



Skills Alliance for Industrial Symbiosis: A Cross-sectoral Blueprint for a Sustainable Process Industry (SPIRE-SAIS)

Training Framework: Development of training courses, measures, arrangements, tools and ac- tivities for integration within VET, compa- ny and association training programmes

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1 Executive Summary

The infrastructure for sharing learning solutions between stakeholders of the SPIRE-SAIS Online Training Eco-system and *Regional Training Eco-systems* from the Learning Solution Directory (a central repository) available in SKILLS4Planet, was developed and successfully implemented. Besides, a Data Base of Skills for the Industrial Symbiosis and Energy Efficiency, which reflect training need, was implemented in the Skill Directory of SKILLS4Planet. This Directory was used to curate the learning solutions and create innovative solutions in the framework of Capability Assessor to improve the identification of skill gaps into the companies.

A successful implementation of the first version of SKILLS4Planet infrastructure have been achieve, which include i) the integration of training providers with new learning solutions into the system to cover the knowledge and skills gaps defined by the SPIRE-SAIS Skills Assessment Checklist and Survey reflected in the Skill Directory, ii) The develop a Capability Assessment module to identify Skill Gaps to support the conversation between employee and employer to up and re-skill them, iii) Integration of the learning solutions into stakeholder of the ecosystem following a business model that assure sustainability of the solution and iv) the development of a methodology to deliver a highly accepted Blended Training Path.

The next step is continued with the integration of Publishers and Organisation into the tool as well as find solutions to the emerging problem of translation to reach all the levels of the workforce into the companies. Besides, it is required to continue the development to integrate innovative solutions that simplify the maintenance of the infrastructure and support a smooth experience of the learners, like Artificial Intelligent tools to matching learning outcomes of solutions and competence map.

2 Introduction

The SPIRE-SAIS Blueprint is answering the industry skills demands with the establishment of **Skills Intelligence** via a **Foresight Observatory** and the **Online Training Platform SKILLS4Planet**, in the further course by establishing a **European Training Community for Industrial Symbiosis**, supported by **Image and Recruitment** concepts.

2.1 Governance Structure

The supply side of SPIRE-SAIS is ensuring the continuous update of the demand side and a timely provision of training measures and support, continuously updated. Therefore, we established **Skills Intelligence via a Foresight Observatory** as the core coordination element of SPIRE-SAIS, complemented by the running online training platform SKILLS4Planet and a to be established Sectoral-National-Regional Community of Training Practice. Within the Observatory:

- Technology and skills foresight will be done on a regular basis, e.g. via a (bi-)annual survey "**Industrial Symbiosis Technology and Skills Radar**".
- Technological and economic development and skills related projects will be listed in a **Project Repository**, continuously updated.
- Recommendations, indicators and incentives will be developed pushing the focus on qualifications, competences and skills for Industrial Symbiosis and Energy Efficiency.
- Pilot measures and test options for IS and EE skills adjustments will be supported and fostered, including looking for (European and national) funding schemes.
- The **Online Training SKILLS4Planet Platform** is giving immediate answers to the industry skills demands.
- Industry image campaigns for recruitment and talent attraction will be supported focusing on IS / EE skills and qualifications.
- Leadership is defined in an Open Coordination way, dividing responsibilities between the main and willing actors.

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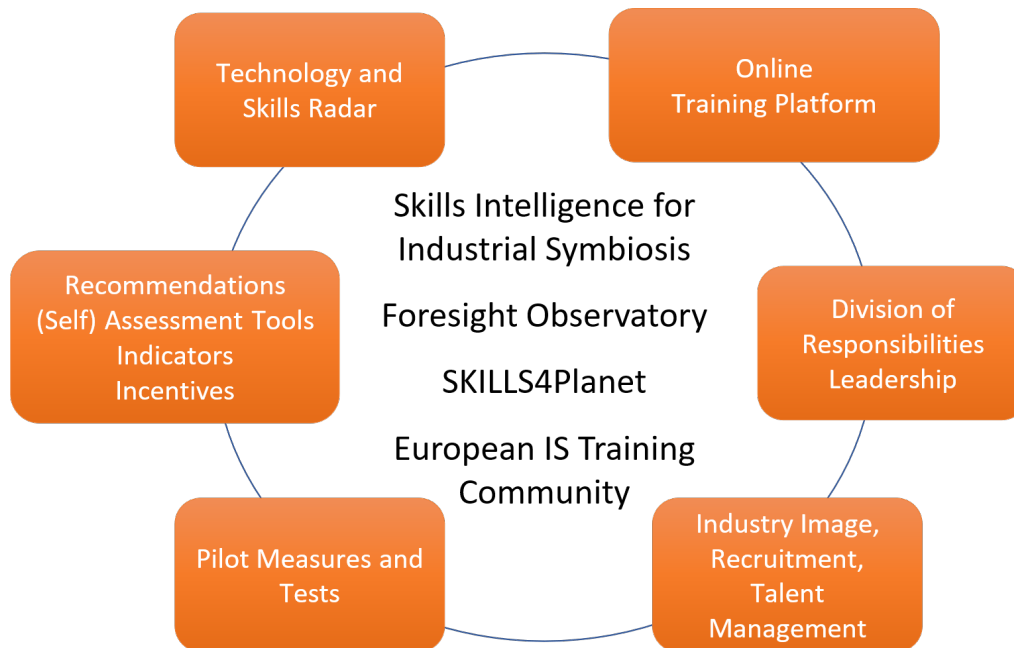


Figure 1: Foresight Observatory and Training Community

The *Foresight Observatory* is the core element of the coordination of SPIRE-SAIS and Skills Intelligence for Industrial Symbiosis, including a regular survey giving insight in the recent and coming technological and economic developments concerning Industrial Symbiosis and related Energy Efficiency skills demands. This *Industrial Symbiosis Technology and Skills Radar* will be based on (bi-)annual questionnaires, taking up the methodological and field experience of the SPIRE-SAIS questionnaire already conducted but improving and shortening it to the main dimensions. It is foreseen to discuss the quantitative results of the Skills Radar with a number of experts, esp. from the different sectors (e.g. with the Steering Committee Sector Representatives) in workshops or a forum at the website of SPIRE-SAIS.

Additionally, the Foresight Observatory will integrate a **Project Repository**, initially designed for collecting material from partners to develop the desk research for the technological and economic development and skills demands. However, this repository is a good reference disseminated to the whole A.SPIRE community and the interested public. The repository is organized per sector, in order to include the projects mainly based on Industrial Symbiosis and Energy Efficiency in the different sectors involved. In addition, a cross-sectoral project section is present, including projects on Industrial Symbiosis and Energy Efficiency that are transversal across the different industries. The template for collecting the projects comprises different aspects listed in Figure 2: Sectors involved, funding scheme (e.g. RFCS, FP6, FP7, H2020), title and acronym of the project, main key words, start and end date, short description of the project and if the project involves either Industrial Symbiosis or Energy Efficiency (or both), what kind of flows of Energy/Material are involved, the main objectives and outcomes, the website of the project and the final report (if available). The summary description of each project has been also included in the dedicated sections of the Deliverable 2.1 (Branca et al., 2024). At the same time, forms have been updated and a dedicated folder will be created to share the repository with the interested public. It will include all forms developed for of all projects and subdivided in sub-folders related to each involved sector. The repository will be updated continuously taken over by the Foresight Observatory beyond the project duration.

EU PROJECTS	
Please fill in the tables with some details of European Projects as in the provided example:	
Sectors involved	
Funding (e.g. RFCS, FP6, FP7, H2020)	
Title	
Acronym	
Key words	
Start date - End date	
Short Description:	
Industrial Symbiosis (YES or NO):	
Energy Efficiency (YES or NO):	
Energy/Material flows exchanged:	
Objectives:	
Meaningful outcomes¹:	
Available on: URL (e.g. link to EU bookshop):	

¹technical (e.g. by-products recycling, digitalization, etc.), regulatory (e.g. environmental legislation), economic (e.g. new business models) and social/organisational (e.g. impact on the workforce) aspects should be highlighted.

Figure 2: Project Repository (Template)

2.2 European Industrial Symbiosis Training Ecosystem

To enable the implementation of Industrial Symbiosis and Energy Efficiency in Energy Intensive Industries, SPIRE-SAIS developed a strategic Blueprint to facilitate communication, coordination, and collaboration between all the stakeholders of the Training and Development Ecosystem to consolidate an Alliance guaranteeing a **current and future workforce highly qualified, specialized, and multi-skilled for the all the sectors**.

The SPIRE-SAIS Training Framework outlines the structure of the training measures to close identified skills gaps of the identified job profiles for Industrial Symbiosis and related Energy Efficiency. Against this backdrop, upskilling schemes, mechanisms for implementing tailor-

made and demand-oriented trainings were created, leading to the online training platform SKILLS4Planet.

