four main user profiles were identified and characterised, mapped according to their roles in the industrial ecosystem and the respective levels of the European Qualifications Framework (EQF). These profiles include factory operators and technicians (blue-collar), typically associated with EQF levels 3 to 5 and focused on the application of technologies and the operation of upcycling processes; engineers and technical managers (white-collar), mostly at EQF levels 6 to 7, with responsibilities in terms of modelling, process optimization and digitalization; researchers and trainers, also white-collar, with EQF levels between 6 and 8, focused on regulatory validation, standardization and systemic innovation; and political decision-makers and representatives of associations, also included in EQF levels 6 to 8, focusing on environmental regulation, business models and intersectoral cooperation.

The analysis of skills gaps, based on the responses of 19 participants to the applied survey, revealed that the most critical training needs are concentrated in technical, regulatory and digital areas, essential for the valorisation of secondary materials

and for the achievement of the green and digital transition. In particular, significant gaps in knowledge about product applications in paving, embankments and hydraulic uses stand out, associated with a perceived gap of 74%; in the field of standardization and regulation, particularly about the End-of-Waste (EoW) status, with a perceived gap of 63%; in process optimization and quality assurance, including monitoring environmental performance through leaching tests and modelling of steel slag, also with a gap of 63%; and, finally, in digital skills, with particular emphasis on the Digital Product Passport (DPP), with an identified gap of 53%.

Based on these results, D10.1 defined four Modular Training Packs, designed to respond differently to the needs of various user profiles. The first package (TP1), aimed at EQF levels 3 to 5, focuses on operational proficiency, energy efficiency and the implementation of technologies in industrial contexts, responding to the needs of blue-collar profiles. The second package (TP2), aimed at EQF levels 6 to 7, focuses on integrated resource management, the digitalisation of processes and the use of technologies such as DPP, artificial intelligence, machine learning and IoT. The third package (TP3), aimed at EQF levels 6 to 8, addresses topics of standardisation, certification and systemic innovation, focusing particularly on critical gaps related to product applications, EoW status and environmental validation. Finally, the fourth package (TP4), also for EQF levels 6 to 8, focuses on public policies, environmental regulation, communication and business models for the circular economy.

The results of T10.1 establish the strategic and pedagogical framework that directly guides the OER desk research within the scope of T10.2. Therefore, D10.2 is explicitly based on the training needs, user profiles and structure of Training Packs defined in D10.1.

Firstly, the selection of OERs is guided by thematic relevance, privileging resources that address the competence domains associated with the most critical gaps identified. This includes, as a priority, resources related to applications of upcycled products in construction, paving, landfills and hydraulic uses; content on regulatory compliance, including End-of-Waste status, certification and leach testing; and materials dedicated to advanced digitalisation, namely the Digital Product Passport (DPP) and the application of emerging digital technologies in industrial processes.

Second, the resources identified in D10.2 are analysed and classified according to their alignment with the EQF levels and user profiles defined in D10.1. Resources of a more operational and practical nature are mapped to the requirements of TP1, while materials of a more analytical, regulatory or strategic nature are associated with TP2, TP3 and TP4, ensuring an adequate match between the complexity of the content and the level of qualification.

Finally, the selection of OERs considers alignment with the learning outcomes defined for each training package. The resources must contribute in a concrete way to the development of the skills foreseen in the different modules, including, for example, the ability to use modelling tools to optimise the use value of steel slag, as foreseen in the modules associated with TP2.

This methodological connection ensures that the inventory of OERs presented in D10.2 is not limited to a descriptive listing of resources but constitutes a structured evidence-based approach guided by real needs, which will support the efficient and targeted development of the modular training resources in Task 10.3, complementing existing knowledge and closing the most critical skills gaps identified in the ICARUS project.

1.5. Scope and limitations of D10.2

The scope and limitations of Deliverable D10.2 are defined by the need to identify, analyse and inventory training materials that directly respond to the skills gaps identified in Deliverable D10.1, and that support the development of modular training packages (Training Packs) provided for under Work Package 10 (WP10).

D10.2 thus assumes an instrumental function, providing a structured reference base for the subsequent Task 10.3, responsible for creating and adapting online training resources.

The scope of D10.2 is deliberately broad, covering a diversity of OER formats available online, considered relevant for the development of training content. The inventory includes, in particular:

- Online courses and e-learning content, such as structured, free-to-access courses and modules, are provided by universities, specialised industrial platforms (e.g. Steeluniversity) and international organisations, including the UNIDO Training Academy and the World Bank Group.
- Academic and technical publications, including scientific articles and research reports focusing on methodologies, technologies and regulatory framework, identified by DOI and predominantly aimed at EQF qualification levels 6 to 8.
- Practical guides, tools and project reports, covering benchmarking documents, resource efficiency toolkits, guides on Industrial Symbiosis and final reports on projects funded by the European Union.
- Multimedia resources, such as videos, podcasts and technical and thematic tutorials, made available on public platforms, including YouTube, and focused on technical, regulatory and management aspects.
- Platforms and knowledge repositories, including websites and platforms specialising in European Union policies, the Circular Economy and Secondary Raw Materials, such as the EU Academy and the Ellen MacArthur Foundation.

The sectoral, thematic and geographic scope of the benchmark is determined by the strategic priorities of the ICARUS project, with a particular focus on the valorisation of secondary materials from process industries.

Regarding sectors and themes, the resources analysed cover the main areas associated with the skills gaps identified in D10.1, including the Circular Economy and Secondary Raw Materials, with special attention to the recovery of industrial waste, such as ash and steel slag; relevant European regulations, with emphasis on the End-of-Waste criteria, the Digital Product Passport (DPP), Ecodesign and the Carbon Border Adjustment Mechanism (CBAM); industrial digitalization, including applications of Artificial Intelligence, Machine Learning and Internet of Things in the context of Industry 4.0; assessment methodologies, such as Life Cycle Assessment (LCA) and Life Cycle Costing (LCC); and practices and methodologies associated with Industrial Symbiosis.

Regarding the geographic dimension and the platforms of origin, although many of the resources analysed have a global scope, coming from international organisations such as UNIDO and the World Bank Group, the benchmark gives priority to European initiatives and resources resulting from projects co-financed by the European Union. In this context, particular attention is paid to the capitalisation of relevant European projects.

Regarding languages, the resources identified and analysed in D10.2 are all available in English, reflecting common practice in the technical-scientific and regulatory domains covered.

The ICARUS project framework does not define an explicit time limit for Open Educational Resources research (e.g., restrictions to the last five or ten years). However, the approach adopted in D10.2 clearly prioritises the recency and timeliness of content, particularly in the areas of digitalisation and European regulation, which are characterised by rapid evolution. In this sense, the inventory includes a significant number of academic publications and resources developed in 2024 and 2025.

In parallel, D10.2 also contemplates the valorisation of already completed European projects, which implies the inclusion of resources developed in previous periods. These resources are considered relevant if their content remains technically valid, methodologically sound and applicable to the current training needs of the ICARUS project.

In short, the scope and limitations of D10.2 reflect a balanced approach between thematic coverage, strategic focus and timeliness, ensuring that the OER inventory constitutes a solid, relevant and reusable basis for the development of modular training resources under Task 10.3.

2. Introduction

Deliverable 10.2 (D10.2), entitled Benchmark report on existing available Open Education Resources, constitutes the main result of Task 10.2 (T10.2) of Work Package 10 (WP10) of the ICARUS project. Its objective is to systematically identify, map and analyse the training resources already available that are relevant to the needs of the project. This deliverable plays a strategic role in WP10, by establishing a consolidated knowledge base that ensures that the subsequent development of the modular training packages in Task 10.3 (T10.3) is efficient, coherent and sustainable, avoiding duplication of efforts and promoting the reuse of validated knowledge.

The identification and selection of OER were directly guided by the results of Deliverable D10.1, which identified and characterised critical skills gaps for different groups of ICARUS users. The research, therefore, focused on the thematic domains associated with the greatest knowledge gaps, in particular, the application of products in paving and hydraulic uses (74% of perceived gap), the regulatory framework of the End-of-Waste Statute (EoW, 63%) and the Digital Product Passport (DPP, 53%). The selection criteria ensured coverage of all levels of the European Qualifications Framework (EQF 3–8), allowing resources to be aligned with both operational profiles (blue-collar) and technical and strategic profiles (white-collar), as defined in D10.1.

The methodology adopted was based on desk research, which included the analysis of online courses (MOOCs) and specialised platforms (such as Steeluniversity and UNIDO Training Academy), scientific publications with DOI — with a special focus on EQF levels 6–8 — and the capitalisation of projects funded by the European Commission, including initiatives such as SPIRE-SAIS and CIRPASS. This process resulted in the identification of 490 Open Educational Resources, covering courses, technical publications, videos and specialised repositories. By providing this structured inventory and related review, D10.2 establishes the evidence base that will support the targeted development of new training resources in T10.3.

3. Methodology

The preparation of D10.2 was based on a systematic desk research methodology, designed to ensure the identification, analysis and inventory of relevant, reliable training resources aligned with the needs of the ICARUS project.

The methodological approach adopted was structured to ensure coherence with the results of Deliverable D10.1, particularly concerning the skills gaps identified and the modular training paths defined within the scope of WP10.

The information collection strategy combined two complementary methodological dimensions: (i) systematic document analysis (desk research), and (ii) directed exploration of training platforms. This combination made it possible to simultaneously ensure coverage, thematic relevance and technical depth in the OER inventory.

Desk research constituted the central axis of Task 10.2, and its main objective was to create a structured inventory of existing training resources capable of being reused or adapted in the development of ICARUS training packages.

The document analysis was conducted systematically and focused on different categories of sources:

Firstly, academic and technical literature was reviewed, including scientific articles, technical reports and specialised publications, identified through Digital Object Identifiers (DOI). These resources, mostly falling within EQF levels 6 to 8, address advanced methodologies and technologies relevant to the project, such as Life Cycle Assessment (LCA), Life Cycle Costing (LCC), process modelling and optimization using Artificial Intelligence and Machine Learning, as well as the characterization and valorisation of secondary materials (for example, steel slag and ceramic waste).

In parallel, a targeted analysis of e-learning platforms and MOOCs was carried out, with the aim of identifying open, structured and reusable courses and training modules. The platforms analysed include, among others, Steeluniversity, UNIDO Training Academy and EU Academy, considered particularly relevant for providing modular, flexible training aligned with the needs of different user profiles.

Additionally, specific attention was dedicated to valuing projects financed by the European Commission, as a privileged source of validated knowledge, good practices and lessons learned. The inventory includes resources from relevant European projects, such as SPIRE-SAIS, INSIGHT, CIRPASS, Ecosign Project and REPAiR, ensuring the integration of content aligned with European policies and priorities.

The selection and analysis of OERs under D10.2 were explicitly guided by the results of Deliverable D10.1, ensuring methodological coherence and strategic alignment.

In thematic terms, the collection of resources focused on areas associated with the largest skills gaps identified, with emphasis on the End-of-Waste (EoW) status, the Digital Product Passport (DPP) and the main vectors of the green and digital transition, including sustainability, energy efficiency and the application of digital technologies (AI, ML and IoT) for the optimization of industrial processes.

Additionally, the identified resources were mapped by levels of the European Qualifications Framework (EQF), allowing them to be adapted to the different user profiles (blue-collar and white-collar) defined in D10.1. This mapping ensures that the selected resources can be effectively integrated into the modular training packages to be developed in Task 10.3.

In summary, the methodology applied in D10.2 combines rigorous document analysis with the capitalisation of the consortium's specialised knowledge, ensuring that the Open Educational Resources inventory is simultaneously comprehensive, technically robust and aligned with the real training needs of the ICARUS project. This methodological approach ensures that the subsequent development of the modular Training Packs in Task 10.3 is based on solid evidence, promoting efficiency, quality and impact of the training resources to be developed.

3.1. Sources of information and types of resources analysed

D10.2 is based on a structured desk research methodology, aiming to identify and analyse relevant OERs to fill the skills gaps identified in D10.1 and support the development of WP10 Training Packs. The analysed sources were organised into methodological categories, according to their nature, level of maturity and relevance to the objectives of the ICARUS project.

Open OER platforms and training academies

Online learning platforms that provide structured, modular and open access courses, often aligned with the levels of the European Qualifications Framework (EQF 3–8), were analysed. Highlights include Steeluniversity, with specialised courses in steel manufacturing, sustainability and Industry 4.0; the UNIDO Training Academy, with modules on eco-industrial parks, industrial digitalisation and good laboratory practices; and the EU Academy, as the European Union's official platform for sustainability skills (GreenComp) and Science for Policy.

Additionally, e-learning modules from the European Commission were considered, namely on the Carbon Border Adjustment Mechanism (CBAM), as well as resources from other relevant platforms, such as the World Bank Group, the Open University – OpenLearn and Skills4Planet, with introductory content on Industrial Symbiosis.

Thematic repositories and reference organisations

This category includes websites and platforms from international and European organisations that produce policy guidance, technical guides, data and benchmarking studies on Circular Economy (CE) and Secondary Raw Materials (SRM). Resources from the Ellen MacArthur Foundation, the European Circular Economy Stakeholder Platform (ECESP) and standardisation and certification bodies, such as GS1 and RILEM, were analysed, among others.

Methodological resources in sustainability and impact assessment were also considered, including the Life Cycle Initiative (UNEP), the Ecoinvent database and the World Resources Forum (WRF), as well as sectoral and regulatory information from the European Environment Agency (EEA) and technical entities specialised in steel slag.

Projects financed by the European Union

A central component of the benchmark focused on resources produced by projects funded by the European Union, considered particularly relevant as they address technical, regulatory and digital challenges aligned with ICARUS priorities. Projects in the field of Industrial Symbiosis and resource efficiency were analysed (e.g. SPIRE-SAIS, INSIGHT, SCALER, ReWaise), as well as

projects focused on regulation, traceability and Digital Product Passport (DPP), including CIRPASS and initiatives related to Eco-design for Sustainable Products Regulation (ESPR).

Additionally, sustainable construction and waste upcycling projects (such as CINDERELA, ICEBERG, REPAiR and AshCycle) were considered, as well as multimedia resources from projects such as the Ecosign Project. CORDIS was used as a transversal repository to identify relevant deliverables and technical reports.

Scientific and technical publications

Finally, the benchmark included scientific and technical publications with a DOI, mostly aimed at EQF levels 6–8, which address advanced skills gaps. These include studies on the valorisation and upcycling of industrial waste (namely steel slag), End-of-Waste (EoW) regulatory frameworks, applications of Artificial Intelligence and Machine Learning in the optimisation of industrial processes, Digital Product Passport, as well as Life Cycle Assessment (LCA), Life Cycle Costing (LCC) and leaching assessment methodologies.

3.2. Selection and evaluation criteria for OERs

The selection and evaluation of OERs under D10.2 followed explicit criteria, ensuring that the resource inventory is directly relevant, usable, and aligned with the strategic needs of the ICARUS project, particularly in relation to the development of Training Packs in Task 10.3.

Relevance to skills gaps

The main criterion was the thematic alignment of resources with the skills gaps and training priorities identified in D10.1. REAs that address:

- Secondary Materials Applications (SRM), including paving, landfills, hydraulic uses and optimisation of formulations with steel slag, ash and ceramic waste.
- Regulation and compliance, including the End-of-Waste (EoW) Charter, leach testing and environmental requirements.
- Industrial digitalisation, focusing on Digital Product Passport (DPP), Digital Twin, Artificial Intelligence (AI) and Machine Learning (ML) applied to process optimisation.
- Each resource was mapped to one or more training modules (M1–M5) and respective Training Packs (TP1–TP4).

Adequacy to the technical and professional level (EQF 3–8)

The resources were evaluated for their suitability for the WP10 target audience (blue-collar and white-collar), with explicit classification by EQF level, recorded in the inventory:

- EQF 3–5 (operational) - practical guides, introductory content on sustainability, energy efficiency and basic skills.
- EQF 6–8 (specialisation/advanced) - scientific publications, advanced modelling, simulation, digitalisation and regulatory framework courses.

Accessibility and format

To facilitate integration into online modular Training Packs, only resources were considered:

- Free and online access, preferably classified as OER.
- Available in modular formats, such as short courses, videos and tutorials, or deliverables and technical project reports.

Source quality and credibility

Pedagogical and technical quality was ensured through the selection of resources from recognised sources, including:

- Academic and research institutions.
- European and international organisations.
- Industrial associations and sectoral reference platforms.

Current affairs and alignment with EU policies

Priority was given to resources developed in the context of European Union-funded projects, ensuring alignment with current EU policies and strategies. Content reflects the latest regulatory framework, including CBAM and Digital Product Passport, as well as recent scientific publications and policy documents (2024–2025), ensuring the inventory is current and relevant.