The SPIRE-SAIS Foresight Observatory as a continuous monitoring and exchange platform for the skills demands side will inform the Online and Regional Training Eco-systems (SKILLS4Planet and National-Regional Learning Arrangements) as the **supply side**. As information and exchange platform for training development and offers the related Training Framework designs (updated or new) training courses and (digital and "analogue") on the job learning. New skills demand has to be aligned to the job profiles of different production areas of the Energy Intensive industries and VET system occupations. Any subsequent impact on VET systems for those occupations effected must be identified and necessary changes made to the curricula and training offers.

The SKILLS4Planet as the core Online Training System and as the support tool for Regional Training Eco-systems will serve new ways to incorporate new skills related to job profiles within company training provision in more immediate ways to meet pressing needs.

However, this was also a starting point to find new avenues of VET system support online and/or in the regions (Member States) for industry needs in the short-term, especially when it comes to the higher basic skills of new generations (including pre-VET education) and increasing the attraction for process industries.

SPIRE-SAIS stresses virtual, presential and on-the-job learning, which are in a best way combined with each other. Therefore, the European perspective of SPIRE-SAIS intends to focus on the European level by the **Online Training Eco-system SKILLS4Planet** (digital platform) and on the level of regions by specific **National-Regional Training Eco-Systems**. Both systems are complementary and could be combined by adding specific advantages to each other (such as combining online and regional on-site training modules that could be integrated in a broader training program of the companies and VET providers):

- virtual/online: independence of time and space, integration of relevant modules in company and individual learning paths, selecting tailor-made individual learning paths and assessment tools, etc.
- analogue/workplace related: real working experience, interactive learning, workplace/project-based learning, mutual learning of peers and trainers, technology developers, etc.

Concerning VET system integration such a complementarity could be seen as follows:

1. Online ecosystem provides guidance on how to better navigate and make use of national VET (especially CVET and recognition of non-formal and informal learning procedures) and EU frameworks; also, the online ecosystem can build micro-credentials on top of VET systems to fill gaps and complement them with more customised training.
2. Regional/national ecosystem addresses recommendation to the states and VET systems (especially IVET and the integration in formal occupations) where gaps emerge and provide relevant and up-to-date information on sectoral trends and skills gaps on the basis of which the key actors can act to change the VET system from within (e.g. improve curricula, take into account different learning arrangements); also, providing policy-makers with models and examples of effective regional VET-business configurations.

Based on the SPIRE-SAIS approach and partnership (integrating stakeholders from companies, associations and social partners, training providers, research and development organisations) the Online Training Eco-System conceptualised as a "**SKILLS4Planet**" is implementing and transfer human resources and training relevant contents and issues *from and to* all the relevant stakeholders.

The online eco-system **SKILLS4Planet** is engaging all the relevant and willing stakeholders and will continuously integrate and update job profiles and competences as well as a people/learner profile database (human resources databases). Technology based assessment, different contents and personalised learning paths / curricula will feed the SKILLS4Planet and give a basis for analytical reports. The systematisation considers the relevant topics, the expected level of the audience (basic to advanced) and the language issues (translation is important esp. relevant for lower skills levels). Courses are described in a comparable way and customer-oriented. General training courses but also modules for specific technology demands are developed.

Identify the key stakeholders for executing different aspects of the strategic blueprint requires clearly definition of their roles, responsibilities, and areas of ownership. These stakeholders collaborate to ensure the effective design, delivery, and management of training and development initiatives inside and outside of the industry. Table 1 describes relevant stakeholder areas and their relation to VET in general - feeding in inputs to the SKILLS4Planet and taking back outcomes or training results in an interrelated way.

Stakeholder	Description
Training providers	<p>Given the improvements in delivery methods, online learning environments provide a greater degree of flexibility than traditional classroom settings (Douglas Business School, 2017; Giesbers et al., 2014). Online platforms can also offer more diverse representations of student populations as learners prepare for working in the twenty-first century (Stewart et al., 2011). The diversity comes from interacting with students outside of one's geographical location, possibly offering a variety of perspectives on course content (Stewart et al., 2011). Courses offered completely online are primarily delivered in an asynchronous learning or synchronous learning format.</p> <p>This generate that the training providers platform starts concentrating on courses and certificate programs from individual experts, professors, VET System players, equipment providers, association, etc. Normally this programme is part of non-formal and informal education and allows individuals worldwide to access skills and knowledge on demand. Examples of these platform are Degreed¹, Coursera² and LinkedIn³.</p> <p>These platforms can take courses already curated and aligned with the needs of the industry, uploaded in SKILLS4Planet improving the offer to their users. On the other hand, training providers (experts, professors, VET System, etc) will be able to reach a broad audience with their content.</p>
Learning and	Learning and development (L&D) aims to improve group and individual perfor-

¹ <https://degreed.com/>

² <https://www.coursera.org/>

³ <https://www.linkedin.com/>

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development	<p>mance into an organisation by increasing and honing skills and knowledge. L&D is designed to align group and individual goals and performance with the organisation's overall vision and goals. On a practical level, the organisation must identify skills gaps among groups and teams and then finding suitable training to fill these gaps.</p> <p>The identification of the training is not an easy task due to the amount of possible options. Usually, the training that represents the core of the business is delivered by internal instructors. Despite the fact that normally the internal instructors do not have the pedagogic skills, they generate high level of knowledge transfer and motivation, due to their deep understanding of processes and add values with specific example and cases.</p> <p>On the other hand, generic training is usually delivered by external instructors or using online resources from supply chain (like Danieli Academy⁴ and SandVik Coromant⁵), private training providers (like ToolingU⁶ and Vector Solution⁷), re-search center (like Material Processing Institute⁸) and also through other companies.</p> <p>Due to the digitalisation of contents, it is possible to integrate them into SKILLS4Planet. The content is curated with standard competences to <i>easily identify</i> the training for the particular skill gap required by the company. Besides, cost-sharing is given for development and maintenance of high-quality content like simulators and videos. Furthermore, having a rating capability for each content, the evaluation of the students can be centralised in order to identify best practice and trends from pedagogic perspective.</p>
Government, other Blueprints and EU Tools	<p>Under the EU Erasmus+ program for sectoral cooperation on skills, stakeholders work together in sector-specific partnerships, called alliances for sectoral cooperation for skills, which develop and implement strategies to address skills gaps in these sectors. The idea of skilling for a job is central to blueprint alliances. They address skills shortages by:</p> <ul style="list-style-type: none">• gathering information for the European skills panorama⁹• developing a sector skills strategy• developing occupational profiles, vocational programmes and qualifications• designing a long-term action plan to be rolled out at the national and regional levels• promoting the use of EU tools such as<ul style="list-style-type: none">– European qualifications framework (EQF)¹⁰– European skills, competences, qualifications and occupations (ESCO)¹¹– Europass¹²

⁴ <https://www.danieli.com/en/danieli-education/danieli-academy.htm>

⁵ <https://www.sandvik.coromant.com/en-gb/services/education/pages/e-learning.aspx?Country=be>

⁶ <https://www.toolingu.com/>

⁷ <https://www.vectorsolutions.com/>

⁸ <https://www.mpiuk.com/index.htm>

⁹ https://skillspanorama.cedefop.europa.eu/en/useful_resources/including-sectoral-skills-evidence-skills-panorama-practical-framework

¹⁰ <https://www.cedefop.europa.eu/en/events-and-projects/projects/european-qualifications-framework-eqf>

¹¹ <https://ec.europa.eu/social/main.jsp?catId=1326&langId=en>

	<ul style="list-style-type: none"> - European credit system for vocational education and training (ECVET)¹³ - European quality assurance in vocational education and training (EQAVET)¹⁴ <p>The standardization of specific and transversal skills proposed by this program make it possible to integrate and curate all the content into a centralised platform to be accessed by different stakeholders of the ecosystem in each sector. In particular, for Automotive and Construction sectors, which sharing not only transversal skills but also some specific skills, are excellent candidates for content sharing with energy intensive industry sector. Besides, because many companies also have business downstream on the automotive and construction sector, they will find this centralised repository very useful to search for training offers and cost sharing development.</p> <p>Finally, having all the analysis received from the interaction with content and assessment of the student storage into the same database makes it possible to integrate with related individual learners and tools like European skills intelligence¹⁵ and Europass¹⁶.</p>
<p>Industrial and professional Associations</p>	<p>For the purpose of this document, we can define the "trade association" and "professional association".</p> <p>A trade association¹⁷, also known as an industry trade group, business association, sector association or industry body, is an organisation founded and funded by businesses that operate in a specific industry. An industry trade association participates in public relations activities such as advertising, <i>education</i>, publishing, lobbying, and political donations, but its focus is collaboration between companies. Associations may offer other services, such as producing conferences, holding networking or charitable events, or offering <i>classes or educational materials</i>. Regarding the service in education of associations, they normally focus on specific training to developed skills to do something rather than just know about something. Training can be specific for the needs, vocation or skills-gap of the people. The focus of those training is for people who want to implement a new system, improve a specific ability or further their ability in something. Those skills are normally identified by the industries, collected by the association and delivered by subject matter experts from the industry, supply chain or VET System. In many cases this training is delivered in a non-formal or informal way.</p> <p>The Professional Association¹⁸ represents the interest of the professional practitioners. According to Science Council¹⁹ in the UK, this association can be defined</p>

¹² <https://ec.europa.eu/social/main.jsp?catId=1266&langId=en>

¹³ <https://www.cedefop.europa.eu/en/events-and-projects/projects/european-credit-system-vocational-education-and-training-ecvet>

¹⁴ <https://www.eqavet.eu/>

¹⁵ https://skillspanorama.cedefop.europa.eu/en/useful_resources/including-sectoral-skills-evidence-skills-panorama-practical-framework

¹⁶ <https://ec.europa.eu/social/main.jsp?catId=1266&langId=en>

¹⁷ https://en.wikipedia.org/wiki/Trade_association

¹⁸

https://en.wikipedia.org/wiki/Professional_association#:~:text=The%20roles%20of%20professional%20associations,represent%20the%20interest%20of%20the

	<p>as, "an organisation with individual members practicing a profession or occupation in which the organisation maintains an oversight of the knowledge, skills, conduct and practice of that profession or occupation". Many professional bodies are involved in accrediting degrees, defining and examining the skills and competencies necessary to practice a person, and granting professional certifications²⁰ to indicate that a person is qualified in the subject area. Besides, there are some advanced professional certificates, which are a result of an educational process designed for individuals. Those certificates are designed for both newcomers to the industry as well as seasoned professionals. Certificates are awarded by an educational program²¹ or academic institution²².</p> <p>In the both cases the need of a <i>strong communication channel</i> between VET System, Association and Industry to align the training offers and skills needed in order to offer a high quality and industry-oriented training program for individuals is identified, to be realised by the SKILLS4Planet.</p>
<p>VET System</p>	<p>Online learning²³ involves courses offered by postsecondary institutions that are 100% virtual, excluding massively open online courses²⁴ (MOOCs). Online learning or virtual classes offered over the internet are contrasted to traditional courses taken in a brick-and-mortar school building. Learner experience is typically asynchronous but may also incorporate synchronous elements. Most institutions utilise a Learning Management System for the administration of online courses. As theories of distance education evolve, digital technologies to support learning and pedagogy continue to transform as well.</p> <p>Most online learning occurs through a college's or university's learning management system²⁵ (LMS). A LMS is a software application for maintaining, delivering, and tracking educational resources. According to the Educause Center for Analysis and Research (ECAR) use of a LMS is nearly ubiquitous as 99% of colleges and universities report having one in place (Dahlstrom et al., 2014). Among faculty, 87% report using a LMS and find them useful for "enhancing teaching (74%) and student learning (71%)" (Dahlstrom et al., 2014, p. 10). Similarly, 83% of students use an LMS for their learning, with the majority (56%) using them in most or all courses.</p> <p>Access to online content hosted in SKILLS4Planet allows the VET System to use content developed by other training resources like interactive models developed by industry equipment providers, industry experts delivering practical training, Virtual Reality and Augment Reality games for teaching that usually is economically difficult develop them into the VET System. On the other hand, VET System contribute with a high-level education material developed by academics that are useful for the development of the workers into the industry and its supply chain.</p>

Table 1: Interrelation of stakeholder groups with the SKILLS4Planet

¹⁹ https://en.wikipedia.org/wiki/Science_Council

²⁰ https://en.wikipedia.org/wiki/Professional_certification

²¹ https://en.wikipedia.org/wiki/Educational_program

²² https://en.wikipedia.org/wiki/Academic_institution

²³ https://en.wikipedia.org/wiki/Online_learning_in_higher_education

²⁴ https://en.wikipedia.org/wiki/Massively_open_online_course

²⁵ https://en.wikipedia.org/wiki/Learning_management_system

2.3 Upskilling schemes

To detect the best upskilling schemes a workshop with companies and training providers about training measures and upskilling schemes compared the experiences of centralised sector specific training systems like the ESSA steelHub and the E2Driver (automotive) with other training platforms aligning training offers to specific company and learner needs: KATCH-e (alliance of higher education institutions, companies, and research centres developing products and services for a circular and sustainable economy), CircularStart (focused on start-ups supporting incubators, trainers, and consultants in sustainability and circularity training of start-ups, ISL Industrial Training Program).

Centralised systems have the advantage of one stop and open system space centralising and systematising existing training offers and integrating new ones, on a sustainable platform with a business model addressing specific sector needs. Challenging is a wide range of thematic issues to be addressed, providing the training offers and materials in different languages, and combining online and theoretical learning with on-the-job training.

The discussed **specific target group oriented systems** are developing target group specific modules, integrating training for trainers, show a variety of (digital) learning modalities, problem-based learning and self-learning modules to attract the learners. But they have a project character leading to static and not updated results and no sustainability after the project life span, because a provider and further resources are needed

Industrial Symbiosis related training programs like the one from ISL take up the importance of addressing own thematic issues as well as adapting to the needs of companies, allowing for a fluid exchange of information and conversation with companies. Main challenge here is to address the training to the right people (which departments and profiles?).

Against this backdrop *lessons learned* and relevance for SPIRE-SAIS could be listed as such:

- A general cross-sectoral training for IS/EE and additional in-depth training topics and illustrating (sector) specific cases should be combined,
- Job profiles and levels for the training should be defined (e.g. managers, engineers, operators)
- Training should be workplace and problem based and modular structured, online and blended learning
- We need a concept of integrating companies, training providers, trainers, education systems, and the individual learner
- What about integrating additional target groups, e.g. unemployed people, teachers in CVET/IVET/HE, consultants, incubators, start-ups?
- Sustainability should be considered with the development of business models and market orientation, understanding who will be the end user (e.g. trainers, company buyers, end users directly?)

Saying this, a *challenge* was to find a SPIRE-SAIS solution maintaining itself alive beyond the end of the project. This includes not only a sustainable running of SPIRE-SAIS but also its rollout of training courses to the member states within the different, at least of the main languages.

Against the backdrop of the results above, an integrating training platform as a one stop and open system space (instead of standalone solutions of specific modules) was foreseen and established: SKILLS4Planet online training platform. This platform centralises and systematise existing training offers and integrates new ones, on a sustainably planned platform addressing generic and sector specific skills needs. Challenging is a wide range of thematic issues to be addressed, providing the training offers and materials in different languages, and combining online and theoretical learning with on-the-job training. Even more challenging is to ensure updating and sustainability of the platform after the project life span via an accepted and supported business model.

To establish this training platform, mechanisms were created for:

- The identification of skills demands, related to Industrial Symbiosis and Energy Efficiency, considering skills gaps and needs for IS and EE deployment
- The identification and organisation of (cross)sectoral upskilling and/or reskilling schemes, promoting an efficient knowledge management and skills provision
- The facilitation of instruments and resources that allow the implementation of measures to meet the identified skills needs.

The identification of skills demands is based on the already described job profiles (see Figure 10) and related skills classification (see Figure 11). Against this backdrop companies could do an *inventory and comparison of skills* already in place and skills necessary to implement Industrial Symbiosis. This will give companies a sense of their *skills readiness* for IS, even if they haven't start implementing it yet.

Additionally, a broader identification of the company maturity level of Industrial Symbiosis based on the IS Readiness Levels of Sommer (2020) and adapted for a Self-Assessment Module of the CircLean project (integrated in the generic part of the trainings in SKILLS4Planet) helps to set the scheme not only for related skills demands but also for attracting companies to IS/EE measures to be taken up. The company's IS maturity level can then link to courses that will facilitate progression in that company maturity level – through the offering of specific courses for both management and operational levels as required.

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- 9 All resources quantified and posted on matching tool/or company is actively looking for solutions
- 8 Resources prioritised for IS with management buy-in to advance IS opportunities
- 7 Check costs, regulations and other technology specifications to be met for IS opportunities
- 6 Resources identified, quantified and characterised for IS
- 5 Internal data sources identified for quantification
- 4 Initial ideas on which resources might suit IS
- 3 Processes mapped and targeted for IS
- 2 Initial ideas of where company can engage
- 1 Awareness of IS and potential benefits

Level 1 means your company has an awareness of IS but has not carried out anything active to instigate industrial symbiosis.

Level 9 means your company has posted resources on the matching tool and/or is actively looking for solutions.