OER mapping results

The desk research resulted in the identification of a total of 490 OERs, organised into four main categories, as shown in Table 1.

Table 1. OERs inventoried

Category	Number of Resources	Main Thematic Focus
Online Courses and E-learning	45	Steel manufacturing, sustainability in EAF, Digital Twin, Industry 4.0, Industrial Symbiosis and EU regulation (e.g. CBAM).
Scientific and Technical Publications	195	EQF 6–8 level content on steel slag upcycling, End-of-Waste criteria, LCA/LCC and process optimisation.
Videos and Multimedia Resources	164	Tutorials and lectures on Ecodesign, Industrial Symbiosis, DPP and leaching assessment.
Platforms and Repositories	86	Institutional and sectoral sources (e.g. Ellen MacArthur Foundation, ECESP, EIT Raw Materials, CORDIS, RILEM) with policies, guides and data on Circular Economy and SRM.
Total OERs inventoried: 490.		

This inventory forms the primary knowledge base for Task 10.3, allowing the development of modular training resources to be efficient, targeted, and complementary to existing materials. In this way, D10.2 helps to avoid duplication of efforts and ensures that new content accurately responds to the skills gaps identified in the ICARUS project.

4. Consolidated List of OERs

The following tables (tables 2-5) present the inventory of OER identified within the scope of Task 10.2, constituting a structured mapping of free training offers relevant to the objectives of Work Package 10 (WP10). This inventory provides the reference basis for the development of modular Training Packages in the subsequent task (Task 10.3), ensuring coherence, complementarity and avoiding duplication of existing content.

The selection of resources was guided by the project's priority skills gaps, in alignment with the European Union's priorities for the digital and green transition. Areas such as Industrial Digitalisation and Industry 4.0, Sustainability and Decarbonization of Industry (including energy efficiency, industrial symbiosis, circular economy and remanufacturing) and EU Regulation were prioritised, with emphasis on instruments such as CBAM, CSRD and the European GreenComp competence framework.

The inventoried resources cover EQF levels 3–8, ensuring suitability for different professional profiles, from technical and operational functions to advanced levels of specialisation and decision-making. Tables include: Online Courses and E-learning; Scientific and Technical Publications; Videos and Multimedia Resources and Platforms, and Repositories.

This mapping makes it possible to identify content already available and highlight specific gaps where the development of new materials in WP10 could generate greater added value, contributing to the efficient use of project resources and maximising its impact, in line with the principles of Horizon Europe.

4.1. Online Courses and E-learning

Table 2. Online courses and E-learning

Title	Summary	Topic	Time	Modality	EQF	Link	Source	Price	Created by	European Project
MAN0110 – 3D Printing – Additive manufacturing with steel	During this course, you will be introduced to 3D printing with steel, also called additive manufacturing. Starting from what is additive manufacturing? Later the different technologies and possible printing materials with special focus on metal. After that, different applications of this technology will be presented from prototyping up to production developments. Finally, the challenges and possible innovations that the lecture is facing during the research and development.	Steel Manufacturing	1 hour	Online	6-8	https://steeluniversity.org/courses/man0110-3d-printing-additive-manufacturing-with-steel/	Steelunivers ity	Free	Steel institute VDEh	No
MAN0201 – Industry 4.0 as enabler to realise a Smart Steel Industry	The presentation will give an overview of what Industry 4.0 means specifically for the steel industry. Starting from the technical core “Cyber-Physical System”, the various aspects of Industry 4.0 will be presented: (1.) horizontal and (2.) vertical integration, (3.) end-to-end engineering and the (4.) human being as conductor of value chain. Then Industry 4.0 is interpreted especially for the steel industry and described along the steel production route. After units on the topics “Digital Twin” and “Big/Smart Data”, the lecture concludes with practical examples of Industry 4.0 in the steel industry.	Steel Manufacturing	1 hour	Online	6-8	https://steeluniversity.org/courses/man0201-industry-4-0-as-enabler-to-realise-a-smart-steel-industry/	Steelunivers ity	Free	Steel institute VDEh	No
MAN0202 – Digitalization towards the learning steel plant	The challenge that the steel industry is facing are from different aspects like process, efficiency, sustainability and market. One of the key points of this is to convert information into value. The lecture of Bernhard Steenken, CEO of SMS digital GmbH, will present an overview of digitalization for the steel industry. From the technology to automation and digitalization passing for the new standard for the future automatic control and remote operation up to Digital Twins always turning data into value.	Steel Manufacturing	1 hour	Online	6-8	https://steeluniversity.org/courses/man0202-digitalization-towards-the-learning-steel-plant/	Steelunivers ity	Free	Steel institute VDEh	No

Title	Summary	Topic	Time	Modality	EQF	Link	Source	Price	Created by	European Project
MAN2502 – Modelling and simulation – From microstructure to component performance	Digitalization is not only changing the production but also the Research and development. In this context, the modelling and simulation of complex systems can replace expensive experiments. Therefore, for example, in the field of mechanical engineering and automotive development, modelling and simulation is a huge field of possibilities.	Steel Manufacturing	1 hour	Online	6-8	https://steeluniversity.org/courses/man2502-modelling-and-simulation-from-microstructure-to-component-performance/	Steeluniversity	Free	Steel Institute VDEh	No
MAN0501 – Introduction to Computer Numerical Control	Computer Numerical Control (CNC) Machining is the process through which computers control machine-based processes in manufacturing. The kinds of machines controlled include lathes, mills, routers and grinders – all used for the manufacturing of metal and plastic products. In this course, you'll learn the ins-and-outs of CNC machining, building the essential knowledge to develop and operate a project with a CNC machine.	Steel Applications	4-8 hours	Online	6-8	https://steeluniversity.org/courses/man0501-introduction-to-computer-numerical-control/	Steeluniversity	Free	Tenaris University	No
MET01002 – Introduction to Steel	Introduction to Steel is a journey with Professor Mark Miodownik through the different aspects of steel. At first, Mark will explain the basics of how to turn rock into steel. At the end of this section, you will see an experiment about steelmaking. After that, the professor will explain the microstructure of steel and its properties. Then he explains steel alloys and associates different compositions of steel with mechanical properties. Finally, he introduces current and future applications of steel.	Steel Applications	3 hours	Online	3-8	https://steeluniversity.org/courses/met01002-introduction-to-steel/	Steeluniversity	Free	Tenaris University	No
MET01012 – Thermodynamics & Kinetics	The thermodynamics and kinetics module is part of the ferrous metallurgy course. This module explores the thermodynamics and kinetics behind the removal of carbon, oxygen, sulfur, hydrogen, nitrogen and phosphorus from steel, which are essential to the production of steels tailored to the demands of the consumer or specific applications. Topics covered include: Deoxidation, Decarburisation, Desulfurisation, Dephosporisation, Hydrogen removal, and Nitrogen removal.	Steel Metallurgy	2 hours	Online	6-8	https://steeluniversity.org/courses/met01012-thermodynamics-kinetics/	Steeluniversity	Free	Steeluniversity	No
SAF0201 – Hydrogen Safety workshop	Provide basic safety information about hydrogen and generate a common platform to discuss local hydrogen safety challenges and concerns.	Steel Safety	2,5 hours	Online	3-8	https://steeluniversity.org/courses/saf0201-hydrogen-safety-workshop/	Steeluniversity	Free	World Steel Association	No

Title	Summary	Topic	Time	Modality	EQF	Link	Source	Price	Created by	European Project
SAF0503WS – Human and Organisational Performance	This course is an Introduction to Human and Organisational Performance (HOP) Concepts. HOP is designed to reveal truths about human behaviour and system design that have historically remained unseen in the operational world. The class uses storytelling, behavioural science research and real-life examples to challenge assumptions and create new paradigms. This "new view" helps us manage and create resilience in a complex system.	Steel Safety	3 hours	Online	3-8	https://steeluniversity.org/courses/saf0503ws-human-and-organizational-performance/	Steeluniversity	Free	World Steel Association	No
SUS0103AA – Sustainability in EAF steelmaking	Sustainability is a topic on everyone's lips these days. Everyone is talking about decarbonising the steel industry, but this does not stop at ironmaking; even so, this process at the moment is accountable for the biggest share of CO2 emissions in the steel industry. Sustainability covers more aspects than just the CO2 emissions of a process. But what does it mean for EAF steelmaking?	Sustainability	1,5 hours	Online	3-8	https://steeluniversity.org/courses/sus0103aa-sustainability-in-eaf-steelmaking/	Steeluniversity	Free	RWTH Aachen University	No
SUS0203 – Climate Change Fundamentals	Do you know the difference between global warming and climate change? How about the causes or the impacts of it today and in the future? Some of these terms and concepts are talked about so often in today's world, but we don't stop to check we understand what they mean!	Sustainability	35 minutes	Online	3-8	https://steeluniversity.org/courses/sus0203-climate-change-fundamentals/	Steeluniversity	Free	Green Steel Academy	No
STK0145 – Sustainable EAF Steelmaking	Sustainability and the reduction of fossil CO2 emissions are very important topics these days. Everyone is talking about decarbonising the steel industry. However, sustainability covers more aspects than just the CO2 emissions of a process. But what does it mean for EAF steelmaking and its future? To answer the question, this course will touch upon topics like energy efficiency, resource efficiency and carbon footprint of EAF steelmaking. The concepts will be defined und factors influencing the sustainability will be discussed. Finally, options to increase the sustainability of EAF steelmaking and future steelmaking concepts, including the EAF like fossil carbon substitutes, energy efficiency improvements, and circular economy approaches, will be discussed.	Sustainability	1 hour	Online	3-8	https://steeluniversity.org/courses/stk0145-sustainable-eaf-steelmaking/	Steeluniversity	Free	RWTH Aachen University	No

Title	Summary	Topic	Time	Modality	EQF	Link	Source	Price	Created by	European Project
MAN0105AA – Advanced Model of Electric Arc Furnace	As one of the most important components in modern steelmaking, the EAF plays a crucial role in the production of high-quality steel. However, operating an EAF can be complex and challenging due to the numerous variables that affect its performance. To master the art of EAF operation, steelmakers need to develop a deep understanding of the furnace's mechanics, its electrical and thermal characteristics, and the complex interactions between different variables.	Steel Manufacturing	3 hours	Online	6-8	https://steeluniversity.org/courses/man0105aa-advance-eaf-simulation/	Steeluniversity	Free	RWTH Aachen University	No
SUS0210 – Energy efficiency	Energy-intensive industries face significant challenges in improving energy efficiency due to high energy consumption and the continuous need for process optimisation. These challenges include outdated technology, energy loss, and difficulty integrating renewable energy sources. This course provides a comprehensive overview of the problems related to energy efficiency, emphasising its importance, benefits, and practical implementation in various industries such as cement, ceramics, water, minerals, and steel.	Sustainability	3 hours	Online	3-8	https://steeluniversity.org/courses/sus0210-energy-efficiency/	Steeluniversity	Free	Spire Sais	Yes
SUS0310 – Industrial Symbiosis	Welcome to the Industrial Symbiosis course, where you will embark on a comprehensive journey to explore the principles and practices of sustainable industrial collaboration. This course is designed to provide you with an in-depth understanding of how different industries can work together to achieve greater resource efficiency, reduce waste, and promote environmental sustainability. By integrating knowledge from various sectors, you will learn how industrial symbiosis can be a powerful tool for fostering innovation and creating a more sustainable future.	Sustainability	3 hours	Online	3-8	https://steeluniversity.org/courses/sus0310-industrial-symbiosis/	Steeluniversity	Free	Spire Sais	Yes
GreenComp - Let's learn together	In this podcast entitled "Let's learn together, we talk about the European Sustainability Competence Framework (or GreenComp). The idea is to share knowledge and experience around the four competence areas of GreenComp, focusing on what they are and entail, and how to use the Framework in learning communities. Listen to the episodes! We publish one every week. This podcast is hosted by the GreenComp community. To learn about community activities, and to engage with community members around the European Sustainability Competence Framework and this podcast: join the GreenComp community.	Sustainability	1 hour	Online	3-5	https://academy.europa.eu/courses/greencomp-let-s-learn-together/view/	EU Academy	Free	European Union	Yes

Title	Summary	Topic	Time	Modality	EQF	Link	Source	Price	Created by	European Project
Fundamentals of Energy Efficiency	This course provides an introduction to demand-side Energy Efficiency (EE) and its role in sustainable development. Participants will examine the drivers, barriers, and processes that shape EE implementation. They will also gain a solid understanding of the EE project cycle for planning and executing impactful initiatives.	Sustainability	1 hour	Online	3-5	https://academy.worldbank.org/en/infrastructure/energy/fundamentals-of-energy-efficiency	World Bank Group	Free	World Bank Group	No
Energy Efficiency Lesson Pack	A lesson pack that covers the following: Define energy efficiency. Describe energy efficiency in terms of input and output of energy. Calculate the energy efficiency of household products. Draw Sankey diagrams to represent energy efficiency. Includes a presentation and worksheets for your students to complete.	Sustainability	1 hour	Online	3-5	https://www.twinkl.com/resource/energy-efficiency-lesson-pack-au-sc-1709520910	Twinkl	Free	Twinkl	No
Energy Efficiency Checklist for Schools	Our ACES Energy Efficiency Checklist is a helpful tool for schools. Find out how much energy your school is using, and spot areas where you can reduce costs and cut carbon emissions.	Sustainability	1 hour	Online	3-5	https://ace-schools.org/resource/schools-energy-efficiency-checklist/	ACES	Free	ACES	No
Energy Literacy: Essential Principles for Energy Education	WHAT IS ENERGY LITERACY? - Energy Literacy is an understanding of the nature and role of energy in the world and daily lives, accompanied by the ability to apply this understanding to answer questions and solve problems.	Sustainability	1 hour	Online	3-5	https://ocm.iccrom.org/documents/energy-literacy-essential-principles-energy-education	ICCROM	Free	ICCROM	No
INSIGHT - Industrial Symbiosis Facilitator Training - Online	To develop the Industrial Symbiosis Facilitator professional profile, the INSIGHT partners designed a dedicated training curriculum. Built taking into consideration the European Framework for Vocational Education and Training (VET), the training course is composed of five modules divided into several training units. Learning outcomes in terms of knowledge, skills, and competencies are associated with each unit. ECVET points are allocated to these learning units based on time and relevance. The INSIGHT curriculum has a duration of 150 hours, corresponding to a total of 6 ECVET points.	Sustainability	150 hours	Online	3-6	https://epale.ec.europa.eu/en/resource-centre/content/insight-industrial-symbiosis-facilitator-training-online	INSIGHT	Free	INSIGHT	Yes
CBAM – Introduction (nano-learning)	We're thrilled to announce the release of our brand-new e-Learning opportunities on the Carbon Border Adjustment Mechanism (CBAM), the instrument implemented by the European Union to address carbon leakage.	Sustainability	1 hour	Online	3-8	https://customs-taxation.learning.europa.eu/local/mvpdgtaxud/pages/news/view.php?key=64	European Commission	Free	European Commission	Yes

Title	Summary	Topic	Time	Modality	EQF	Link	Source	Price	Created by	European Project
Carbon Border Adjustment Mechanism (CBAM): Aluminium sector	The Carbon Border Adjustment Mechanism (CBAM) is an instrument implemented by the European Union to reduce greenhouse gas emissions and address carbon leakage. It aims to ensure that imported goods are subject to a carbon price equivalent to the carbon price of domestic production in the EU. CBAM affects the aluminium sector by putting a price on emissions associated with aluminium produced in countries outside the EU, with the goal of encouraging sustainable practices and reducing carbon footprint.	Sustainability	1 hour	Online	3-8	https://customs-taxation.learning.europa.eu/course/view.php?id=803&section=1	European Commission	Free	European Commission	Yes
Carbon Border Adjustment Mechanism (CBAM): National Competent Authorities	The Carbon Border Adjustment Mechanism (CBAM) is an instrument implemented by the European Union to reduce greenhouse gas emissions and address carbon leakage. It aims to ensure that imported goods are subject to a carbon price equivalent to the carbon price of domestic production in the EU. This eLearning course on CBAM for the EU Member States' National Competent Authorities (NCA) and customs authorities offers a comprehensive exploration of the Carbon Border Adjustment Mechanism (CBAM) specifically for the authorities that will implement the CBAM.	Sustainability	1 hour	Online	3-8	https://customs-taxation.learning.europa.eu/course/view.php?id=861	European Commission	Free	European Commission	Yes
Eco-Industrial Parks (Introduction)	This UNIDO Eco-Industrial Parks (EIP) training is designed to create a common understanding of eco-industrial parks, aligned with the International Framework for Eco-Industrial Parks developed by UNIDO, GIZ and the World Bank. In taking this course, participants will learn about key resources and tools available to support the identification, development, and implementation of EIP approaches in industrial parks in order to understand and learn about the opportunities, challenges and success factors for the mainstreaming of EIPs in their countries.	Sustainability	7 hours	Online	3-8	https://hub.unido.org/training-modules-eco-Industrial-parks	UNIDO Training Academy	Free	UNIDO Training Academy	No

Title	Summary	Topic	Time	Modality	EQF	Link	Source	Price	Created by	European Project
Industry 4.0	The accelerated and widespread expansion of digital technologies across business and society has resulted in the emergence of the Fourth Industrial Revolution (4IR), also known as Industry 4.0 (I4.0). While the 4IR describes a technologically-driven paradigm change that affects all spheres of life, Industry 4.0 represents the economic point of view, focusing on industry, manufacturing and the fact that major technological advancements are revolutionising industrial production. Industry 4.0 will affect all sectors and disciplines, bringing about a structural transformation in the global economy and leading to a new division of labour, which will have a huge impact on developing countries. Current production systems and global value chains will become more dynamic, flexible, efficient and sustainable, with high possibilities for customisation and personalisation. Industry 4.0 has the potential to contribute to increased resource efficiency and help to achieve environmental sustainability.	Innovation/Sustainability	6 hours	Online	3-8	https://hub.unido.org/training-modules-industry-4	UNIDO Training Academy	Free	UNIDO Training Academy	No
International Business Alliances	The globalisation of markets is characterised by an aggressive competitive environment and a development scenario of continuing and accelerated technological innovation and change that can generate disruptions anytime, anywhere. The main players in this context are, on the one hand, the multinational enterprises (MNEs) and their evolving internationalization strategies; and on the other hand, governments and enterprises of developing countries, who aim at technological progress, economic growth and social development by taking advantage of foreign direct investment and other forms of association to MNEs operations such as sub-contracting, original equipment manufacturing (OEM), participation in global supply chains and value chains (GSCs, GVCs), global manufacturing networks (GMNs), joint ventures (JVs) and other kinds of business alliances.	Innovation/Sustainability	4 hours	Online	6-8	https://hub.unido.org/training-modules-international-alliances	UNIDO Training Academy	Free	UNIDO Training Academy	No

Title	Summary	Topic	Time	Modality	EQF	Link	Source	Price	Created by	European Project
OECD Good Laboratory Practices	This course is your gateway to understanding the fundamentals and applications of OECD Good Laboratory Practices (GLP). Through a structured and engaging approach, you will explore the key principles that form the foundation of GLP, gaining insights into their practical implementation in laboratories and testing facilities. Beyond the technical aspects, the course emphasises the significance of non-clinical safety studies in the regulatory approval process for substances and products, while also highlighting their broader impact on safeguarding health and the environment. Designed to accommodate learners of all levels, this course offers valuable knowledge whether you're starting your journey with GLP or seeking to refine your expertise.	Quality & Standards	10 hours	Online	3-8	https://hub.unido.org/node/12446	UNIDO Training Academy	Free	UNIDO Training Academy	No
Inclusive and Sustainable Cluster Development	UNIDO supports cluster development as a strategic approach to economic growth and competitiveness, aiming to achieve inclusive and sustainable industrial development globally by fostering collaboration among businesses, research institutions, and other stakeholders within a specific geographic area or industry sector.	Quality & Standards	10 hours	Online	6-8	https://hub.unido.org/training-modules-Inclusive-and-Sustainable-Cluster-Development-english	UNIDO Training Academy	Free	UNIDO Training Academy	No
Introduction to Industrial Symbiosis (CircLean)	The CircLean course introduces the concept of industrial symbiosis, the methodologies for its implementation within your company, and how industrial symbiosis can benefit your organisation. It includes all resources (materials, capacity, expertise, energy, etc.) and creates an impact through profitable transactions that imply novel sourcing of inputs, value-added destinations for non-product outputs, and improved business and technical processes. The course also offers guided exercises to help you gain practical experience with these concepts and activities, facilitating your understanding of potential industrial symbiosis opportunities.	Industrial Symbiosis	2 hours	Online	5-8	https://hub.skills4planet.eu/catalog/course/SUS0208	Skills4Planet	Free	Skills4Planet	Yes
Enterprise Design Thinking	Modern teams need more than process, they need purpose. Enterprise Design Thinking® gives you a shared language to align faster, focus on what matters and deliver with empathy and speed. In a world of constant change, alignment is a competitive advantage. Enterprise Design Thinking helps teams cut through noise, stay focused and move with clarity. The Enterprise Design Thinking Practitioner course has helped thousands of teams across industries	Human-Centricity	2 hours	Online	3-8	https://www.ibm.com/training/enterprise-design-thinking	IBM	Free	IBM	No

Title	Summary	Topic	Time	Modality	EQF	Link	Source	Price	Created by	European Project
	adopt a more aligned, human-centered approach to operations and innovation.									
Multi-Stakeholder Partnerships (MSPs)	MSPs are a promising approach to foster collaborative solutions to global challenges. With our free web-based training, learners can dive deeper into their workings, success factors and more. Partnerships2030 has launched a new self-paced interactive online training on MSPs. It consists of four modules with audio, continually guiding you from the fundamentals towards a deeper understanding of MSPs. In about 60 to 70 minutes, you will learn how MSPs work and what it takes to build them up successfully.	Sustainability	1 hour	Online	3-8	https://partnerschaften2030.de/en/publications/online-training-on-multi-stakeholder-partnerships/	Partnerschaften2030 / GIZ & atingi	Free	Partnerschaften2030 / GIZ & atingi	No
Digital Health Ecosystem Orchestration	The digital transformation of healthcare is reshaping how we understand, deliver, and sustain care. From artificial intelligence and remote monitoring to data-driven prevention and personalised medicine, innovation in digital health is expanding at an unprecedented pace. Yet, turning promising technologies into real, system-level impact requires more than great ideas – it demands a deep understanding of the health ecosystem, collaboration across sectors, and strategic navigation of complex market environments.	Digital	9 hours	Online	3-8	https://eit.icarus.education/courses/introduction-to-health-ecosystems/	EIT Digital / 28DIGITAL	Free	EIT Digital / 28DIGITAL	No
An introduction to remanufacturing	Remanufacturing is a term coined for the process of taking a previously sold, worn, non-functional product or component and reviving it to turn it into a like-new condition, which thereby extends the product lifecycle. The process of remanufacturing is becoming increasingly popular across many industries, ranging from aerospace to food production, thanks to the reduction in resources and offering a more sustainable manufacturing solution.	Sustainability	2 hours	Online	3-8	https://nmis.scot/what-we-do/manufacturing-skills-academy/continuous-professional-development/anintroductiontoremanufacturing/	National Manufacturing Institute Scotland (NMIS)	Free	National Manufacturing Institute Scotland (NMIS)	Yes

Title	Summary	Topic	Time	Modality	EQF	Link	Source	Price	Created by	European Project
Design for remanufacture	Remanufacturing is a term coined for the process of taking a previously sold, worn, non-functional product or component and reviving it to turn it into a like-new condition, which thereby extends the product lifecycle. The process of remanufacturing is becoming increasingly popular across many industries, ranging from aerospace to food production, thanks to the reduction in resources and offering a more sustainable manufacturing solution.	Sustainability	2 hours	Online	3-8	https://nmis.scot/what-we-do/manufacturing-skills-academy/continuous-professional-development/designforremanufacture/	National Manufacturing Institute Scotland (NMIS)	Free	National Manufacturing Institute Scotland (NMIS)	Yes
LCA Beginner Course	This course is for anyone who wants to learn the basics of Life Cycle Assessment (LCA). The course is meant to get you started with the methodology and to help you navigate the ways LCA could yield value for your company. At the end of the course, we hope you'll feel more excited and confident to start using LCA in your work!	Sustainability	4 hours	Online	3-8	https://academy.ecochain.com/course/lca-beginner-course	Ecochain Academy	Free	Ecochain Academy	No
CSRD Fundamentals	All professionals involved in any sustainability-related or non-financial reporting roles, and anyone who wishes to learn more about the CSRD. CSRD Fundamentals is an excellent introduction for professionals aiming to grasp the critical aspects of the CSRD, from understanding the requirements for compliance to leveraging sustainability reporting to enhance business strategy.	Sustainability	1 hour	Online	3-8	https://csrdinstitute.eu/course/csrd-fundamentals	CSRD Institute	Free	CSRD Institute	No
Blockchain for Business Sustainability	The Blockchain for Business Sustainability course investigates the transformative role of blockchain technology in sustainable business practices. The opaque nature of conventional supply chains poses significant challenges to businesses and consumers alike, often hindering informed decision-making and sustainable production. By enhancing transparency, traceability, and accountability, blockchain emerges as a powerful tool in supply chain management, circular economy, renewable energy, ESG reporting, and incentivization.	Digital	3 hours	Online	3-8	https://www.binance.com/en/academy/track/blockchain-for-business-sustainability	Binance Academy & University of Oulu	Free	Binance Academy & University of Oulu	No
Learning how to learn	Learning how to learn: a process we all engage in throughout our lives, but no single method of learning guarantees success. This free course, Learning how to learn, aims to make the process of learning much more explicit by inviting you to apply various ideas and activities to your own study as a way of increasing your awareness of your own learning. Most learning has to be an active process, and this is particularly true of learning how to learn.	Human-Centricity	1 hour	Online	3-8	https://www.open.edu/openlearn/education-development/learning-how-learn/content-section-0?active-tab=description-tab	Open University – OpenLearn	Free	Open University – OpenLearn	No

Title	Summary	Topic	Time	Modality	EQF	Link	Source	Price	Created by	European Project
Community Organising for Youth Leaders	This course was co-financed by the Youth National Agency of Italy through the EU-funded programme Erasmus Plus; its content, though coherent with the underlying founding values of the European Union, does not necessarily reflect the views and positions of the EU on this matter. Moreover, given its public funding nature, the manual is freely accessible by all who desire to do so through all the available channels. Anyone is welcome to use it and disseminate it and its content; just for tracking purposes, if you intend to use and publish the manual or parts of its content and its translations, please inform us by contacting us at ka2@youngeffect.org.	Human-Centricity	3 hours	Online	3-8	https://www.communityorganisers.eu	Community Organisers eLearning (EU Erasmus+ project)	Free	Community Organisers eLearning (EU Erasmus+ project)	Yes
Science for Policy - Maximise your Policy Impact	The scientific world has changed beyond recognition in recent years. The days when scientists produced reports and expected policy-makers to read and then act upon them are long gone! Through sharing of state-of-the-art knowledge, interactive games and best practice examples, this course outlines the skills scientists need for their research results to have a bigger impact on policy and society in general.	Human-Centricity	1 hour	Online	5-8	https://academy.europa.eu/courses/science-for-policy-maximise-your-policy-impact	EU Academy (European Commission)	Free	EU Academy (European Commission)	Yes
Social dialogue and industrial relations: a self-guided induction course	The primary goal of the ILO is to promote opportunities for women and men to obtain decent and productive work in conditions of freedom, equality, security and human dignity. Social dialogue plays a key role in achieving this objective. It is a means of strengthening democratic decision-making and achieving decent work, and an end in itself. As much as social dialogue may differ from country to country, the overriding principles of freedom of association and the effective recognition of the right to collective bargaining remain the same. Indeed, these are essential preconditions for sound social dialogue and industrial relations. The main aim of social dialogue is to improve the quality of decisions and policies by involving the main stakeholders in the world of work, notably employers, workers and their representatives. Successful social dialogue structures and processes have the potential to resolve important economic and social issues, deal with crises such as COVID-19, encourage good governance, reduce inequality and promote growth.	Human-Centricity	3 hours	Online	3-8	https://www.itcilo.org/courses/social-dialogue-and-industrial-relations-self-guided-induction-course	ITCILO – International Training Centre of the ILO (Torino)	Free	ITCILO – International Training Centre of the ILO (Torino)	No

Title	Summary	Topic	Time	Modality	EQF	Link	Source	Price	Created by	European Project
Impact Assessment	The e-learning course "Impact Assessment" aims to train IFAD staff, project staff, local researchers, as well as the wider public, on conducting impact assessments and making impact assessments understandable and applicable to all learners. Participants will learn about how to conduct impact assessments using IFAD's approach to measure results at both the project and corporate levels. We made this resource accessible to any user, anywhere and at any time. This course combines theoretical knowledge and methods with their applications in real-world situations. It covers the whole process of impact assessments as well as the main underlying theories and methodologies. Specifically, participants will learn about preparation for an impact assessment, principles of method selection, ethical issues, data collection, data preparation, analysis, interpretation and utilisation.	Sustainability	10 hours	Online	6-8	https://www.ifad.org/e-learning/ifad-impact-assessment/	IFAD (UN International Fund for Agricultural Development)	Free	IFAD (UN International Fund for Agricultural Development)	No
Deepweld: Deep-tech driven, inclusive, and socially-aware circular material joining & welding	This course aims to equip learners with the knowledge and skills needed to navigate the future of sustainable circular material welding. As advanced materials and recycling technologies reshape the manufacturing landscape—particularly in the automotive and construction sectors—there is a pressing need for upskilling in sustainable welding methods. The course addresses this need by integrating cutting-edge deep-tech solutions such as AI-powered inspection, human-machine interaction, and automated welding systems.	Sustainability	60 hours	Online	6-8	https://www.eitdeeptechtalent.eu/courses/deepweld-deep-tech-driven-inclusive-and-socially-aware-circular-material-joining-welding/	EIT Deep Tech Talent / CERTH (EU)	Free	EIT Deep Tech Talent / CERTH (EU)	Yes
Contract Management: Build Relationships in Business (MOOC)	Struggling to understand business contracts at work? Try our free 3-week online course to understand contract management processes, gain the confidence to develop new contracts and build successful business relationships. Contracts are fundamental to business activities, and relationships are fundamental to all contracts. Learn all about the intricacies of contract management today.	Human-Centricity	9 hours	Online	6-8	https://www.worldcc.com/Learn/Online-Professional-Development/Contract-Management-MOOC	World Commerce & Contracting (WorldCC)	Free	World Commerce & Contracting (WorldCC)	No

4.2. Scientific and technical publications

Table 3. Scientific and technical publications

Module	Subject	Title	Link	EQF
M1.1	Fundamentals of Eco-design and SRM Formulation	Methodology of Eco-Design and Software Development for Sustainable Product Design	https://doi.org/10.3390/su16072626	6-8
		Does Product Eco-design Promote Remanufacturing: Application of a Stylised Game-theoretic Model	https://doi.org/10.3390/su15010691	6-8
		Eco-Design of Polymer Matrix Composite Parts: A Review	https://doi.org/10.3390/polym15173634	6-8
		Eco-Design and Characterisation of Sustainable Lightweight Gypsum Composites for Panel Manufacturing including End-of-Life Tyre Wastes	https://doi.org/10.3390/ma17030635	6-8
		Upcycling steel slag into construction materials	https://doi.org/10.1016/j.conbuildmat.2024.137882	6-8
		Upcycling of textile waste into high added value cellulose porous materials, aerogels and cryogels	https://doi.org/10.1039/D2SU00084A	6-8
		Utilization of steel slag as partial replacement for coarse aggregate in concrete	https://doi.org/10.1007/s41062-024-01464-y	6-8
		Microstructural, Mechanical and Fresh-State Performance of BOF Steel Slag in Alkali-Activated Binders: Experimental Characterization and Parametric Mix Design Method	https://doi.org/10.3390/buildings15122056	6-8
		Economic-Environmental and Multi-Criteria Optimization for Predicting Alkaline Ratios in Waste Cement Concrete-Based Geopolymer Using Central Composite Design	https://doi.org/10.1186/s40069-025-00767-3	6-8
		Evaluation of copper slag and stainless steel slag as replacements for blast furnace slag in binary and ternary alkali-activated cements	https://doi.org/10.1007/s10853-023-08815-7	6-8
		Review on Recycled Materials for Additive Manufacturing	https://doi.org/10.1007/s40684-025-00788-z	6-8
M1.2	Standardisation and Regulatory Compliance	Is this the end of end-of-waste? Uncovering the space between waste and products	https://doi.org/10.1016/j.resconrec.2019.104656	6-8
		THE TACIT END-OF-WASTE STATUS IS DE FACTO USED IN THE EU AND CRUCIAL FOR THE CIRCULAR ECONOMY	https://doi.org/10.31025/2611-4135/2024.18384	6-8
		How should we deal with the interfaces between chemicals, product and waste legislation?	https://doi.org/10.1186/s12302-019-0236-7	6-8
		Machine-interpretable Engineering Design Standards for Valve Specification	https://doi.org/10.48550/arXiv.2510.01736	6-8
		Why Harmonised Standards Should Be Open	https://doi.org/10.1007/s40319-023-01372-1	6-8
		Status and Future Prospects of the Standardization Framework Industry 4.0: A European Perspective	https://doi.org/10.48550/arXiv.2503.08460	6-8
		European AI Standards – Technical Standardisation and Implementation Challenges under the EU AI Act	https://doi.org/10.1017/err.2025.10032	6-8
		Standards, Certification, and Accreditation: Indispensable Tools for European Safety Regulations?	https://doi.org/10.1007/978-3-031-49570-0_8	6-8
M1.3	Performance Validation and Environmental Safety	Soil column leaching experiments – inverse modelling to derive environmental fate parameters	https://doi.org/10.1016/j.envadv.2025.100615	6-8
		Microbial, chemical, and isotopic monitoring integrated approach to assess potential leachate contamination of groundwater in a karstic aquifer (Apulia, Italy)	https://doi.org/10.1007/s10661-024-12477-6	6-8
		Evaluation of Standardised (ISO) Leaching Tests for Assessing Leaching and Solid–Solution Partitioning of Perfluoroalkyl Substances (PFAS) in Soils	https://doi.org/10.3390/environments12060179	6-8