Figure 3: Readiness Levels (Adapted by the CircLean project from Sommer (2020)) (study and portfolio review of the projects on Industrial Symbiosis in DG Research and Innovation: Findings and recommendations Industrial Symbiosis. European Commission)

Based on the analysis of the training needs and already existing educational resources and training courses for IS/EE (see Table 2 and the repository in version 1 Deliverable 5.1 (Almeida et al., 2021) in the Annex) the SPIRE-SAIS training framework is targeted at generic training courses that impart basic understanding and skills (such as the introduction to Industrial Symbiosis), job profile and skills topic related courses (business, regulatory, professional/technical, transversal/individual) and courses to serve the need of the various industry sectors. These trainings are collated in SKILLS4Planet consisting of (a) existing courses collected and distributed, and (b) additional courses development if relevant, not existing and capable of being developed by consortium members (especially the sector specific trainings).

UN/ABADE:

Case added by:	Title	Country	Area(s)	Case type (national or regional policy level /VET level / Company level)	Short description of the case (incl. the reference to the information)
ITC	GENERALITIES OF LIFE CYCLE ANALYSIS OF CERAMIC PRODUCTS	SPAIN	GREEN SKILLS	COMPANY LEVEL	This is a course requested to ITC by a VET center. The aim was to receive training in the Life Cycle Analysis methodology to be applied to the ceramic tiles it manufactures and, subsequently, to be able to prepare its own Environmental Product Declaration under the labelling programme it considers most appropriate, as well as to have the necessary information and criteria to be able to evaluate environmental improvement measures. Duration: 15 hours
ITC	ENERGY EFFICIENCY IN THE CERAMIC INDUSTRY	Spain	EE	Company Level /VET Level/Regional Policy Level	Knowing the main energy consumption that occurs in large industries ceramics, as well as being able to identify and implement the necessary measures to reduce this consumption avoiding any cross media effect (decrease of product quality). Specific bjectives: identify the points of greatest potential for savings in industrial plants, as well as the key factors that determine their analysis. Knowing energy conservation techniques and the best available technologies that support them to achieve optimum performance and reduce the consumption of industrial facilities. Addressing real cases: diagnostics energy in industrial plants. Technical-economic analysis of solutions. Duration: 20 hours
ITC	Course on LIFE CYCLE ANALYSIS CERAMIC AND	Spain	EE & IS	Company level	OBJECTIVE: This course achieves several objectives and allow companies to assess the circular benefits gained due to energy efficiency measures adopted and/or industrial symbiosis practices applied in their processes: - To study and apply in a theoretical and practical way the fundamental concepts and methodology of

Table 2: Training Database

Based on or integrated in a generic training module setting the scheme to manage and act for IS and EE

SPIRE-SAIS: Training Framework (Deliverable 5.1)

- thematic in-depth and advanced training courses (e.g. for an assessment of financial benefits),
- sector specifications and illustrations (ensuring the practical workplace integration and perspective),
- job profile and function related courses

are in place to improve the skills and qualifications in line with specific needs and interests of the learners (see Figure 4).



Figure 4: SPIRE-SAIS Training Framework

A connection of the online trainings to European tools (esp. the European Skills Competence Occupation ESCO Database and EQF) is given as well as to the formal national VET systems qualification offers. This is done against the basis of the VET matrix to:

- Inform and enable national VET systems authorities to communicate new qualifications of Process Industry (in general) and IS (in particular). This provides a wider visibility to national VET systems' efforts towards contributing to a more sustainable society.
- Offer the possibility to pinpoint existing qualifications in formal VET systems that may help suppress the lack of skills for IS in the labour market (or even in the companies themselves). A challenge here, of course, is how to finance and address different languages.

2.4 Skills-based development program Framework (ADDIE model)

ADDIE model describes a flexible, systematic process to develop training programs for adult learners. The cyclical model has five stages: Analyze, Design, Develop, Implement, and Evaluate. Each stage has a deliverable that feeds into the next stage and includes opportunities to gather feedback that informs training development. The following diagram shows how the different modules of SKILLS4Planet are integrated in this Framework, to ensure that training is well-planned, aligned with objectives, and continuously improved based on feedback and evaluation.

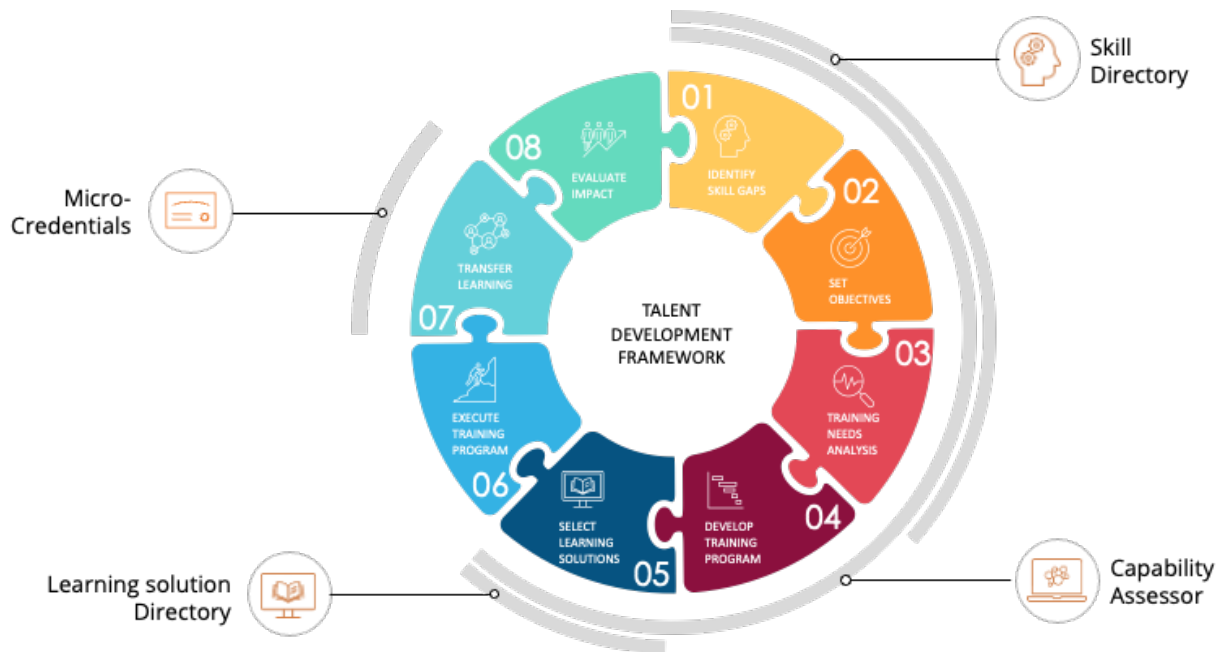


Figure 5: ADDIE Model adapted to skill-based development programs

Starting with the analysis of skills gaps and related objectives and training needs, designing and developing, implementation and evaluation of the trainings are subsequent phases.

2.4.1 Analysis

The Analysis phase involves conducting a thorough needs assessment to identify the training needs and performance gaps within the organisation or a specific department. It includes gathering information about the target audience, their existing knowledge and skills, and the desired learning outcomes. The analysis phase helps establish clear objectives for the training program and informs subsequent design decisions.

- 01 Identify Skill Gaps:** Assessing the current skills of your employee, team or organisation and compare them to the desired skill set needed to achieve your goals.
- 02 Set Objectives:** select what skills need to be acquired or improved from the skill gap identified and establish measurable targets to track progress. Make sure the objectives are aligned with the overall strategic goals of the organisation and define priorities based on them.
- 03 Training Needs Analysis:** Perform a comprehensive analysis to determine the specific training and development needs required to bridge the skill gaps. This analysis may involve surveys, interviews, performance evaluations, and benchmarking against industry standards.

2.4.2 Design

In the Design phase, the focus is on creating the blueprint for the training program. Based on the objectives identified in the analysis phase, instructional strategies, content, and activities are determined. The design phase includes developing the overall structure and sequencing of the training, defining learning objectives, selecting appropriate instructional methods, and

designing assessments or evaluation methods. This stage ensures that the training program aligns with the identified needs and desired outcomes.

- 04 Design Training Program:** Based on the identified skill gaps and training needs: Design a training program that addresses those gaps. Determine the appropriate training methods such as workshops, online courses, coaching, mentoring, or on-the-job training.

2.4.3 Development

The Development phase involves creating the actual training materials and resources based on the design. This may include developing instructional materials, such as presentations, handouts, e-learning modules, or interactive exercises. Content is organized and presented in a format that supports effective learning and engagement. The development phase also includes reviewing and refining the training materials to ensure accuracy and relevance.

- 05 Select and Develop Learning Solutions:** Select the appropriate learning solutions that align with the training program. This can include internal solutions such as subject matter experts, existing training materials, or external resources such as third-party training providers, online courses, or books.