Module	Subject	Title	Link	EQF
		Leaching characteristics of metals from recycled concrete aggregates (RCA) and reclaimed asphalt pavements (RAP)	https://doi.org/10.1016/j.heliyon.2024.e30407	6-8
		A state-of-the-art review of solid waste leaching mechanisms and evaluation methodologies	https://doi.org/10.1016/j.wasman.2025.114941	6-8
		Statistical Process Control in the Environmental Monitoring of Water Quality and Wastewaters: A Review	https://doi.org/10.3390/w17091281	6-8
		Durability Assessment of Cement Mortars with Recycled Ceramic Powders	https://doi.org/10.3390/ma18184420	6-8
		Microstructure and transport properties of cement mortar made with recycled fine ceramic aggregates	https://doi.org/10.1016/j.dibe.2025.100643	6-8
		Sustainable concrete production: the role of ceramic waste as a partial coarse aggregate substitute	https://doi.org/10.1007/s44290-025-00198-9	6-8
		A comprehensive assessment of ceramic wastes in ultra-high-performance concrete	https://doi.org/10.1007/s41062-024-01806-w	6-8
		Transforming concrete with steel slag: exploring the pores' dual effect for sustainable and high−performance urban construction	https://doi.org/10.1007/s44290-025-00243-7	6-8
		Valorization of Steel Slag and Fly Ash in Mortar: Modeling Age-Dependent Strength with Response Surface Methodology	https://doi.org/10.3390/ma18102203	6-8
M1.4	Systemic Innovation and Life Cycle Analysis	A comparative life cycle assessment (LCA), life cycle cost analysis (LCCA), mechanical and long-term leaching evaluation of road pavement structures containing multiple secondary materials	https://doi.org/10.1016/j.jclepro.2024.142484	6-8
		Life cycle assessment applications to reuse, recycling and circular practices for textiles: A review	https://doi.org/10.1016/j.wasman.2024.04.016	6-8
		Life cycle assessment of a circular textile value chain: the case of a garment made from chemically recycled cotton	https://doi.org/10.1007/s11367-024-02346-2	6-8
		Exploring the Environmental Impact of Textile Recycling in Europe: A Consequential Life Cycle Assessment	https://doi.org/10.3390/su17051931	6-8
		An investigation into modelling approaches for industrial symbiosis: A literature review and research agenda	https://doi.org/10.1016/j.clscn.2021.100020	6-8
		Investigating the use of network analysis metrics to benchmark Industrial Symbiosis development	https://doi.org/10.1016/j.jclepro.2024.143078	6-8
		System thinking approaches for circular economy: enabling inclusive, synergistic, and eco-effective pathways for sustainable development	https://doi.org/10.3389/frsus.2023.1267282	6-8
		Spanning the industrial symbiosis within the circular economy: Critical issues and future research agenda	https://doi.org/10.1111/jiec.70005	6-8
		Industrial symbiosis readiness level assessment—A stakeholder co-designed matrix tool for guidance and evaluation	https://doi.org/10.1016/j.rcradv.2025.200270	6-8
M2.1	Digital Product Passport (DPP) and Traceability	The Digital Product Passport, as defined in the Proposal for Eco-design for Sustainable Product Regulation (ESPR)	https://cirpassproject.eu/wp-content/uploads/2023/03/ESPR-short-summary-Final.pdf	3-8
		Digital Product Passport (DPP): The Complete Guide	https://shorturl.at/RPNej	3-8
		REGULATION (EU) 2024/1781 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 June 2024	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32024R1781&qid=1719580391746	6-8
		Digital product passports for electric vehicle batteries: Stakeholder requirements for sustainability and circularity	https://doi.org/10.1016/j.clpl.2024.100090	6-8
		Stakeholder perspectives on digital product passports for construction products	https://doi.org/10.1016/j.clscn.2025.100275	6-8
		Developing Traceability Systems for Effective Circular Economy of Plastic: A Systematic Review and Meta-Analysis	https://doi.org/10.3390/su16229973	6-8
		Elevating Recycling Standards: Global Requirements for Plastic Traceability and Quality Testing	https://doi.org/10.3390/su16125122	6-8

Module	Subject	Title	Link	EQF
		Blockchain-based trusted traceability and sustainability certification of leather products	https://doi.org/10.1371/journal.pone.0333192	6-8
M2.2	Use Value Modelling and Optimisation	Multivariate Adaptive Regression Splines Enhance Genomic Prediction of Non-Additive Traits	https://doi.org/10.3390/agronomy14102234	6-8
		Model selection in multivariate adaptive regressions splines (MARS) using alternative information criteria	https://doi.org/10.1016/j.heliyon.2023.e19964	6-8
		Utilizing Multivariate Adaptive Regression Splines (MARS) for Precise Estimation of Soil Compaction Parameters	https://doi.org/10.3390/app132111634	6-8
		Optimizing multivariate adaptive regression splines (MARS) with coordinate descent to accurately select the best model for house price prediction	https://doi.org/10.1007/s42452-025-06922-5	6-8
		Modeling and response surface methodology optimization of reaction parameters for aqueous mineral carbonation by steel slag	https://doi.org/10.1016/j.ccst.2024.100229	6-8
		Carbon dioxide sequestration through steel slag carbonation: Review of mechanisms, process parameters, and cleaner upcycling pathways	https://doi.org/10.1016/j.jcou.2024.102736	6-8
		Kinetics of steel slag dissolution: from experiments to modelling	https://doi.org/10.1098/rspa.2018.0830	6-8
		Modeling the application of steel slag in stabilizing expansive soil	https://doi.org/10.1007/s40808-023-01734-1	6-8
M2.3	Real-Time Optimisation (AI, ML, IoT)	A Dataflow-Oriented Approach for Machine-Learning-Powered Internet of Things Applications	https://doi.org/10.3390/electronics12183940	6-8
		Real-time processing and optimization strategies for IoT data streams	https://doi.org/10.2478/amns-2024-2978	6-8
		Artificial Intelligence and Machine Learning Applications in Smart Production: Progress, Trends, and Directions	https://doi.org/10.3390/su12020492	6-8
		Data Analytics and Machine Learning for Smart Process Manufacturing: Recent Advances and Perspectives in the Big Data Era	https://doi.org/10.1016/j.eng.2019.01.019	6-8
		Automated Data Pipeline Optimization for Real-Time Machine Learning Inference	https://ijisae.org/index.php/IJISAE/article/view/7522	6-8
		Optimal data-driven control of manufacturing processes using reinforcement learning: an application to wire arc additive manufacturing	https://doi.org/10.1007/s10845-023-02307-w	6-8
		Enabling real time big data solutions for manufacturing at scale	https://doi.org/10.1186/s40537-022-00672-6	6-8
		OPTIMIZING MACHINE LEARNING ALGORITHMS FOR REAL-TIME DATA PROCESSING	https://doi.org/10.12732/ijam.v38i8s.556	6-8
		AI-Powered Workflow Optimization in Multi-Tenant Cloud Environments: A Novel Approach to Minimizing Latency in Shared Resources	https://hkjml.org/index.php/hkjml/article/view/11	6-8
		Real-time monitoring and optimization of machine learning intelligent control system in power data modeling technology	https://doi.org/10.1016/j.mlwa.2024.100584	6-8
M2.4	Advanced SRM Management	Assessment of valorisation opportunities for secondary metallurgy slag through multi-criteria decision making	https://doi.org/10.1016/j.jclepro.2023.136838	6-8
		Industrial Symbiosis: A Mechanism to Guarantee the Implementation of Circular Economy Practices	https://doi.org/10.3390/su142315872	6-8
		Exploring the Potential for Steel Slags Valorisation in an Industrial Symbiosis Perspective at Meso-scale Level	https://doi.org/10.1007/s12649-022-01940-5	6-8
		Carbon dioxide sequestration through steel slag carbonation: Review of mechanisms, process parameters, and cleaner upcycling pathways	https://doi.org/10.1016/j.jcou.2024.102736	6-8
		Circular Economy Business Models, Value Creation and Humane Entrepreneurship: A Micro-Sized and Social Enterprise Perspective	https://doi.org/10.1007/s43615-024-00419-w	6-8
		Integrating Circular Economy Principles in Business Strategies: a Policy-Driven Approach	https://doi.org/10.1007/s43615-025-00523-5	6-8
		When Industry 5.0 Meets the Circular Economy: A Systematic Literature Review	https://doi.org/10.1007/s43615-025-00570-y	6-8
		Business Model Innovation: A Framework for Assessing Corporate Engagement with Sustainability	https://doi.org/10.1007/s43615-025-00565-9	6-8
		Recent advances in research on steel slag for asphalt pavements: A review	https://doi.org/10.1016/j.cscm.2025.e04698	6-8

Module	Subject	Title	Link	EQF
M3.1	Sustainable Product Validation	Recent development and application of natural fibre in asphalt pavement	https://doi.org/10.1016/j.jclepro.2024.141832	6-8
		Development of sustainable, high-strength slag-based alkali-activated pavement quality concrete using agro-industrial wastes: properties and life cycle analysis	https://doi.org/10.1080/10298436.2024.2410953	6-8
		Performance Evaluation of Porous Asphalt Mixture Reinforced with Waste Cellulose Acetate Fibres	https://doi.org/10.3390/su17083447	6-8
		Low-permeability sealing materials based on sewage, digestate and incineration industrial by-products in the final landfill cover system	https://doi.org/10.1016/j.conbuildmat.2024.134889	6-8
		Controlling the hydration rate of alkali-activated slag by the slow release of NaOH	https://doi.org/10.1016/j.geoen.2023.211960	6-8
		Leaching Behaviour of Synthetic Leachate through a Sewage Sludge and Red Gypsum Composite as Intermediate Landfill Cover	https://doi.org/10.3390/su15054229	6-8
		Harnessing Secondary Resources for Sustainable and Circular Practices in the Construction Sector: A Scoping Review	https://doi.org/10.3390/app15105410	6-8
M3.2	Compliance and Standardisation (Quality)	A state-of-the-art review of solid waste leaching mechanisms and evaluation methodologies	https://doi.org/10.1016/j.wasman.2025.114941	6-8
		Assessment of Dynamic Surface Leaching of Asphalt Mixtures Incorporating Electric Arc Furnace Steel Slag as Aggregate for Sustainable Road Construction	https://doi.org/10.3390/su17083737	6-8
		The validation of converting pyrite ash-contaminated soil into End-of-Waste by the High-Performance Solidification/Stabilization process application	https://doi.org/10.1002/ieam.4707	6-8
		Classification and predictive leaching risk assessment of construction and demolition waste using multivariate statistical and machine learning analyses	https://doi.org/10.1016/j.wasman.2025.02.033	6-8
		A comprehensive review of landfill leachate treatment technologies	https://doi.org/10.3389/fenvs.2024.1439128	6-8
		End-of-waste criteria for waste plastic for conversion – Technical proposals: final report	https://data.europa.eu/doi/10.2791/13033	6-8
		Analysis of green certification standards related to recycled materials involving textiles based on life cycle thinking	https://doi.org/10.1016/j.spc.2023.08.001	6-8
		Sustainable waste management through end-of-waste criteria development	https://doi.org/10.1007/s11356-015-5990-5	6-8
		A Circular Construction Product Ontology for End-of-Life Decision-Making	https://doi.org/10.48550/arXiv.2503.13708	6-8
		Digital Product Passport Management with Decentralised Identifiers and Verifiable Credentials	https://doi.org/10.48550/arXiv.2410.15758	6-8
M3.3	Life Cycle Analysis	Life cycle assessment of an innovative high-value-recovery crystalline silicon photovoltaic recycling process – the environmental impacts and benefits	https://doi.org/10.1051/epjpv/2024034	6-8
		Life cycle assessment of recycling waste crystalline silicon photovoltaic modules: A comparison between traditional and green solvent recycling processes	https://doi.org/10.1016/j.cej.2024.157132	6-8
		Life Cycle Assessment of Disposed and Recycled End-of-Life Photovoltaic Panels in Australia	https://doi.org/10.3390/su131911025	6-8
		Environmental and Economic Aspects of Using Recycled Materials in Solar Collector Manufacturing	https://doi.org/10.1051/e3sconf/202564803019	6-8
		Integration of life cycle assessment and life cycle costing within a BIM-based environment	https://doi.org/10.3389/frsus.2022.1002257	6-8
		A Case Study on Sustainable Technologies in Residential Buildings from a Life Cycle Cost Analysis (LCC) Perspective	https://doi.org/10.3390/su162410892	6-8
		Boosting circular economy solutions in the construction sector using a life cycle assessment	https://doi.org/10.1111/jiec.13614	6-8
		Integrating life cycle assessment and cost analysis in decision making: Optimising design choices in a public building case study	https://doi.org/10.1016/j.enbuild.2025.116399	6-8

Module	Subject	Title	Link	EQF
		Real-Time LCA/LCC Integration: A Framework of Agile Sustainability and Cost Management	https://doi.org/10.3390/su17219433	6-8
		Evaluating the sustainability performance of sustainable, innovative, and affordable housing	https://doi.org/10.1080/13563475.2025.2550970	6-8
M3.4	Leadership in Systemic Innovation	Conceptualizing systems thinking and complexity modelling for circular economy quantification: A systematic review and critical analysis	https://doi.org/10.21203/rs.3.rs-5844499/v1	6-8
		Investigating the use of network analysis metrics to benchmark Industrial Symbiosis development	https://doi.org/10.1016/j.jclepro.2024.143078	6-8
		The role of trophic, mutualistic, and competitive interactions in an industrial symbiosis process implementation: an ecological network perspective	https://doi.org/10.1007/s11356-024-33454-z	6-8
		Spanning the industrial symbiosis within the circular economy: Critical issues and future research agenda	https://doi.org/10.1111/jiec.70005	6-8
		Catalysing the Circular Economy: Socio-cultural and Spatial Trajectories in Industrial Ecosystems	https://doi.org/10.55845/BHLO9795	6-8
		Identifying the skills requirements related to industrial symbiosis and energy efficiency for the European process industry	https://doi.org/10.1186/s12302-023-00762-z	6-8
		Industrial Symbiosis Practice for Stakeholders: Insights from Textile Practices for Sectoral Transformation	https://doi.org/10.1007/s40684-025-00767-4	6-8
		Industrial symbiosis in circular economies through policy and practice for waste to resource innovation	https://doi.org/10.1007/s43621-025-02127-3	6-8
		Toward a collaborative circular ecosystem within the built environment	https://doi.org/10.1016/j.spc.2024.10.019	6-8
		Do local subsidiaries have unique characteristics in strategies, knowledge, and digital transformation efforts to achieve circular economy goals?	https://doi.org/10.1016/j.jik.2025.100802	6-8
M4.1	Introduction to IS and EE Fundamentals	Industrial Symbiosis and Energy Efficiency in European Process Industry: State of the Art and Future Scenario	https://pact-for-skills.ec.europa.eu/community-resources/publications-and-documents/industrial-symbiosis-and-energy-efficiency-european-process-industry-state-art-and-future-scenario_en	3-5
		GUIDE FOR INDUSTRIAL SYMBIOSIS FACILITATORS	https://www.symbiosis.dk/wp-content/uploads/2021/03/Guide-for-IS-facilitators_online2.pdf	3-5
		INSET Resources — Industrial Symbiosis for Businesses (Project INSET)	https://inset-symbiosis.eu/inset-resources?utm_source	3-5
		Significance of Industrial Symbiosis	https://www.wisdomlib.org/concept/industrial-symbiosis?utm_source	3-5
		Industrial Symbiosis	https://www.ingenjor40.se/module/industrial-symbiosis/?utm_	3-5
		Industrial Symbiosis Guideline	https://iproduce-project.eu/wp-content/uploads/2023/04/iPRODUCE-Industrial-Symbiosis.pdf	3-5
		Energy Literacy: Essential Principles for Energy Education	https://ocm.iccrom.org/documents/energy-literacy-essential-principles-energy-education	3-5
M4.2	Operational Waste Management (Upcycling)	Waste-to-Energy Technologies and Global Applications	https://wtert.org/resources/learning-resources/	3-5
		Energy from waste: a good practice guide	https://wtert.org/resources/learning-resources/	3-5
		Integrated Solid Waste Management: Engineering Principles and Management Issues	https://wtert.org/resources/learning-resources/	3-5