2.4.4 Implementation

In the Implementation phase, the training program is delivered to the participants. Trainers or facilitators conduct the training sessions using the developed materials and instructional methods. They create a supportive learning environment, provide clear instructions, engage participants in learning activities, and address any questions or concerns. This stage involves effective communication and delivery of the training content to maximize learning outcomes.

- 06 Deliver Training Program:** Execute the training program by scheduling, delivering and monitoring the learning solutions. Use evaluation methods such as quizzes, tests, assignments, and practical assessments to measure knowledge and skill improvement.

- 07 Transfer Learning:** To assure transfer learning, offer ongoing support and resources to the participants even after the formal training program ends. Encourage continuous learning through mentoring, coaching, access to learning materials, and creating a supportive work environment.

2.4.5 Evaluation

The Evaluation phase focuses on assessing the effectiveness and impact of the training program. Evaluation can occur at multiple levels, including the reaction of participants, their learning outcomes, changes in behavior or performance, and the overall impact on organisational goals. Evaluation methods may include participant feedback surveys, assessments, observations, or interviews. The feedback and data collected are analyzed to identify strengths and areas for improvement in the training program. The evaluation results inform future iterations or modifications to enhance the training's effectiveness.

08

Evaluate Impact: Evaluate the overall effectiveness of the development plan by measuring the impact on closing the skill gaps. Use quantitative and qualitative measures to gauge success. Identify areas for improvement and refine the development plan for future iterations. Continuously adapt the plan to changing skill requirements and emerging needs.

2.5 Innovative Learning Solutions and Programs

Training offers should reflect (new) **learning arrangements**. Digital transformation is not only focusing on re- and upskilling of the workers but also relevant for new learning and teaching arrangement. Digitalisation will also improve and increase new learning possibilities and arrangements (quantitatively and qualitatively): Training providers, companies, workers and apprentices have to improve their digital skills for both **learning and operating** at the workplace. Not only the Covid-19 pandemic but also the speed of (technological and continuous) changes show the importance of more and new (digital) online learning and training possibilities. Digitalisation of learning modules, improved digital skills, flexible and agile trainers and learners are relevant elements of new digital learning strategies and alliances. New formats are needed articulating new developments in time comprising different possibilities such:

- Online training and simulation
- On the job training
- Integration of general or specific modules in company training schemes
- Reverse mentorship as a two-way process between older and younger employees (as suggested by the Energy intensive Sector Careers Blueprint)
- Webinars
- Individual and specific groups training paths (in-company, across companies, individual)
- Self-learning modules and models (with real time feedback for iterative corrections)
- Experiential learning (e.g. production process assessment concerning energy efficiency)
- Blended learning, combining classroom and workplace, linking VET schools and workplace, improved coordination of knowledge acquisition and practical learning)
- Project-based, challenge-based and integrative learning, game-based learning
- Social and collaborative learning
- New forms of assessment and validation: ePortfolios, learning challenges, feedback to learners, new links between assessors and learners
- Virtual Reality environments
- and others.

Hundreds of digital education tools have been created with the purpose of giving autonomy to the learner, improving the administration of training processes, encouraging collaboration, and facilitating communication between teachers/trainers and learners. The following image summarizes the digital resources and interaction that can be part of a training program at the level of the online and regional ecosystem.

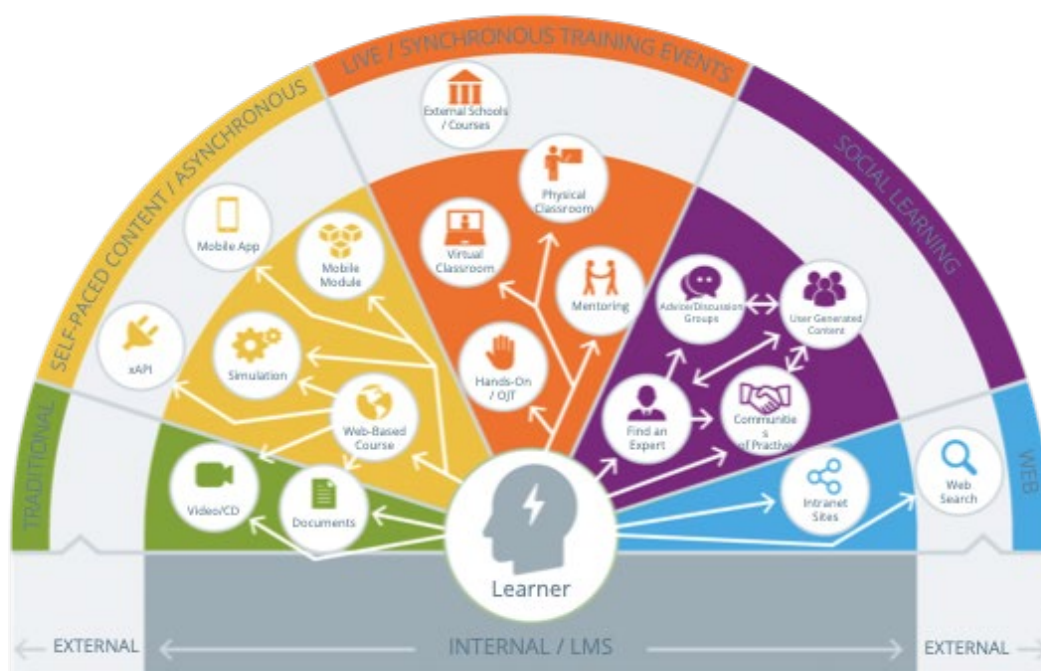


Figure 6: The learning ecosystem (adapted from Gipple (n. d.))

To organize the Learning Solutions provided by Publishers in SKILLS4Planet, ESSA defined a categorization of the solution as follow:

- **E-Learning:** educational content and training through digital platforms and technologies. It involves the use of the internet, computers, and various digital learning modules (3D Models, Videos, Interactive HTML5 exercise, among others) to facilitate and enhance the learning process.
- **Webinar:** web-based seminar or presentation conducted over the internet. It is a live, interactive online event that allows participants to join remotely and engage in real-time learning and discussion. Webinars could be recorded and delivered asynchronous over a digital platform.
- **Certification:** It is a formal document that serves as evidence or proof of accomplishment, completion, or achievement in a specific area of study or training, for example, after completion of an Exam, Simulation or Games.
- **Cognitive Assessment or Exam:** It is a standardized evaluation that assesses an individual's cognitive abilities and mental functioning. It measures various aspects of cognitive processes, including attention, memory, language, problem-solving, reasoning, and perception.
- **Videos:** They offers several benefits, including visual engagement, increased retention, accessibility, and the ability to cater to different learning styles. There are several formats, like i) Educational Tutorials, ii) Animated Educational Videos, iii) Virtual Lab Demonstrations, iv) Subject Explainers, v) Science Experiments and Demonstrations, among others.
- **3D Interactive Models:** These models provide a highly engaging and immersive learning experience that enables learners to visualize and interact with complex concepts and objects.

- **Simulations:** They are a powerful educational tool that involves creating realistic, interactive environments or scenarios to replicate real-life experiences and situations. It allows learners to actively engage, experiment, and apply knowledge and skills in a safe and controlled setting.
- **Game:** the use of games for education offers a unique and effective approach to engage learners, promote active learning, develop skills, and bridge the gap between theory and practice. By making learning enjoyable and meaningful, games have the potential to transform the educational experience and improve learning outcomes.

3 Online Training Platform SKILLS4Planet

Against this background and to develop a highly qualified, specialised and multi-skilled workforce the SKILLS4Planet and the National-regional Training Ecosystems were composed as platforms to facilitate coordination, communication and collaborative partnership between all the relevant stakeholder groups of the ecosystem: research centres, associations and social partners, equipment and service providers, companies, training providers, and public authorities to be interlocked (see Figure 7).

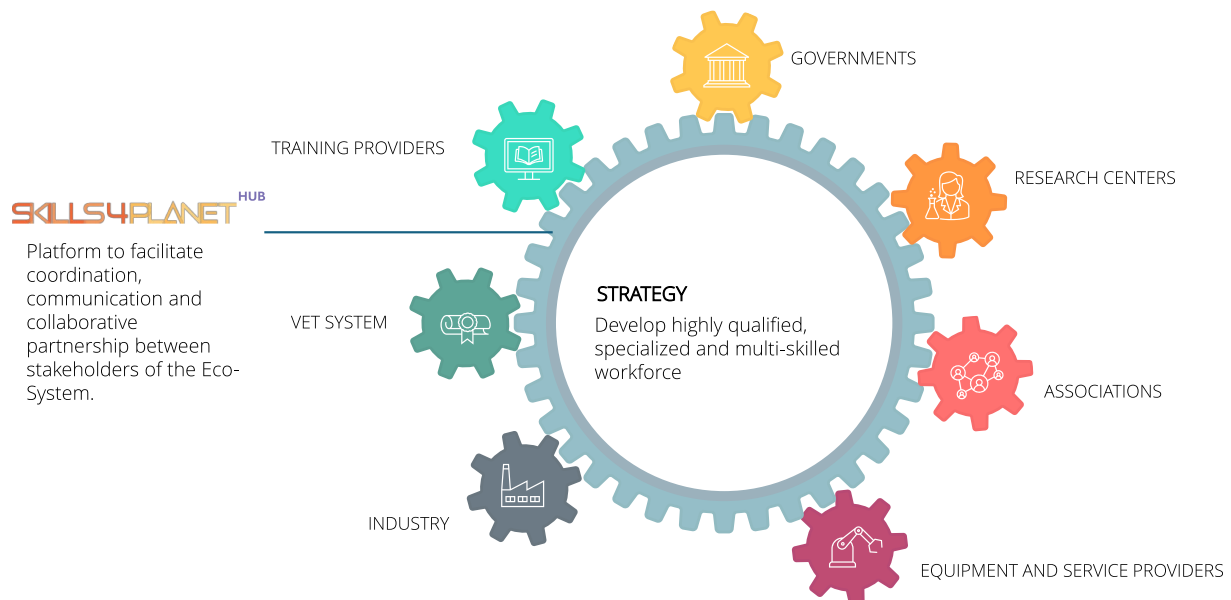


Figure 7: Training and Development Ecosystem (SKILLS4Planet)

As a central element of the strategic Blueprint and being an ecosystem as well, SPIRE-SAIS developed the **SKILLS4Planet**, a centralized digital platform to facilitate communication, collaboration, and coordination. **SKILLS4Planet** sets the infrastructure for a European exchange of content to create a Learning Solution Directory for the sector. This directory is a collection of learning solutions delivered by Publishers into the framework of a marketplace business model.

One important component of this platform is the Skill Directory, which represents the current and future training needs for implementation of Industrial Symbiosis and Energy Efficiency. This Directory is used to curate the learning solutions. Using a standard terminology and big data infrastructure, **SKILLS4Planet** can identify skill gaps and the most demanded skills for the sector to guide the training solutions development as well as analyze trends that can

support governments to define new regulation and funding tools to support the triple transition of each sector.

The integrated design of the platform offered by **SKILLS4Planet** enable the possibility to develop new and innovative solutions into the context of **Capability Assessor** using a variety of methods to evaluate an individual's capabilities, including self-assessment, interviews, tests, and job simulations. The goal of the assessment is to determine whether an individual has the necessary skills and experience to perform effectively in each role, task or skill needed and design a custom development plan for each organisation or individual.

The flexible integration of this platform offers organisations the ability to easily connect and integrate learning solutions with their own training systems, which can improve productivity, reduce costs, and enhance overall efficiency. Besides, regional industrial and professional association can integrate these solutions to provide learning solutions to their members.

The following diagram represent the different modules included in this platform.



Figure 8: Modules of Digital Platform – SKILLS4Planet

Each of these modules involve tasks that have been developed during piloting and implementation phase but need to continuously executed to assure good service and quality. A description of the ongoing tasks for each pillar are:

- **Skill Directory**¹, a centralize repository of skills and knowledge that represent the current and future training need of the sector.
- **Capability Assessor**², solutions to deliver capability assessments to organisations and individuals for Self-Directed Learning, to support individuals take primary responsibility for planning, organizing, and executing their own learning process.
- **Learning Solution Directory**³, which is a collection of learning solutions for up- and re-skilling current and future workforce base on publisher contribution.
- **Qualifications Directory**⁴, A Qualifications Directory is crucial for learners as it provides clarity and guidance on available qualifications, helping them make informed decisions about their educational and career paths. Besides, this directory helps to cross check learning outcomes required by the industry with formal VET programs and curricula to assure a proper alignment.

- **Micro-Credentials**, Crucial for learners as they offer flexibility, relevance, and speed in acquiring new skills. Focused on specific, in-demand abilities, they enable learners to quickly enhance their qualifications and employability.
- **Delivery**, flexible IT infrastructure that assure several integration options to meet the unique needs of organisations of different sizes and types as well as individuals. This includes the development of integration solutions for the following cases. Besides, this pillar includes the development and maintenance of a Dashboard with the data collected from the interaction of the learners with these pillars to support the Expert Panel in the identification of emerging skills and training needs.

To assure the continuation of the SKILLS4Planet a non-for-profit business model was put in place to assure a self-sufficient economical model (see annex of Deliverable 6.2 (Schröder et al., 2024)). The foreseen business model of SKILLS4Planet is based on the successful one of the ESSA steelHub up to now integrating 28 companies, 8 associations, 2 equipment providers, 1 Education and training provider and 10 R&D institutes and Universities. A total of 13,406 activate learners used learning solutions available in the steelHub now also available in SKILLS4Planet.

The industries are rethinking their approach to human capital and talent management and moving beyond degrees and job titles to focus more on the skills a job requires and that a candidate possesses, and they're doing so in greater numbers, based on McKinsey research conducted in partnership with the Rework America Alliance. Therefore, *skills-based development program methodology*, which is a structured initiative designed to enhance and develop specific skills and competencies among individuals, was selected to design the infrastructure of the SKILLS4Planet.

There are several frameworks and models to implement skills-based development methodology. The main purpose is to breakdown the process into actionable steps. This systematic process, ensures to follow key steps for successful development, provides a guide for managing the training project, and helps to support communication about the scheme with internal and external stakeholders in the company. Every organisation use a specific framework or model that fits to their specific training needs. The solutions of SKILLS4Planet can be integrated at different stages of the particular framework that companies use. To have a common ground to identify key steps to improve communication and integration of SKILLS4Planet solutions, SPIRE-SAIS selected and implemented *ADDIE Model* adapted to skills-based development program. The ADDIE model is a widely used instructional design framework that provides a systematic approach to developing effective training programs.

In the following sections, more in detail description for each module of SKILLS4Planet and the ADDIE model are provided.

By integrating publishers and organisations into SKILLS4Planet, which is a marketplace of learning solutions, the platform can offer a comprehensive collection of educational resources to organisation while providing publishers with increased visibility, collaboration opportunities, and access to a broader customer base.

4 Skill Directory

4.1 Methodology

An initial list of skills of prominent importance for the implementation of Industrial Symbiosis (IS) and Energy Efficiency (EE) in Process Industry was identified under the Company Skills Requirements and Foresight studies (see Deliverable 3.2; Bayón, 2024), where the range of essential skills, knowledge and attitudes that workers require to adopt Energy Efficiency and Industrial Symbiosis in their daily work has been analysed. For their identification and final selection, three major inputs were considered i) Literature review, ii) SPIRE-SAIS consortium members input and iii) Industry inputs.

First a literature review on studies about future skill needs in process industries originated a list of 60 skills. As a result of the Company Skills Requirements and Foresight studies, the skills needed to implement IS and EE were identified through a detailed desk research.

It is important to note that CEDEFOP defines “Green Skills” as the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society. Therefore, “Green Skills” category is acknowledged as a wide-ranging skills classification that involves the skills related to “Industrial Symbiosis” and “Energy Efficiency”. Similarly, the effect of the digital transformation on the skills needs related to IS and EE were considered during the analysis.

An initial set of skills (60 in total) for the implementation of Industrial Symbiosis (IS) and Energy Efficiency (EE) across four broad categories were identified: technological, individual and personal, regulatory and business related. Within each category, more specific skills are present (See Figure 9).

Technological	Individual/Personal	Regulatory	Business related
Industrial Symbiosis			
sustainability	multidisciplinary thinking and acting	general regulatory awareness	project planning and management
circular economy	collaboration	waste management legislation	commercial
resource, re-use and recycling	think systemically	legislation about CO2 emissions	economics
product life cycle thinking assessment	effective communication	legislative and compliance requirements	networking
field experience	team-based approach		fostering cooperation
Industrial Symbiosis core concepts	strategic thinking		encourage collective decisions
Industrial Symbiosis basic understanding	environmental awareness		business model transformation
waste management	complementary thinking		identification of potential opportunities
eco-design of product, technology and processes	cooperation		development of business cases
water conservation	working autonomously		globally relevant emerging trends
sustainable resource management	decision-making		integrate energy efficiency findings into cross-business operational plans
Industrial Symbiosis methodologies	critical thinking		complex financial analysis & planning
waste reduction & prevention	creativity		financial planning
environmental monitoring	awareness of consequences of energy use		accounting and audit
	initiative taking and entrepreneurship		negotiation
Energy Efficiency			develop an entrepreneurship mindset
system optimisation			financial management
process analysis			
industry knowledge & field experience			
energy data collection and analysis			
selection and use of monitoring equipment for energy consumption			Higher Priority
monitoring and investigating			Medium Priority
complex information processing and interpretation			Lower Priority
understanding energy use & costs			
manufacturing principles to reduce energy consumption			
developing and installing analysis systems for energy use			
energy management of equipment and plants			

Figure 9: SPIRE-SAIS skills categorisation and prioritisation

As the second step, **SPIRE-SAIS consortium members input** was collected and analysed in order to have a general idea about the weight of each skill, SPIRE-SAIS consortium members were asked to select 25 most relevant skills among the list of 60 skills to ensure a de-

ployment of IS and EE to its full potential in Process Industry. In Figure 9, the intensity of the (green) colour demonstrates the weight of the skills according to the answers of the members.