Module	Subject	Title	Link	EQF
		Decision Maker's Guides for Solid Waste Management Technologies	https://wtert.org/resources/learning-resources/	3-5
		HANDLING OF BY-PRODUCTS AND TREATMENT OF WASTE	https://www.fao.org/4/x6114e/x6114e07.htm	3-5
		WASTE EDUCATION GUIDE FOR ADULT EDUCATORS AND TEACHERS	https://zerowaste-project.idu.edu.tr/wp-content/uploads/2023/07/Q1A4-WASTE-EDUCATION-GUIDE-EN.pdf	3-5
		Resource Recovery Technology for Municipal and Rural Solid Waste	https://www.perlego.com/book/4466970/resource-recovery-technology-for-municipal-and-rural-solid-waste-classification-mechanical-separation-recycling-and-transfer-pdf	4-8
		Learning about waste management: The role of science motivation, preferences in technology and environmental values	https://doi.org/10.1016/j.sftr.2021.100054	4-8
		DRYING-GRINDING EXPERIMENTS	https://flashphos-project.eu/app/uploads/D3.1-Drying-Grinding-experiments.pdf	3-5
		POTENTIAL PATHWAYS FOR STEEL SLAG VALORIZATION AND USAGE IN CANADA	https://publications.gc.ca/collections/collection_2025/rncan-nrcan/M154-176-2024-eng.pdf	3-5
		Processes for the Dry Processing of Steel Slags	https://www.loesche.com/sites/default/files/list-content/brochure/2017-08/259_LOESCHE_EDS%20Steel%20Slag_EN.pdf	3-5
		Silica Sand Dryer Guide: The Smart Choice for Your Plant	https://www.ftmmachinery.com/blog/efficient-silica-sand-dryer.html	3-5
M4.3	Operational Optimisation and Digitalisation	Guide for Industrial Symbiosis Facilitators	https://www.symbiosis.dk/wp-content/uploads/2021/03/Guide-for-IS-facilitators_online2.pdf	3-5
		Industrial Symbiosis Guideline	https://iproduce-project.eu/wp-content/uploads/2023/04/iPRODUCE-Industrial-Symbiosis.pdf	3-5
		D8.7 – Toolkit of guidelines and training materials (final)	https://ec.europa.eu/research/participants/documents/downloadPublic?appId=PPGMS&documentIds=080166e520653653&utm	3-5
		Resource Efficiency — Toolkit for Small & Medium Businesses	https://www.midwestern.nsw.gov.au/files/assets/public/v/1/community/sustainable-living/resource-efficiency-toolkit.pdf	3-5
		Unlocking More Value with Fewer Resources" — Practical guide	https://economiacircular.gov.pt/contents/documentacao/unlocking-more-value-with-fewer-resources.pdf	3-5
		Toolkit — Skills for the Green Transformation	https://vettoolbox.eu/wp-content/uploads/2023/01/S4GT_Toolkit.pdf	3-5

Module	Subject	Title	Link	EQF
		Industrial Symbiosis & Energy Efficiency in European Process Industry	https://www.aspire2050.eu/sites/default/files/users/user85/spire-sais_deliverable_d2.1_technological_develpment.pdf	3-5
		Industrial Symbiosis to Circular Economy: What Does the Literature Reveal for a Successful Complex Industrial Area?	https://doi.org/10.1007/s43615-022-00153-1	4-8
		Monitoring and Evaluation Tools eBook	https://www.sopact.com/ebooks/monitoring-and-evaluation-tools-ebook	3-5
		Smart Digital Monitoring Systems for Occupational Safety and Health: Workplace Resources for Design, Implementation and Use	https://www.certifico.com/component/attachments/download/35541	3-5
		Digital Twin-Based Active Learning for Industrial Process Control and Supervision in Industry 4.0	https://doi.org/10.3390/s25072076	4-5
		Energy Data Management Guid	https://eere.energy.gov/energydataguide/	3-5
		Comprehensive Guide to Energy Data Management Practices	https://www.empoweredautomation.com/comprehensive-guide-to-energy-data-management-practices	3-5
		Practices to collect and assess data on energy audits and energy management systems to inform the implementation of the European Energy Efficiency Directive	https://doi.org/10.1007/s12053-025-10365-7	4-8
M4.4	Operational Soft Skills	How Multitasking Affects Productivity and Brain Health	https://www.verywellmind.com/multitasking-2795003	3-5
		Artificial intelligence for worker management	https://data.europa.eu/doi/10.2802/76354	3-5
		Support for employers: Training and orientation for young and new workers	https://www.worksafebc.com/en/resources/health-safety/books-guides/support-for-employers-training-and-orientation-for-young-and-new-workers?lang=en&utm	3-5
		A Guide to Sustainable Corporate Responsibility	https://doi.org/10.1007/978-3-030-88203-7	4-8
		Organizing for Sustainability	https://doi.org/10.1007/978-3-030-78157-6	4-8
		Sustainable Business	https://doi.org/10.1007/978-3-031-25397-3	4-8
		The Palgrave Handbook of Sustainable Digitalization for Business, Industry, and Society	https://doi.org/10.1007/978-3-031-58795-5	4-8
		Guide to Corporate Sustainabilit	https://baselgovernance.org/sites/default/files/2019-02/un_global_compact_guide_to_corporate_sustainability.pdf	3-5
		The Business Guide to Sustainability	https://api.pageplace.de/preview/DT0400.9781136554834_A23851193/preview-9781136554834_A23851193.pdf	3-5
		Manual for Sustainable Business Guidance	https://academiadeprodutoresculturais.com/wp-content/uploads/2025/01/manual_final_EN.pdf	3-5
M5.1	Environmental Regulation and Frameworks	The End-of-Waste for the Transition to Circular Economy: A Legal Review of the European Union Waste Framework Directive	https://doi.org/10.3233/EPL-2200	6-8
		European waste management regulations and the transition towards circular economy. A shift-and-share analysis	https://doi.org/10.1016/j.jenvman.2024.120423	6-8

Module	Subject	Title	Link	EQF
		The impact of the Circular Economy Act on waste volumes in Germany: An analysis using Regression Discontinuity Design	https://doi.org/10.1016/j.jclepro.2025.146770	6-8
		From Efficiency to Circularity in the Wastewater Sector: A Review of Performance Indicators in Regulated Countries	https://doi.org/10.3390/w17152226	6-8
		2002–2022: 20 years of e-waste regulation in the European Union and the worldwide trends in legislation and innovation technologies for a circular economy	https://doi.org/10.1039/d4su00548a	6-8
		Recent Developments in EU Environmental Policy and Legislation	https://doi.org/10.1163/18760104-20030009	6-8
		Energy-Efficient Green AI Architectures for Circular Economies Through Multi-Layered Sustainable Resource Optimization Framework	https://doi.org/10.48550/arXiv.2506.12262	6-8
		Conceptualizing circular economy policy instruments: The case of recycled content standards	https://doi.org/10.1016/j.spc.2024.11.009	6-8
		From waste to wealth: Policies to promote the circular economy	https://doi.org/10.1016/j.jclepro.2024.141086	6-8
		Industry hybrid regulation: Exploring a model for business-driven circular economy	https://doi.org/10.1016/j.rcradv.2024.200205	6-8
		Unpacking Policy Determinants for Circular Business Models: An Updated Comprehensive Review and an Actionable Analytical Framework	https://doi.org/10.3390/su17209090	6-8
		Sustainability from Policy to Practice: Assessing the Impact of European Research and Innovation Frameworks on Circular Bioeconomy	https://doi.org/10.3390/su16062355	6-8
		Circular economy perspectives: challenges, innovations, and sustainable futures	https://doi.org/10.1007/s43621-025-01606-x	6-8
M5.2	Managing Cross-Sectoral Complexity (IS)	From adversaries to allies: cross-sector partnerships for sustainability between businesses and civil society organisations—a systematic literature review and future research avenues	https://doi.org/10.1007/s11301-025-00573-x	6-8
		Promoting Urban Net Zero Transitions Through Multi-Level Governance: The Intermediary Role of Systemic Collaborative Platforms	https://doi.org/10.3390/su16219470	6-8
		Developing sustainable global value chain: role of multi-stakeholder collaborations and digitalization	https://doi.org/10.1016/j.clscn.2025.100271	6-8
		Bridges over troubled waters: Climate clubs, alliances, and partnerships as safeguards for effective international cooperation?	https://doi.org/10.1007/s10784-024-09639-9	6-8
		Does stakeholder participation improve environmental governance? Evidence from a meta-analysis of 305 case studies	https://doi.org/10.1016/j.gloenvcha.2023.102705	6-8
		Inter-organisational Sustainability Cooperation Among European Regions and the Role of Smart Specialisation	https://doi.org/10.1007/s13132-024-01760-z	6-8
		Towards holistic environmental policy assessment. multi-criteria frameworks and recommendations for modelers	https://doi.org/10.1038/s44168-025-00274-x	6-8
		Industrial symbiosis in circular economies through policy and practice for waste to resource innovation	https://doi.org/10.1007/s43621-025-02127-3	6-8
		Industrial Symbiosis Practice for Stakeholders: Insights from Textile Practices for Sectoral Transformation	https://doi.org/10.1007/s40684-025-00767-4	6-8
		Development of urban-industrial symbiosis to support sustainability: bibliometric analysis and systematic literature review	https://doi.org/10.1007/s43621-025-01030-1	6-8
		Economic evaluation framework for Industrial Symbiosis through network lenses: a systematic literature review	https://doi.org/10.13135/2704-9906/10926	6-8
M5.3	Circular Business	Sustainable international business model innovations for a globalizing circular economy: a review and synthesis, integrative framework, and opportunities for future research	https://doi.org/10.1057/s41267-023-00652-9	6-8
		Overarching Business Models for a Circular Bioeconomy: Systematising archetypes	https://doi.org/10.1016/j.spc.2023.11.010	6-8

Module	Subject	Title	Link	EQF
	Models and Strategy	Circular business model innovation: Uncovering practices and patterns to retain the value of resources	https://doi.org/10.1016/j.spc.2025.06.009	6-8
		Determinants of circular business model adoption—A systematic literature review	https://doi.org/10.1002/bse.3470	6-8
		Circular Economy and Corporate Sustainability: Shaping New Business Models for a Resilient Future	https://doi.org/10.2478/raft-2025-0011	6-8
		Developing entrepreneurial mindset through sustainability-informed entrepreneurial education	https://doi.org/10.2478/ijm-2024-0009	6-8
		Measuring the Entrepreneurial Mindset: The Motivations behind the Behavioral Intentions of Starting a Sustainable Business	https://doi.org/10.3390/su142315997	6-8
		Entrepreneurial Mindset as Personal Characteristic Capital to Compete in the Era of Society 5.0	https://doi.org/10.1229/tecempresarialjournal.v18i2.334	6-8
		Educational insights into digital entrepreneurship: the influence of personality and innovation attitudes	https://doi.org/10.1186/s13731-025-00475-y	6-8
		Cultivating the Entrepreneurial Mindset: Integrating Theory and Practice in Curricula across University Departments	https://doi.org/10.55529/jpome.46.24.34	6-8
M5.4	Communication and Social Acceptance	The role of communication in environmental awareness according to circular economy stakeholders	https://doi.org/10.1016/j.jenvman.2025.124112	6-8
		Communication of Circular Economy in the Public Sector in Bulgaria: a Study of Space, Agenda, Language, and Tools	https://doi.org/10.1007/s43615-025-00694-1	6-8
		Theories, techniques and strategies of sustainable circular economy: a systematic literature review	https://doi.org/10.1007/s43621-025-01161-5	6-8
		A systematic literature review exploring the nexus between circular economy and communities	https://doi.org/10.3389/frsc.2024.1404279	6-8
		A Systematic Review of Driving Sustainability Through Circular Economy Marketing: Insights and Strategies for Green Marketing Innovation	https://doi.org/10.3390/encyclopedia5020061	6-8
		The Role of Consumers in Transitioning to a Circular Economy	https://doi.org/10.1007/s43615-025-00617-0	6-8

Note: publications indicate the D10.1 modules and submodules for which they are recommended.

4.3. Videos and multimedia resources

Table 4. Videos and multimedia resources

Module	Subject	Title	Time	EQF	Language	Link	Created by	Europen Project
M1.1	Fundamentals of Eco-design and SRM Formulation	Basic Concepts on Ecodesign: Presentation of the Basic Course	8'35''	3-8	English	https://www.youtube.com/watch?v=r8NWfyHsoeY	Ecosign Project	Yes
		Basic Concepts on Ecodesign - Unit 1: Introduction to Ecodesign	8'44''	3-8	English	https://www.youtube.com/watch?v=C6tyMgRw_QI	Ecosign Project	Yes
		Basic Concepts on Ecodesign - Unit 2 Video: The State of the Art on Ecodesign	12'08''	3-8	English	https://www.youtube.com/watch?v=nePUH5v59K8	Ecosign Project	Yes
		Basic Concepts on Ecodesign - Unit 3 Video: Search for Legislation and Applicable Normative	5'50''	3-8	English	https://www.youtube.com/watch?v=OtjcQKLb02Y	Ecosign Project	Yes
		Basic Concepts on Ecodesign - Unit 4 Video: Life Cycle Analysis	12'45''	3-8	English	https://www.youtube.com/watch?v=DTEch5TMVR8	Ecosign Project	Yes
		Basic Concepts on Ecodesign - Unit 5 Video: Optimisation of Useful Cycle: CETEM laboratory	3'48''	3-8	English	https://www.youtube.com/watch?v=Qz-GgD_5zSY	Ecosign Project	Yes
		Basic Concepts on Ecodesign - Unit 6: Environmental Aspects of an Organisation	7'45''	3-8	English	https://www.youtube.com/watch?v=8261Yi8R-VU	Ecosign Project	Yes
		Basic Concepts on Ecodesign - Unit 7 Video Coca-Cola: Environmental Strategy	4'53''	3-8	English	https://www.youtube.com/watch?v=3rv9cOQqp8Q	Ecosign Project	Yes
		Basic Concepts on Ecodesign - Unit 8: Continuous Improvement in Management Systems	7'25''	3-8	English	https://www.youtube.com/watch?v=IaeuhHSAWYM	Ecosign Project	Yes
		Basic Concepts on Ecodesign - Unit 9: Implementing Standard ISO 14006	7'42''	3-8	English	https://www.youtube.com/watch?v=-By-eEkkI7Q	Ecosign Project	Yes
		Basics Concepts on Ecodesign - Unit 10: Carbon Footprint	5'58''	3-8	English	https://www.youtube.com/watch?v=kbRkcrBEKI8	Ecosign Project	Yes
		Basics Concepts on Ecodesign - Unit 11: Environmental Product Declaraion. Communication	9'59''	3-8	English	https://www.youtube.com/watch?v=wZ_zi9qg35A	Ecosign Project	Yes
		Basics concepts on Ecodesign - Unit 12: Success Cases on Ecodesign in Food Packaging: Hero España	18'08''	3-8	English	https://www.youtube.com/watch?v=ZwRQiy3xUnE	Ecosign Project	Yes
		Episode 18 - S… for Secondary Raw Materials	6'40''	3-8	English	https://www.youtube.com/watch?v=09Er-jShL68	Saint-Gobain	No