Finally, **industry inputs** are reflected in the creation of representative sector flow-charts by integrating the companies of the consortium. Based on these, the current professional profiles existing in the company(ies) were identified in each section of the flow-charts and summarised in cross-sectoral generic job profiles (see Figure 10).

A condensed and shortened version of the skills list was generated in order to simplify the analysis of the needed skills for each job profile and therefore, to facilitate the job profile description process. Figure 11 is the condensed and final version of the skills list. In this version, four main categories were kept same: Technological, Individual/personal, Regulatory, Business related. In addition, this time, skills were categorized also into 2 other groups (1) for Management and Operators and (2) only for Management.

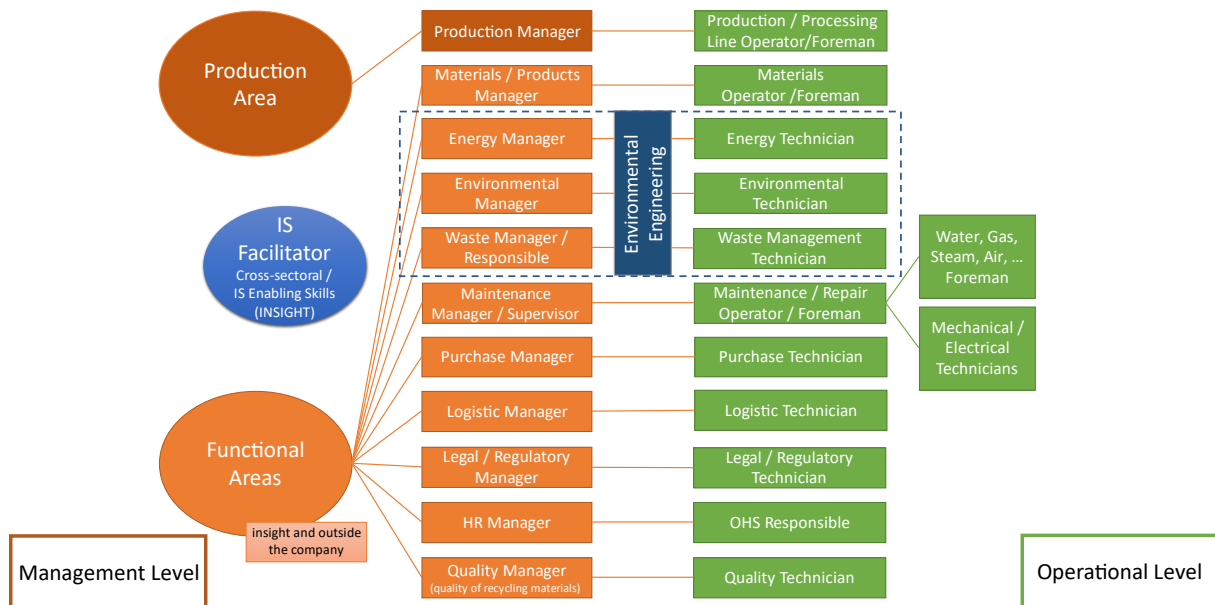


Figure 10: Generic Job Profiles across the involved sectors

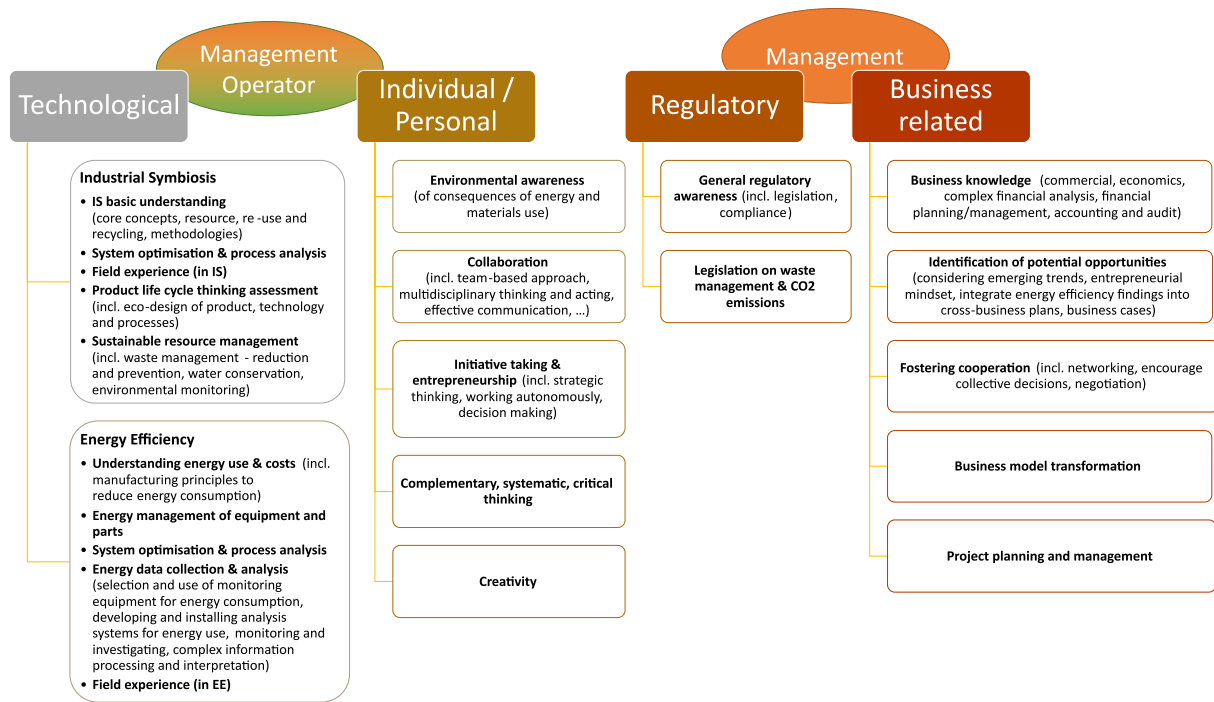


Figure 11: Industrial Symbiosis and Energy Efficiency Skills Classification

Sustainable anticipation of new skills demands is foreseen within a Foresight Observatory, closely aligned with the development of new technologies: For instance through a close co-operation with the SPIRE Processes for Plant Program and its Strategic Research Agenda (A.SPIRE, 2021) on the European level as well as with the planned European Community of Practice for Industrial Symbiosis (concerning the regional rollout of SPIRE-SAIS). To update the skills demands, the planned SPIRE-SAIS *Foresight Observatory* will include a regular survey on recent and future technological and economic developments and related Industrial Symbiosis and Energy Efficiency skills demands (within an *Industrial Symbiosis Technology and Skills Radar*). The results of this radar will improve the training framework and platform with relevant upskilling necessities or even new job profiles needed.

The developed industry-based skills catalogue was integrated into the Skill Directory Module of **SKILLS4Planet**. The Skill Directory Module is a centralized IT infrastructure to manage a skill database to offer the following benefits:

Data Consistency: Storing all skill-related information in a single, unified database. This eliminates the possibility of duplicate or conflicting skill data and ensures that all users have access to the most up-to-date and accurate information.

Efficient Data Management: Simplifies data management processes by providing a centralized repository for storing, organizing, and updating skill-related information, making it easier to maintain and manage the data. Centralized data management ensures that skill data is easily accessible, searchable, and shareable across members of the ecosystem.

Enhanced Data Integrity: Implement robust data governance practices to ensure data integrity. This is done by established data quality standards, validation rules, and data maintenance processes to maintain the accuracy and consistency of skill data. Data validation and quality checks are performed at a centralized level, minimizing the risk of errors and inconsistencies.

Improved Collaboration and Communication: A centralized IT infrastructure facilitates collaboration and communication within the members of the ecosystem. With a central skill database, different teams and stakeholders can access and contribute to the same pool of skill data. This promotes knowledge sharing, cross-functional collaboration, and effective workforce planning by enabling stakeholders to make informed decisions based on accurate and consistent skill information.

Streamlined Reporting and Analytics: It allows streamlined reporting and analytics. It enables the generation of comprehensive reports and analytics on skill gaps, skill trends, training needs, and workforce capabilities. This centralized view enables data-driven decision-making, resource allocation, and strategic planning for talent development and acquisition.