Module	Subject	Title	Time	EQF	Language	Link	Created by	Europen Project
		e-waste Recycling - Prospecting Secondary raw materials in Urban mining - ProSUM	2'33''	3-8	English	https://www.youtube.com/watch?v=m0-xZOUkv2M	WASTERUSH	No
		Industrial waste as a Secondary Raw Material (SRM) for the production of construction materials	4'11	3-8	English	https://www.youtube.com/watch?v=G4Vq6-r9jXE	Cinderela Project	No
		Integrating Secondary Raw Materials Into Ceramics Industry | ICARUS	3'	3-8	English	https://www.youtube.com/watch?v=CaYgFen6KbE	Icarus Project	Yes
		Why are raw materials important?	6'46''	3-8	English	https://www.youtube.com/watch?v=ADWsTD4-Waw	EIT RawMaterials	Yes
M1.2	Standardisation and Regulatory Compliance	Less waste, more value: focus on End of Waste criteria – CESC 2020	56'56''	3-8	English	https://www.youtube.com/watch?v=HlxpGpxHxX4	EU Environment	Yes
		How Regulations Revolutionized Waste Management	3'15''	3-8	English	https://www.youtube.com/watch?v=78d9Z_F17Mw	Science·WHYS	No
		End of Waste? Circular Economic Substitutions / New Raw Material	92'20''	3-8	English	https://www.youtube.com/watch?v=M4zam6So1Dw	Yale School of Architecture	No
		Is Trash The Building Material of The Future? | World Wide Waste | Business Insider Marathon	44'	3-8	English	https://www.youtube.com/watch?v=pWpH9R-yY4c	Business Insider	No
		What Legislation Governs Extended Producer Responsibility? - Earth Science Answers	3'06''	3-8	English	https://www.youtube.com/watch?v=30-uuOW8DqA	Earth Science Answers	No
		Urban Mining: How E-Waste Creates a Circular Economy for Critical Minerals	6'13''	3-8	English	https://www.youtube.com/watch?v=Fr5fCk7-B-c	Breeze of Science	No
		How Does Industrial Symbiosis Create New Raw Materials? - How It Comes Together	2'46''	3-8	English	https://www.youtube.com/watch?v=lCJ0JjDgOlQ	How It Comes Together	No
		How to Find Product Standards in the European Union	6'10''	3-8	English	https://www.youtube.com/watch?v=POf1SESkDJ8	Compliance Gate	No
		Lithium Battery Regulations and Standards in the European Union	10'28''	3-8	English	https://www.youtube.com/watch?v=xmykRO53VMk	Compliance Gate	No
		How to create a Declaration of Conformity	7'04''	3-8	English	https://www.youtube.com/watch?v=lFnyh3Jkweo	Compliance Gate	No
M1.3	Performance Validation and Environmental Safety	Environmental Monitoring (EM)	26'13''	3-8	English	https://www.youtube.com/watch?v=AnpbGZllaaE	BioNetwork	No
		What Is Leachate?	3'11''	3-8	English	https://www.youtube.com/watch?v=cJoJfgJ0Ai0	Earth Science Classroom	No
		Environmental monitoring – methods and case studies	9'53''	3-8	English	https://www.youtube.com/watch?v=JT4IR8nHDWo	StatSoft Polska	No
		Environmental monitoring for a safe and sustainable indoor environment	18'28''	3-8	English	https://www.youtube.com/watch?v=E0gxq0nMQ1c	OAE Publishing	No
		Extractive Metallurgy Course: Lecture N°9: Hydrometallurgy: Leaching process	32'16''	3-8	English	https://www.youtube.com/watch?v=4OTrba3Sm3Y	Oscar Jaime Restrepo Baena	No
		Mechanical Properties of Concrete Ceramic Waste Materials	10'40''	3-8	English	https://www.youtube.com/watch?v=Mgvb17bPP1o	American Concrete Institute	No
		CERAMIC INDUSTRIAL WASTE AS REPLACEMENT MATERIAL OF FINE AGGREGATE IN CONCRETE MIX	2'54''	3-8	English	https://www.youtube.com/watch?v=0AJbR_iIHj4	ICC UTHM	No

Module	Subject	Title	Time	EQF	Language	Link	Created by	Europen Project
		125: Experimental characterization of mortar with recycled PET aggregate: preliminary results	8'50''	3-8	English	https://www.youtube.com/watch?v=n0p-WllxjPU	IGF Gruppo Italiano Frattura	No
		How Can I Make Mortar Stronger? - Chemistry For Everyone	3'43''	3-8	English	https://www.youtube.com/watch?v=t9GdKItUbRk	Chemistry For Everyone	No
M1.4	Systemic Innovation and Life Cycle Analysis	Introduction to life cycle assessment (LCA)	6'02''	3-8	English	https://youtu.be/YDkQJm8722s	SimaPro	No
		What is building life cycle assessment? Building LCA made easy	3'02''	3-8	English	https://youtu.be/Q_iC9irjpOE	One Click LCA	No
		The role of life cycle assessment for chemical recycling deployment and policy decision-making	121'15''	3-8	English	https://youtu.be/YBsTyNdGHfw	CEPS Think Tank	No
		Lecture 5 – Life-Cycle Cost Analysis (LCCA) for Sustainability Projects	11'05''	3-8	English	https://youtu.be/n7lc6Rflnnc	Zayed Zeadat	No
		Inside the world of industrial symbiosis | The origins of the circular economy	22'57''	3-8	English	https://www.youtube.com/watch?v=23Almogc-_Y	Ellen MacArthur Foundation	No
		Complex Systems Thinking – How to change the way we think about problem solving	55'24''	3-8	English	https://youtu.be/0-CSs1UEbFQ	Brady Heywood	No
		Understanding Complexity with Systems Thinking with Dr. Willy Donaldson	51'39''	3-8	English	https://youtu.be/beeEFp1shOU	Red Team Thinking	No
M2.1	Digital Product Passport (DPP) and Traceability	How Will Digital Product Passport (DPP) Data Be Verified? | EU Standards, Blockchain & Compliance	5'21''	3-8	English	https://www.youtube.com/watch?v=GaZm8Pv5lcs	Protokol	No
		CIRPASS Project | Digital Product Passport (DPP) | EU-funded Project	1'59''	3-8	English	https://www.youtube.com/watch?v=MTVYyzp4OXA	CIRPASS Project	Yes
		How to Create a Digital Product Passport: Step by Step	2'14''	3-8	English	https://www.youtube.com/watch?v=3RGRwyhhHpI	Bluestone PIM	No
		The Digital Product Passport (DPP) is not a website linked to a QR code, so what will it be?	24'07''	3-8	English	https://www.youtube.com/watch?v=JZEmDSNMwwk	SyncForce	yes
M2.2	Use Value Modelling and Optimisation	See Simplified MARS® Methods	2'10''	6-8	English	https://www.youtube.com/watch?v=1NiTGhpMiqo	Minitab	No
		Frameworks and Goals of Statistical Modeling	14'42''	6-8	English	https://www.youtube.com/watch?v=Eg0jtVtf9kg	University of Colorado Boulder	No
		Mineral Processing Optimization with SGS Advanced Process Control (APC)	5'14''	3-8	English	https://www.youtube.com/watch?v=y8XmwbYCFPs	SGS	No
		Data analytics and process optimization in metals	2'17''	3-8	English	https://www.youtube.com/watch?v=BnuyhsOezwg	ABB	No
		Ladle Slag Model (LSM) - English	2'01''	3-8	English	https://www.youtube.com/watch?v=s_ETk9Xihg0	RHI Magnesita	No
		Dynamic modelling of BOF process using FactSage macro - Deepoo Kumar	15'17''	3-8	English	https://www.youtube.com/watch?v=cc1wKMsV3Co	GTT Technologies	No
		BOF and EAF Steel Slags: Properties, Challenges and Applications	55'09''	3-8	English	https://www.youtube.com/watch?v=VA-hqavx8Wg	Geoenvironmental Engineering Webinars	No
M2.3		Optimize Industrial Operations with Machine Learning and AI - AWS Online Tech Talks	35'24''	3-8	English	https://www.youtube.com/watch?v=iauRINKBNHY	AWS Developers	No

Module	Subject	Title	Time	EQF	Language	Link	Created by	Europen Project
M2.4	Real-Time Optimisation (AI, ML, IoT)	Building Resilient Machine Learning Pipelines with IoT Data | Keewi	34'41''	3-8	English	https://www.youtube.com/watch?v=IIdhpoJGDYU	Data Council	No
		Real-Time Analytics Pipeline for IoT Device Monitoring and Reporting	37'18''	3-8	English	https://www.youtube.com/watch?v=naNW7bM0Qx8	Databricks	No
		How AI Can Optimize IoT Data Plans to Maximize Productivity	22'14''	3-8	English	https://www.youtube.com/watch?v=wzlB2eoKhi4	Telit Cinterion	No
		Real Time Industrial Process Optimization and Control with AI	56'40''	3-8	English	https://youtu.be/uNsFVvrcMIw	Industry40tv	No
		Designing IoT Data Pipelines for Deep Observability	31'16''	3-8	English	https://www.youtube.com/watch?v=IF-od3kM03A	InfoQ	No
	Advanced SRM Management	How Are Byproducts And Waste Streams Managed In Industrial Chemical Processes?	3'50''	3-8	English	https://youtu.be/AKViZSX9YXo	Chemistry For Everyone	No
		Developing a Waste Management Strategy: Transforming Waste from Problem to Resource	23'33'	3-8	English	https://youtu.be/ltPO_Wq6dm8	IGESjapan	No
		Transforming Waste to Bio-products - Biological Engineering at Utah State University	15'57''	3-8	English	https://youtu.be/rr8BFgMDqpU	Utah State University	No
		Transforming Plastic Waste in the World's Largest Molecular Recycling Facility | Eastman	2'32''	3-8	English	https://youtu.be/H2CWPuxu9mE	Eastman	No
		The business models that make the circular economy work | The Circular Economy Show Highlights	11'40''	3-8	English	https://youtu.be/NqteP6iT3Ys	Ellen MacArthur Foundation	No
		Circularity as the (only) winning business model	64'37''	3-8	English	https://youtu.be/kfuH2I3CqbI	Nordic Sustainability	No
		Webinar: How your business can integrate circular economy principles?	119'26''	3-8	English	https://youtu.be/kSDIWByBs4c	EMEA Think Tank	No
		Circular business models	4'34''	3-8	English	https://youtu.be/xg8HCg9-plE	Orange Business	No
M3.1	Sustainable Product Validation	Cellulose Nanofiber as an Asphalt Mix Additive	54'55''	3-8	English	https://www.youtube.com/watch?v=NSAEEbBaJ_k	ugptindsu	No
		Carbon Steel Slag - an Excellent Raw Material for Road Construction Projects - English version	6'32''	3-8	English	https://www.youtube.com/watch?v=YnOq-rdj5Q8	ZAG	No
		The Role of Slag Cement in Creating Sulfate Resistant Concrete	74'12''	3-8	English	https://www.youtube.com/watch?v=kaS7_DnpdXE	Slag Cement Association	No
		Slag and Portland Limestone Cement: A Symbiotic Relationship	49'04''	3-8	English	https://www.youtube.com/watch?v=AF3uc0IzNb8	American Concrete Institute	No
		Slag Cement's Role in Sustainable Low-Carbon Concrete	62'31''	3-8	English	https://www.youtube.com/watch?v=5xHtPPZDrCQ	American Concrete Institute	No
M3.2	Compliance and Standardisation (Quality)	Less waste, more value: focus on End of Waste criteria – CESC 2020	56'56''	3-8	English	https://www.youtube.com/watch?v=HlxpGpxHxX4	EU Environment	Yes
		2025-10-17 How to improve the proposed EU end-of-waste criteria for crushed concrete aggregates	117'43''	3-8	English	https://www.youtube.com/watch?v=GXojBZJ0jVQ	Nätverket för end-of-waste	No
		Navigating Europe's Revised Waste Framework Directive	38'43''	3-8	English	https://www.youtube.com/watch?v=lssy7506qWI	ECONYL® Brand	No
		29 Jul 2022 | Landfill leachate collection, treatment and monitoring | Tyson Clingan	85'12''	3-8	English	https://www.youtube.com/watch?v=4C-sbM5biro	HydroTerra Pty Ltd	No

Module	Subject	Title	Time	EQF	Language	Link	Created by	Europen Project
		Product Safety Requirements in the European Union	44'	3-8	English	https://www.youtube.com/watch?v=ZdwRPL_IxL4	Compliance Gate	No
		Product Compliance with EU Ecodesign & General Product Safety Regulations (Document Structure)	7'38''	3-8	English	https://www.youtube.com/watch?v=WM7cKy5YoUU	Sofeast	No
		Rebuy 2: How Reused Construction Materials Meet EU Standards	2'56''	3-8	English	https://www.youtube.com/watch?v=cqHUDudfa8Y	Zero Waste Build	No
		Design for Recycling with Recyclass - Plastics Recyclers Europe @ Dynamic Cycle Institute	42'02''	3-8	English	https://www.youtube.com/watch?v=7nEiLND_cG4	Taghleef Industries	No
M3.3	Life Cycle Analysis	Life cycle sustainability assessment (LCSA)	36'27''	3-8	English	https://www.youtube.com/watch?v=OAmlEGff8Yg	Life Cycle Thinking & Environmental Management	No
		Life Cycle Assessment (LCA) to evaluate environmental impacts of Bioeconomy - Cartoon	2'26''	3-8	English	https://www.youtube.com/watch?v=1BoownYXlP4	European Commission	Yes
		Life cycle assessment and absolute sustainability with Michael Hauschild	100'53''	3-8	English	https://youtu.be/mBNSa3zTtWw	UCLouvain - Université catholique de Louvain	No
		Life Cycle Costing (LCC)	30'33''	3-8	English	https://www.youtube.com/watch?v=M3POZBWp3yU	Life Cycle Thinking & Environmental Management	No
		Life Cycle Cost Analysis Part I: Fundamentals	61'34''	3-8	English	https://www.youtube.com/watch?v=499sinofbbY	Federal Highway Administration USDOTFHWA	No
		#3 Life Cycle Costing | Life Cycle Thinking for Sustainability	4'06''	3-8	English	https://youtu.be/_H5EK4XssIA	Life Cycle Lab HKUST	No
		Webinar: Life Cycle Costing in openLCA 1.5 with ecoinvent 3.2 extended	49'01''	3-8	English	https://youtu.be/OSrQwszdy4A	openLCA	No
M3.4	Leadership in Systemic Innovation	Why we need Systems Thinking for Sustainability?	18'14''	3-8	English	https://www.youtube.com/watch?v=gjWMMndBpOs	Systems Innovation Network	No
		Systems Thinking for Digitalised Circular Plastic Value Chains	20'12''	3-8	English	https://www.youtube.com/watch?v=LUl7sZwXo8w	PREVENT Waste Alliance	No
		Systems Thinking #2 - Andrew Howley - NASA, Biomimicry, Circular Economy, Energy Systems	27'41''	3-8	English	https://www.youtube.com/watch?v=Eq6JqwNe-Gc	Systems Thinking with David Shapiro	No
		IES webinar: Making sense of environmental problems using systems thinking approaches	41'02''	3-8	English	https://www.youtube.com/watch?v=0zkUhHI3ijQ	The Institution of Environmental Sciences (IES)	No
		Inside the world of industrial symbiosis | The origins of the circular economy	22'57''	3-8	English	https://www.youtube.com/watch?v=23Almogc-_Y	Ellen MacArthur Foundation	No
		Introduction to industrial symbiosis	3'30''	3-8	English	https://www.youtube.com/watch?v=7daVvUsvBuc	SCALER Project	Yes
M4.1		Industrial symbiosis: an engine for green jobs and growth?	15'43''	3-8	English	https://www.youtube.com/watch?v=q8d0qrlM7sc	International Labour Organization	No

Module	Subject	Title	Time	EQF	Language	Link	Created by	Europen Project
M4.2	Introduction to IS and EE Fundamentals	What is Industrial Symbiosis? - Hug in the Snug	11'49''	3-8	English	https://www.youtube.com/watch?v=ORFVvJCc1fM	Life Size	No
		Sustainable value creation through industrial symbiosis	54'32''	3-8	English	https://www.youtube.com/watch?v=kZfudP_DudM	Institute for Manufacturing (IfM), University of Cambridge	No
		What Energy Efficiency Concepts Actually Work? - Thermodynamics For Everyone	3'36''	3-8	English	https://www.youtube.com/watch?v=QO2TjxDoUtU	Thermodynamics For Everyone	No
		Lecture 36 Energy Efficiency - I	37'59''	3-8	English	https://www.youtube.com/watch?v=2zWt-pBCU2I	IIT Roorkee July 2018	No
		#EUCircularTalks: Industrial Symbiosis	168'33''	3-8	English	https://www.youtube.com/watch?v=GxlPUDVpXAE	ECESP Circular Economy	Yes
	Operational Waste Management (Upcycling)	How to Treat ETP Sludge: Complete Guide to Sludge Drying & Disposal | Industrial Benefits & Solution	2'26''	3-8	English	https://www.youtube.com/watch?v=CzG1ZEuSMw8	Wastewater Treatment Industry Insights	No
		Screening of metal slag with MultaVEX Vibra 10-15	1'16''	3-8	English	https://www.youtube.com/watch?v=de0lPCJH6_c	MultaVEX	No
		Slag Crushing	14'22''	3-8	English	https://www.youtube.com/watch?v=22z-mub5zZg	Stefan Hartl	No
		Screening steel slag (2022)	2'47''	3-8	English	https://www.youtube.com/watch?v=ZtutYBJWeHs	FlipScreen	No
		Scrap waste grinding for metal recovery Panizzolo Mega 1500	7'09''	3-8	English	https://www.youtube.com/watch?v=jNvrHa09qDg	Panizzolo Recycling	No
		Innovative Household Waste Drying System (DRYWASTE ENG)	8'20''	3-8	English	https://www.youtube.com/watch?v=kxov5S-7OT8	drywastelifeproject drywastelifeproject	No
M4.3	Operational Optimisation and Digitalisation	What Is Resource Optimization? - BusinessGuide360.com	2'08''	3-8	English	https://www.youtube.com/watch?v=LnP5YfdJzqE	Business Guide 360	No
		Circularity as the (only) winning business model	64'37''	3-8	English	https://www.youtube.com/watch?v=kfuH2I3CqbI	Nordic Sustainability	No
		Real-time Optimal Resource Allocation in an Industrial Symbiotic Network	14'54''	3-8	English	https://www.youtube.com/watch?v=aoDmXLjO_Kw	Dinesh Krishnamoorthy	No
		Can Industrial Symbiosis Transform Waste Into New Business Opportunities?	3'22''	3-8	English	https://www.youtube.com/watch?v=ejd74ELB-Bk	Smart Logistics Network	No
		Technology strategy: Industrial symbiosis	10'53''	3-8	English	https://www.youtube.com/watch?v=oNfaBSkEdvU	MEM Northwestern	No
		Automate Your Production Monitoring with Machine Data	49'05''	3-8	English	https://www.youtube.com/watch?v=UVVJLb3Sq9c	MachineMetrics	No
		Digitalization Tools in Manufacturing	54'09''	3-8	English	https://www.youtube.com/watch?v=oUJQs2_k4e8	The Financial Executives Networking Group	No
		How to Automate Industrial Process Monitoring?	4'00''	3-8	English	https://www.youtube.com/watch?v=ny5pcvJRsus	Blue Ocean Data Solutions	No
		Energy monitoring for smart manufacturing	4'01''	3-8	English	https://www.youtube.com/watch?v=pvZ3vUgZH6w	Phoenix Contact USA	No
		Analyzing Energy Monitoring Data and Set Alarm | Sensor Data & Alarms	4'21''	3-8	English	https://www.youtube.com/watch?v=dUnG5CjpeGM	Factbird	No
		How Is Data Used In An Energy Management System?	3'14''	3-8	English	https://www.youtube.com/watch?v=B1_r40YDHC8	Earth Science Answers	No
		Overview Energy Management System (EMS)	5'01''	3-8	English	https://www.youtube.com/watch?v=v_dLFbbzvEI	Initial Learn With Me	No
		How To Manage Your Team's Workload	4'47''	3-8	English	https://www.youtube.com/watch?v=wWj_YYpen7E	SystemHUB	No

Module	Subject	Title	Time	EQF	Language	Link	Created by	Europen Project
M4.4	Operational Soft Skills	What is Task Management? Examples, Tips + Methods for Success	5'05''	3-8	English	https://www.youtube.com/watch?v=kGwvrnqLCIc	monday.com	No
		How to use Tasks in Microsoft Teams (To Do + Planner)	15'58''	3-8	English	https://www.youtube.com/watch?v=FJaICKh5kR8	Kevin Stratvert	No
		A Systematic Approach to Sustainability	20'45''	3-8	English	https://www.youtube.com/watch?v=2hXhpUfE4l0	Bridgewater Associates	No
		Systems Thinking for Sustainability Course Intro	3'37''	3-8	English	https://www.youtube.com/watch?v=qOemZZ3A0cE	Systems Innovation Network	No
		Master Sustainability With Ease. Use A Management System Approach!	37'52''	3-8	English	https://www.youtube.com/watch?v=n9sVEg-4zjc	Leadership & Sustainability	No
		Working in Sustainability: Insights Shared by 12 Sustainability Professionals -CSRD, Due Diligence..	14'29	3-8	English	https://www.youtube.com/watch?v=Wptm1q_zdhM	Sustainable Business Insights | Anne Jacobs	No
M5.1	Environmental Regulation and Frameworks	EU Waste Legislation & Circular Economy Webinar Series #1	64'26''	3-8	English	https://www.youtube.com/watch?v=nRoBkJfxBgc	ISWA International Solid Waste Association	No
		Issue in Focus: European waste legislation	2'15''	3-8	English	https://www.youtube.com/watch?v=YkisW0tTZlE	eBay Main Street	No
		European Environmental Regulation for SMEs	16'23''	3-8	English	https://www.youtube.com/watch?v=4-vAXbWtDgg	EU Environment	Yes
		Waste Shipments Regulation | [2024] | Surfing the Tsunami of Sustainability Compliance	16'18''	3-8	English	https://www.youtube.com/watch?v=C7oX3bc6ehs	TEIMAS	No
		Regulatory frameworks	49'18''	3-8	English	https://www.youtube.com/watch?v=INT5UqetA9Q	ANZSOG	No
		What Framework Guides Compliance Policy Development?	3'38''	3-8	English	https://www.youtube.com/watch?v=C0efUYJ_Cyw	Security First Corp	No
		HDIW | Regulatory sandboxes and innovation hubs	8'12''	3-8	English	https://www.youtube.com/watch?v=32TUrI4I720	EU Supervisory Digital Finance Academy	No
		Toolkits 1: Environmental Assessment Toolkit (Deborah Dauber)	12'02''	3-8	English	https://www.youtube.com/watch?v=rOgvCiYOWkw	iBiology Career and Professional Development	No
		AI-driven future of the EU: transforming compliance with regulatory technologies - Media Partnership	94'51	3-8	English	https://www.youtube.com/watch?v=AJjBNjPSF70	Euractiv	No
M5.2	Managing Cross-Sectoral Complexity (IS)	Cross-regulatory cooperation 1	8'12''	3-8	English	https://www.youtube.com/watch?v=aG2dHTlNig0	Privacy Laws & Business	No
		Engaging with Evidence: Cross-sector collaboration: Insights from a leaders' Playbook	91'23''	3-8	English	https://www.youtube.com/watch?v=SFgCp8tZWoA	The Government Outcomes Lab	No
		Industrial Symbiosis Standardization Dialogues- Current approaches, collaborations & bottlenecks'	55'39''	3-8	English	https://www.youtube.com/watch?v=qU-7gjKLIho	CEN and CENELEC	No
		Sustainable value creation through industrial symbiosis	54'26''	3-8	English	https://www.youtube.com/watch?v=cqNSkcdzcNc	SCALER Project	Yes
		Inside the world of industrial symbiosis | The origins of the circular economy	22'57''	3-8	English	https://www.youtube.com/watch?v=23Almogc-_Y	Ellen MacArthur Foundation	No
		Kalundborg Symbiosis 2022	2'20''	3-8	English	https://www.youtube.com/watch?v=Ism7NdQe94I	Symbiosis Center Denmark	No
		Can Industrial Symbiosis Really Create A Circular Economy? - How It Comes Together	3'10''	3-8	English	https://www.youtube.com/watch?v=Y307r6EVCh8	How It Comes Together	No

Module	Subject	Title	Time	EQF	Language	Link	Created by	Europen Project
		Industrial symbioses and eco-industrial parks: the Kalundborg symbiosis	8'06''	3-8	English	https://www.youtube.com/watch?v=1koYpJs5PSo	UVED	No
		Industrial symbiosis: an engine for green jobs and growth?	15'43''	3-8	English	https://www.youtube.com/watch?v=q8d0qrlM7sc	International Labour Organisation	No
		What Is Industrial Symbiosis? - Ecosystem Essentials	3'18''	3-8	English	https://www.youtube.com/watch?v=XOwxPzufS_c	Ecosystem Essentials	No
M5.3	Circular Business Models and Strategy	Five Circular Economy Business Models	1'17''	3-8	English	https://www.youtube.com/watch?v=v6yCgjFv5LM	Veolia | North America	No
		Circular Economy Business Models explained	1'25''	3-8	English	https://www.youtube.com/watch?v=YplBoptex9Q	Askel Sustainability Solutions	No
		Ellen MacArthur | The Circular Economy Imperative	5'53''	3-8	English	https://www.youtube.com/watch?v=yPZFNvrnO4E	World Economic Forum	No
		Circular business models: making the economics work	47'53''	3-8	English	https://www.youtube.com/watch?v=Dq46r3zdJmA	Ellen MacArthur Foundation	No
		Circular Economy Explained: The Future of Sustainable Business?	5'51''	3-8	English	https://www.youtube.com/watch?v=BwNONQiFbmY	IE Insights	No
		The Entrepreneurial Mindset | Parvez Abbasi | TEDxSTMU	17'55''	3-8	English	https://www.youtube.com/watch?v=Xisgwdjbviu	TEDx Talks	No
		The Power of an Entrepreneurial Mindset | Bill Roche | TEDxLangleyED	16'20''	3-8	English	https://www.youtube.com/watch?v=Ihs4VFZWwn4	TEDx Talks	No
		How to Think Like an Entrepreneur | Tejas HR | TEDxDSU	5'24''	3-8	English	https://www.youtube.com/watch?v=3dCvEGym2-A	TEDx Talks	No
M5.4	Communication and Social Acceptance	DS Smith | Communicating Circular Strategy Through Motion Design	1'06''	3-8	English	https://www.youtube.com/watch?v=wqeuJrAvtcU	Alchemy Studio	No
		Communicating the Circular Economy | CWM Environmental | Green Horizons	3'56''	3-8	English	https://www.youtube.com/watch?v=jf53cqDXF4c	Institute of Sustainability & Environmental Prof	No
		Circularity Deck Tutorial	7'31''	3-8	English	https://www.youtube.com/watch?v=cxy90TcMwoM	Circularity Deck	No
		Four Ways to Start Meaningful Conversations About the Circular Economy	30'22''	3-8	English	https://www.youtube.com/watch?v=X20aR9ykpyE	Ellen MacArthur Foundation	No
		Visual Communication Strategy Insights Part #4: Sustainability	1'07''	3-8	English	https://www.youtube.com/watch?v=-fjlXWhZa4k	RENOLIT	No
		Behaviour change for a circular economy - How it works and why it pays off (March 2022)	55'20''	3-8	English	https://www.youtube.com/watch?v=DjyX12Sway0	PREVENT Waste Alliance	No
		Stakeholder Engagement 101: How to Do Stakeholder Engagement Management	7'47''	3-8	English	https://www.youtube.com/watch?v=3251NgEX2M8	Online PM Courses - Mike Clayton	No
		How to Build a Stakeholder Engagement Strategy	14'47''	3-8	English	https://www.youtube.com/watch?v=C4S5YqXo6C0	Product Pathways	No
		Methodology to develop a stakeholder map and stakeholder engagement exercise	20'35''	3-8	English	https://www.youtube.com/watch?v=6f5m1fxLNbA	HumanBrainProject	No
		Workshop: Stakeholder Mapping Made Easy	27'53''	3-8	English	https://www.youtube.com/watch?v=WGLNoQF5Cog	Quorum	No
		Stakeholder Engagement: Building Strong Relationships for Project Success	9'52''	3-8	English	https://www.youtube.com/watch?v=Y2JlOpqU9pQ	Adriana Girdler	No

Note: the OERs referring to this table are indicated as EQF level 3-8, as they can be used for all levels, since what differentiates them in level will be the learning outcome that will be required of them in the learning activity.

4.4. Platforms and repositories

Table 5. Platforms and repositories

Module	Website name	Link	Summary	EQF
M1	WtERT	https://wtert.org/	WtERT® is a leading nonprofit research organisation dedicated to advancing the best available technologies for recovering materials and energy from residual non-recyclable waste globally. WtERT® serves as a unique consortium that bridges industry and academia, fostering collaboration among engineers, policymakers, and scientists across 30 countries.	3-8
	EU Academy	https://academy.europa.eu/	EU Academy is a European Union e-learning platform that offers a variety of free courses on EU-related topics.	3-5
	Zero Waste Europe	https://zerowasteeurope.eu/	Library with reports, guides and documents on circular economy, reuse, waste policies, and management of secondary materials.	3-8
	World Resources Forum (WRF)	https://www.wrforum.org/	International organization focused on resource efficiency, circular economy and sustainable use of raw materials policies — good for articles, conferences and networking with global stakeholders.	3-8
	EIT RawMaterials – "Circular Societies Lighthouse"	https://eitrawmaterials.eu/	Innovation and education platform that encourages recycling, waste reuse and industrial symbiosis, supporting SRM, upcycling and circular economy projects.	3-8
	Recycling Europe	https://recyclingeurope.org/	Confederation of European Recyclers — publishes reports, news, sector policies, discussions on recycling, recycled markets, regulation and advocacy.	3-8
	International Resource Panel (IRP, da ONU / UNEP)	https://www.resourcepanel.org/	Scientific panel that produces international assessments on efficient use of resources, sustainability policies, materials life cycle and recommendations for raw materials governance.	3-8
	WRAP (Waste & Resources Action Programme)	https://www.wrap.ngo/eu	Organization focused on reducing waste, promoting a circular economy, efficient use of resources and developing sustainable products — with useful guides and tools.	3-8
	AshCycle Project	https://www.ashcycle.eu/en/	Project dedicated to the recovery and valorization of incineration waste (ash, slag, mineral waste), with public deliverables: technical reports, characterization data, recovery and upcycling methodologies.	3-8
	Circular Economy Stakeholder Platform (CE Platform, da Comissão Europeia)	https://circulareconomy.europa.eu/platform/en	Official EU circular economy portal — with policies, publications, practice base, case studies, recycling guides, EoW criteria, sector strategies, etc.	3-8

	European Environment Agency (EEA) – "Resource efficiency & waste"	https://www.eea.europa.eu/en	Section dedicated to resource efficiency and waste management, with data, statistics, monitoring reports, circularity metrics — useful for evaluating material flow and impacts.	3-8
	Circular Cities & Regions Initiative (CCRI) — "Background data collection for future EU end-of-waste criteria of C&D waste"	https://circular-cities-and-regions.ec.europa.eu/support-materials/papers-and-reports/background-data-collection-future-eu-end-waste-criteria	Support and research document to define EoW criteria for construction and demolition waste — useful for those working with construction and recycling/transformation materials.	3-8
	Eurima – page about Circular Economy & Sustainable Construction	https://www.eurima.org/circular-economy	The mineral wool and construction industry presents circular economy practices, recycling of slag and industrial waste, and examples of the use of recycled materials in construction — relevant to SRM and upcycling.	3-8
	Wood2Wood Project	https://www.wood2wood-project.eu/	Project for the recovery of waste from the wood industry, with brochures, results, recycling and recovery methodologies — example of industrial waste upcycling.	3-8
	Materials Processing Institute	https://www.iom3.org/resource/fusing-foundations.html	Article/essay on industrial symbiosis in the "foundation industries" sector (metals, ceramics, glass, cement), with reflections on the use of slag, by-products and opportunities for circularity.	3-8
	IMFORMED – "Mineral recycling renaissance"	https://imformed.com/mineral-recycling-renaissance/	Platform and publication specialized in mineral recycling, with information on slag, secondary materials, trends, market opportunities and recycling of industrial minerals.	3-8
	NetZeroCities	https://netzerocities.app/resource-2615	Database of CE solutions applicable to cities and buildings: urban waste management, reuse, recycling of materials, life cycle, reuse of demolition materials, etc. Useful for upcycling, LCA, urban/industrial symbiosis.	3-8
M2	European Circular Economy Stakeholder Platform (ECESP) – DPP Resources	https://circulareconomy.europa.eu/platform/en	Session dedicated to traceability, DPP and legal requirements for circular products.	3-8
	GS1 – Digital Product Passport & Traceability	https://www.gs1.org/	Global authority on product traceability and digital identification standards.	3-8
	Ecodesign for Sustainable Products Regulation	https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/ecodesign-sustainable-products-regulation_en	Requirements, standards, guides and compliance documentation for circular products.	3-8
	NIST Engineering Laboratory – Statistical Modelling & Materials Research	https://www.nist.gov/el	Modeling methods, MARS, industrial materials analysis and process engineering.	3-8
	ScienceDirect – Materials & Design (open abstracts)	https://www.sciencedirect.com/journal/materials-and-design	Studies on steel slag, mixture optimization, predictive modeling.	6-8
	IOM3 – Institute of Materials, Minerals & Mining	https://www.iom3.org/	Technical content on industrial by-products, slag, recycled materials.	3-8
	IBM Research – AI for Industry & IoT	https://research.ibm.com/	Applications of artificial intelligence, process optimization and industry 4.0.	3-8
	Siemens Digital Industries – Industrial IoT Knowledge Hub	https://www.siemens.com/global/en.html	Resources (white papers, practical cases) on IoT, automation and digital twins.	3-8
	Fraunhofer Institute for Industrial Engineering (IAO)	https://www.iao.fraunhofer.de/	Studies on industrial digitalization, IoT, smart manufacturing and real-time optimization.	3-8

	EIT RawMaterials – Waste & Secondary Raw Materials	https://eitrawmaterials.eu/	Content on SRMs, transformation of by-products, recovery technologies.	3-8
	European Environment Agency – Waste & Material Flows	https://www.eea.europa.eu/en/topics/at-a-glance/economy-and-resources	Indicators, analysis methodologies, policies and case studies on valuation.	3-8
	Ellen MacArthur Foundation – Circular Economy Business Models	https://www.ellenmacarthurfoundation.org/	Circular business models, practical cases, implementation guides.	3-8
	CORDIS – EU Projects Repository	https://cordis.europa.eu/	Main repository to find descriptions, results, deliverables, technical reports and documentation of all EU projects, including those linked to CE, SRM, upcycling and innovation.	3-8
	EFIC – Funded EU Projects Portal	https://www.efic.eu/funded-eu-projects	Portal that brings together multiple EU circular economy, innovation and sustainability projects — useful for discovering consortia, calls, initiatives and networking.	3-8
	ROTATE Project	https://rotateproject.eu/	Valorization of critical resources and waste/sludge, resource optimization, recovery and environmental restoration in mines/quarries and industries.	3-8
	European Commission – End-of-Waste & Secondary Raw Materials	https://joint-research-centre.ec.europa.eu/projects-and-activities/less-waste-more-value/end-waste_en	EoW criteria, directives, legislation, technical requirements and SRM certification.	3-8
	Joint Research Centre (JRC) – End-of-Waste & Reference Methods	https://joint-research-centre.ec.europa.eu/index_en	JRC technical reports on leaching, residue assessment, EoW, compliance testing.	3-8
	European Aggregates Association (UEPG)	https://www.aggregates-europe.eu/	Use of recycled aggregates (including LAR and slag) in paving, construction and geotechnical works.	3-8
	Global Slag (ProGlobal Media)	https://www.globalcement.com/	Studies and technical applications of steel slag in pavements, hydraulics and construction.	3-8
	RILEM (International Union of Laboratories and Experts in Construction Materials)	https://www.rilem.net/	Recommendations and research on recycled materials, durability, mechanical performance and leaching.	3-8
	CIRIA (Construction Industry Research and Information Association)	https://www.ciria.org/	Recycled materials for civil engineering, landfill management, hydraulic solutions, and technical guides.	3-8
M3	Life Cycle Initiative (UNEP)	https://www.lifecycleinitiative.org/	LCA guides and tools, including methodologies for waste, SRM and industrial applications.	3-8
	Ecoinvent Database	https://ecoinvent.org/	LCA inventories for assessment of SRM, construction, waste, and environmental impact analysis.	3-8
	International Society for Industrial Ecology (ISIE)	https://is4ie.org/	Industrial symbiosis, complex systems, meta-approaches and systemic modelling.	3-8
	European Circular Economy Stakeholder Platform (ECESP)	https://circulareconomy.europa.eu/platform/en	Cases and projects related to SRM, construction waste, EoW, certification, IS/CE.	3-8
	WBCSD – Circularity & Industrial Transformation	https://www.wbcsd.org/	Frameworks for CE, corporate LCA/LCC, economic and sustainability assessment methodologies.	3-8
	nternational Water Association (IWA) – Resource Recovery Platform	https://www.iwa-network.org/	Valorisation of by-products, water reuse, hydraulic applications and environmental/economic assessment.	3-8
	TRL (UK Transport Research Laboratory)	https://www.trl.co.uk/	Advanced research into pavements using SRM (incl. slag, LAR, cellulose fibres), performance, safety and technical compliance.	3-8

	CINDERELA – SRM for Urban Construction Applications	https://www.cinderela.eu/	SRM formulations for pavements and urban works; EoW; product certification.	3-8
	DESTINY – Advanced Technologies for SRM Processing	https://www.destinyh2020andbeyond.eu/	Advanced processing of industrial waste and slag, energy efficiency.	3-8
	ICEBERG – Circular Economy for Building Materials	https://iceberg-project.eu/	SRM, traceability, quality assessment, EoW, LCA/LCC and digital solutions.	3-8
	REPAiR – Resource Management & CE in Regions	https://h2020repair.eu/	CE, systemic modeling, IS, material flows, support for public policies (policy tools).	3-8
	BAMB – Buildings As Material Banks	https://www.bamb2020.eu/	Traceability, material passport (Material Passport), compliance criteria and EoW.	3-8
M4	International Society for Industrial Ecology (ISIE)	https://is4ie.org/	Contents on industrial symbiosis, material flows and resource optimization.	3-8
	Ellen MacArthur Foundation – Circular Economy Resources	https://www.ellenmacarthurfoundation.org/	Guides on CE, IS, resource efficiency, sustainable management.	3-8
	Industrial Symbiosis/ Kalundborg Symbiosis	https://www.symbiosis.dk/en/	World reference case in Industrial Symbiosis + accessible educational materials.	3-8
	UNIDO – Industrial Energy Efficiency	https://www.unido.org/	Simple guides on industrial energy efficiency, audits, energy monitoring.	3-8
	US Department of Energy – Energy Efficiency & Advanced Manufacturing	http://energy.gov/eere/ammto/advanced-materials-and-manufacturing-technologies-office	Technical content on energy reduction, digitalization and process optimization.	3-8
	IEA – International Energy Agency – Energy Efficiency	https://www.iea.org/	Materials on energy management, monitoring and reduction of consumption.	3-8
	CEM – Clean Energy Ministerial – Energy Management (ISO 50001)	https://www.cleanenergyministerial.org/	Educational information on energy management, measurements, monitoring and good practices.	3-8
	European Environment Agency – Waste Management & Resources	https://www.eea.europa.eu/en/topics/at-a-glance/economy-and-resources	Guides on waste treatment, by-products, recycled materials and SRM.	3-8
	Cement & Concrete Europe – By-product utilisation (Slag, LAR)	https://cembureau.eu/	Technical explanations about slag, mineral waste, grinding, pre-treatments and use in construction.	3-8
	Global Slag (ProGlobal Media)	https://www.globalslag.com/	Educational and technical content on steel slag optimization, grinding, drying and applications.	3-8
	European Federation of Waste Management (FEAD)	https://fead.be/	Waste treatment, recovery, by-products, compliance and operating practices.	3-8
	WRAP UK – Resource Efficiency & Waste Processing	https://www.wrap.ngo/	Simple guides on waste processing, low-cost technologies and resource efficiency.	3-8
	Fraunhofer Institute – Resources, Recovery & Digitalisation	https://www.fraunhofer.de/en.html	Content on process digitalization, monitoring, sensors and industrial IoT.	3-8
	IEMA – Sustainability Skills & Environmental Management	https://www.isepglobal.org/	Educational texts on sustainability, diligent work, environmental standards and good practices.	3-8

	WBCSD – Energy, Resource Optimisation & Sustainability	https://www.wbcsd.org/	Guides for business sustainability, energy optimization and process transformation.	3-8
	ReWaise – Water Smart Industrial Symbiosis Ecosystem	https://rewaise.eu/	IS demonstrator projects in industrial sectors with water management.	3-8
	REVaMP – Resource-Efficient Valorisation of residues from metallurgical plants	https://revamp-project.eu/	Treatment of industrial by-products and waste, including slag.	3-8
	NEMO – Sustainable valorisation of mining and metallurgical waste	https://h2020-nemo.eu/	Technologies for treating and reusing mineral waste and slag.	3-8
M5	CITYLOOPS – Circular Economy frameworks for cities	https://cityloops.eu/	Policy tools, systemic modeling and stakeholder engagement.	3-8
	CIRCULÉIRE – Irish National Platform for Circular Economy	https://www.circuleire.ie/	CE business models, entrepreneurship, industrial demonstrations.	3-8
	SCALER – Scaling Industrial Symbiosis in Europe	https://scalerproject.eu/	Industrial symbiosis, policy tools and intersectoral cooperation.	3-8
	REPLACE – Improving policy instruments for the Circular Economy	https://www.interregeurope.eu/replace	Regulations, policy instruments and institutional collaboration.	3-8
	CICERONE – Circular Economy Policy Alignment & Roadmaps	https://cicerone-h2020.eu/	Public policy, CE strategies and regulatory frameworks.	3-8
	ECOBULK – Circular Business Models and stakeholder engagement	https://www.ecobulk.eu/	Business models, CE communication and stakeholder participation.	3-8
	SYMBI – Industrial Symbiosis for regional policy implementation	https://www.interregeurope.eu/symbi	EoW policy, industrial symbiosis, governance and regulatory oversight.	3-8
	INNOVEAS – Capacity building for SMEs on sustainability & leadership	https://innoveas.eu/	Leadership mindset, CE communication and sustainable business competence.	3-8
	SHARED GREEN DEAL – Social engagement & policy tools for CE	https://sharedgreendeal.eu/	Communication strategies, workshops, social impact and community involvement.	3-8
	ELISE – European Learning and Innovation Space for Ecosystems	https://www.elise-ai.eu/	Learning and collaboration platform for CE and social innovation connecting industry, academia and society.	3-8
	IoT Analytics – Industrial IoT Domain	https://iot-analytics.com/	Articles, reports and analyzes on IoT in industrial process optimization.	3-8
	Industrial Internet Consortium (IIC)	https://www.iiconsortium.org/	Resources on IoT, industrial cases, standards and guidance for digitalization and data flow optimization.	3-8
	Zero Waste International Alliance	https://zwia.org/	Concepts, metrics, policies, and global best practices in waste and by-products.	3-8
	Waste360 – Waste & Recycling Industry News	https://www.waste360.com/	News, white papers and practical cases on waste treatment and transformation.	3-8
	The Recycling Partnership – Insights & Tools	https://recyclingpartnership.org/	Practical guides on waste treatment, urban recycling models and recovery metrics.	3-8
	Carbon Trust – Energy Management Resources	https://www.carbontrust.com/en-eu	Free guides on energy efficiency monitoring, metrics and plans.	3-8

Energy Star – ENERGY STAR for Industry	https://www.energystar.gov/	Energy performance measurement tools and indicators.	3-8
U.S. Department of Energy – Energy Saver	https://www.energy.gov/energysaver/energy-saver	Practical guides for energy management and consumption reduction (suitable for EQF 3–5).	3-5

4.5. Characterisation of selected OERs

Analysis of OER and identified European projects demonstrates a wide coverage of training materials, which serve as a starting point for the development of ICARUS Training Packs.

Survey and Analysis of Open Platforms (OERs)

The inventory is made up of a diversity of e-learning platforms, institutional repositories and open channels, which provide resources for all levels of the European Qualifications Framework (EQF 3–8), presented below in Table 6.

Table 6. Composition of the OERs inventory

Type of Platform/Repository	Examples (Key Sources)	Typical Content
MOOCs and Specialised Academies	Steeluniversity, UNIDO Training Academy, EU Academy, World Bank Group.	Structured courses on Digital Twin, Thermodynamics, Industry 4.0, Laboratory Practices (GLP) and EU Regulation (CBAM).
Open Video Platforms	YouTube.	Short videos on basic concepts of Ecodesign, LCA/LCC, Digital Product Passport (DPP), Industrial Symbiosis (IS) and environmental monitoring.
Scientific/Technical Repositories	Articles with DOI (via ScienceDirect, etc.), CORDIS.	Advanced publications on modeling (MARS), optimization with AI/ML/IoT, End-of-Waste (EoW) and leaching assessment.
CE/Policy Repositories	Ellen MacArthur Foundation, ECESP, EIT RawMaterials.	Guides on circular business models, data on material flows, and regulatory policy reports (DPP, EoW).

Summary of the Relevance of OERs and European Projects

The identified resources have direct relevance to the key skills gaps of the ICARUS project, especially:

- Advanced Digitalization (EQF 6–8): Strong coverage of topics such as Industry 4.0, Digital Twin, process optimization via AI/ML and IoT Data Pipelines. Platforms such as Steeluniversity and IBM Research provide specialized material in this domain.
- Circular Economy (CE) and Industrial Symbiosis (IS): Numerous courses and videos cover the principles of IS, waste management for recovery, and circular business models. Projects such as SCALER and INSIGHT are cited as direct sources of training for IS facilitators.
- EU Regulations and Standards: There is significant coverage of the EU regulatory framework, including courses on the Carbon Border Adjustment Mechanism (CBAM), videos on the Digital Product Passport (DPP), and numerous publications on End-of-Waste (EoW) status. Many of these resources come directly from European projects (e.g. CIRPASS) or the European Commission.
- Technical Applications of SRM: The inventory includes detailed publications (EQF 6-8) on the upcycling of steel slag for construction materials and the assessment of durability and environmental safety (leaching).

Strengths of the OER Base

- High Technical and Professional Level: A significant proportion of resources (mainly scientific publications and Steeluniversity courses) are classified at EQF levels 6–8, filling the need for specialized training for engineers and managers.
- European Validation and Current Affairs: The strong inclusion of European Projects (identified with "Yes", in a total of 20+ projects such as SPIRE-SAIS, INSIGHT, Ecosign Project and CIRPASS) ensures alignment with the latest EU policies and directives.
- Diversity of Digital Content: The combination of modular courses, scientific articles and short videos allows the creation of flexible learning paths that are adaptable to different learning styles.
- Accessibility: All resources listed are free to access.

Limitations and Gaps Identified

- Concentrated Sectoral Focus: Although there is strong specialisation, the inventory shows a significant bias towards the steel industry (via Steeluniversity) and construction materials (slag, ceramics). This may require additional effort in T10.3 to adapt the knowledge to other industrial process sectors.
- Uneven Depth of Formats: Many videos are short and introductory, best suited for EQF 3-5 training (basic LCA concepts, which is useful for the blue-collar audience), but insufficient for advanced engineering training.

5. Conclusions

Deliverable D10.2 fully achieves its intended objective by providing a systematic, evidence-based benchmark of existing Open Educational Resources (OERs), establishing a consolidated and operational reference framework that directly bridges the skills gaps identified in D10.1 with the design and development of the modular training packages foreseen in Task 10.3 (T10.3). By translating training needs into a structured mapping of available knowledge, D10.2 plays a pivotal role in ensuring coherence, efficiency and strategic alignment within Work Package 10 (WP10).

The methodological approach adopted—combining structured desk research, targeted analysis of online learning platforms and MOOCs, peer-reviewed scientific literature with DOI, and the capitalisation of European Union–funded projects—ensures a comprehensive and reliable assessment of the state of the art. This approach not only guarantees the quality and credibility of the identified resources, but also supports the strategic objective of avoiding duplication of efforts by prioritising the reuse, adaptation and integration of validated knowledge already available at the European level.

The resulting inventory, comprising 490 OERs, demonstrates a high degree of technical robustness and strong alignment with both the strategic priorities of the ICARUS project and the objectives of the green and digital transition. In particular, the benchmark confirms extensive coverage in domains where skills gaps were identified as most critical in D10.1, namely advanced industrial digitalisation (including Artificial Intelligence, Machine Learning, IoT and Digital Twin applications) and the evolving European regulatory framework (notably End-of-Waste criteria, the Digital Product Passport and CBAM). The predominance of resources mapped to EQF levels 6–8 is especially relevant for the training of highly qualified technical profiles, researchers and decision-makers, while still ensuring complementary coverage for operational profiles at lower EQF levels.

At the same time, the benchmark analysis provides valuable insights that directly inform the subsequent design choices in T10.3. Two structural limitations were clearly identified. First, a sectoral concentration of available resources on the steel industry and construction materials highlights the need for deliberate efforts to adapt and transfer knowledge to other process industries addressed by ICARUS. Second, an imbalance in the depth of available training formats was observed, with a relatively strong supply of introductory and operational content (EQF 3–5), contrasted with more limited availability of advanced, practice-oriented training materials addressing complex regulatory, methodological and cross-sectoral challenges at EQF levels 6–8.

In this context, D10.2 does not merely function as a descriptive inventory but as a decision-support tool that provides clear guidance for the development of new training content. By identifying both areas of strong coverage and critical gaps, it ensures that the training modules to be developed in T10.3 will be genuinely complementary to the existing state of the art, targeted to real needs, and capable of maximising the added value and impact of the ICARUS training offer.

In conclusion, Deliverable D10.2 establishes a solid, validated and strategically aligned evidence base for the implementation of WP10 training activities. It ensures that the forthcoming modular training packages are grounded in a comprehensive understanding of existing resources, fully aligned with the skills gaps identified in D10.1, and positioned to effectively support capacity building for the green and digital transition across the industrial ecosystems addressed by the ICARUS project.