Scalability and Flexibility: Provides scalability and flexibility in managing the skill database. As the Sectors skill demand grows or evolves, the centralized system can accommodate new skill data, additional users, and evolving skill taxonomies. It allows for easy integration with other systems and applications, enabling seamless data exchange and interoperability.

Data Security and Access Control: Centralizing the skill database enhances data security and access control. SKILLS4Planet implemented robust security measures, such as user authentication, data encryption, and role-based access control, to safeguard sensitive skill data. Centralized security measures reduce the risk of unauthorized access, data breaches, and data loss.

Cost Efficiency: The centralizing IT infrastructure for skill data management leads to cost savings. It eliminates the need for multiple decentralized skill databases, reduces duplication of efforts, and streamlines data management processes. It also simplifies system maintenance and reduces the overall IT infrastructure complexity, resulting in cost efficiencies.

The skills identify for Industrial Symbiosis and Energy Efficiency were uploaded into Skill Directory of SKILLS4Planet. From the platform the user can search for the skill and navigate the description and the 4 proficiency levels. The following picture show and example of the search engine of the skills and also an example of a particular skill and it relationship with occupations.

The screenshot shows the SKILLS4Planet search interface. At the top, there is a search bar with the text "Search...", a dropdown menu for "Please Levels..." (currently showing "Occupation specific" as selected), and a "Categories..." field. Below the search bar is a table with the following columns: Name, Level, and Category. The table contains the following data:

Name	Level	Category
Collaboration		Social
Creative Thinking	Transversal	Individual/Personal
Critical & Systematic Thinking	Transversal	Individual/Personal
Decarbonisation and Energy Transition	Occupation specific	Sustainability
EE Process Optimisation	Occupation specific	Energy Efficiency
Energy Data and Analysis	Sector specific	Energy Efficiency
Energy Efficiency Process Optimisation	Sector specific	Energy Efficiency
Energy Management and Audit	Cross-sector	Energy Efficiency
Energy Resource Management	Cross-sector	Energy Efficiency
Entrepreneurial Thinking	Transversal	Individual/Personal
Environmental Awareness	Sector specific	Sustainability
Environmental Legislation	Cross-sector	Sustainability
Horizon Scanning	Transversal	Methodological
Industrial Symbiosis Fundamentals	Cross-sector	Industrial Symbiosis
Industrial Symbiosis Process Optimisation	Sector specific	Industrial Symbiosis
Innovation Management in IS and EE	Occupation specific	Methodological

SPIRE-SAIS: Training Framework (Deliverable 5.1)

(a)

The screenshot shows the Skill Directory interface. At the top, there is a search bar with the word "Explore" and a language selector set to "English (en)" and a user profile for "Jorge Muract". Below this is a "Description" section for "Industrial Symbiosis Fundamentals", which is defined as the understanding and practice of identifying and leveraging synergies between different industries or organizations within a geographic area or supply chain. It involves recognizing opportunities for resource exchange, waste reduction, and collaboration to achieve mutual economic, environmental, and social benefits.

Below the description is a "Proficiency Level" section with a horizontal scale from 1 to 4. Level 1 is marked as "Beginner" and Level 4 as "Master".

The main content area displays "Level 1" details for the skill. It includes a description: "You understand the basic principles of industrial symbiosis, focusing on resource exchange and waste transformation into valuable by-products. You are aware of the potential benefits and can recognize basic opportunities for resource exchange and waste valorization within your surroundings. You identify low-complexity synergies and describe the foundational principles of industrial symbiosis. You exhibit basic knowledge of circular economy concepts and related regulations." Below this are "Learning outcomes" categorized into "Theoretical" and "Practical".

- Theoretical**
 - Definition of industrial symbiosis
 - Benefits of industrial symbiosis
 - Circular economy concepts and principles
- Practical**
 - Describe the need to protect natural resources and ecosystems, reduce pollution, and minimize waste and emissions.
 - Demonstrates the efficient use of resources
 - Able to describe the principles of the circular economy.

Each learning outcome has a small blue icon with a number (1-5) next to it. At the bottom of the skill details, there is a "Related Occupations" section with four cards:

- Energy Technician**: Performs audits, maintains energy systems, and implements efficiency measures. They collaborate on retrofit projects, use monitoring systems for conservation, conduct maintenance, and...
- Maintenance Team Leader**: The Maintenance Team Leader oversees conducting energy audits and engineering preventive maintenance programs to enhance efficiency and sustainability. This role is pivotal in...
- Production Technician**: The Product Technician is a key player in implementing energy-saving practices and minimizing waste generation, ensuring optimal material usage. This role involves active collaboration on process...
- Waste Management Technician**: A Waste Management Technician supports the development and execution of waste management programs aimed at sustainability and reduction. They conduct assessments, enforce compliance with...

(b)

Figure 12: Skill Directory interphase (a) Search engine for skills and (b) Example of a skill and the relationship with occupations

4.2 Proficiency level

The SPIRE-SAIS skills assessment is based on four proficiency levels. A proficiency level refers to a measurement or assessment of an individual's competence or skill in a particular area of knowledge or performance. It represents the level of mastery or expertise that a person has achieved in a specific domain or skill set.

Proficiency levels serve as a useful tool for evaluating individuals' knowledge and skills, providing a standardized way to communicate their level of expertise. They help in setting learning goals, designing curriculum, assessing progress, and ensuring a common understanding of competency across different contexts. Proficiency level frameworks also assist in identifying areas for improvement, tailoring instruction, and providing targeted support to help individuals advance to higher levels of proficiency.

In SPIRE-SAIS project, each skill has been defined by four levels of proficiency. Figure 13 is an example of the skill, "Hydrogen Combustion and Heat Transfer" and the learning out-

SPIRE-SAIS: Training Framework (Deliverable 5.1)

comes for Level 3. Besides, the European Qualification Framework (EQF) was introduced that help to categorized the learning outcomes for knowledge in Factual and Theoretical, as well as skills in cognitive and practical. Besides, EQF defined 8 level for each learning outcome that was used to categorized them.

Skill Definition	Proficiency Level	Learning Outcomes	European Qualification Framework
Hydrogen Combustion and Heat Transfer Hydrogen Combustion and Heat Transfer involves understanding, managing, and optimizing the combustion and heat transfer processes associated with the use of hydrogen as a fuel in industrial applications. It encompasses knowledge of combustion dynamics, heat transfer mechanisms, safety protocols, and system optimization techniques to ensure efficient and safe utilization of hydrogen for heat generation and industrial processes.	1		Category: EQF Level
	2	Proficiency in numerical methods and computational tools for simulating fluid flow, combustion, and heat transfer.	Theoretical 5
	3	In-depth knowledge of thermodynamic cycles and advanced heat transfer phenomena. In-depth understanding of regulatory requirements and environmental standards related to hydrogen-based processes	Theoretical 5
	4	Predict the impact of changes in combustion parameters on heat transfer efficiency and combustion stability. Validate computational models of hydrogen combustion and heat transfer against experimental data.	Cognitive 4 Cognitive 4

Figure 13: Description of Proficiency Levels of the skill for “Hydrogen Combustion and Heat Transfer”

These definitions are part of the Self-Assessment tool to guide the learners to identify their recent proficiency level for a particular skill. Figure 14 is an example of this assessment.

Capability Assessor

Industrial Symbiosis Fundamentals

Industrial Symbiosis Fundamentals is the understanding and practice of identifying and leveraging synergies between different industries or organisations within a geographic area or supply chain. It involves recognising opportunities for resource exchange, waste reduction, and collaboration to achieve mutual economic, environmental, and social benefits, ultimately fostering a more sustainable and resilient industrial ecosystem.

Occupation: Environmental Manager
 Estimated Time: 10 mins
 Completion:

Proficiency Level

01234

Level 2

You actively explore various industries and their processes to identify opportunities for industrial symbiosis. You can map waste streams for potential reuse/recycling, discuss successful symbiosis projects, and understand the distinctions between industrial symbiosis, circular economy, and sustainability. Additionally, you have knowledge of waste management's environmental and economic impacts.

0%
0/22

Next

Figure 14: Proficiency levels as part of the self-assessment tool

4.3 European Qualification Framework (EQF)

Another important element to classify the level of skills is the interrelation of the **SKILLS4Planet** to the European Qualification Framework (EQF) to make national qualifications easier to understand and more comparable. The EQF seeks to support cross-border mobility of learners and workers, promote lifelong learning and professional development across Europe.

The EQF is an **8-level**, learning outcomes-based framework for all types of qualifications that serves as a translation tool between different national qualifications frameworks. This framework helps to improve transparency, comparability and portability of people’s qualifications and makes it possible to compare qualifications from different countries and institutions.

The EQF covers all types and all levels of qualifications and the use of learning outcomes makes it clear what a person knows, understands and is able to do. The level increases according to the level of proficiency, level 1 is the lowest and 8 the highest level. Most importantly the EQF is closely linked to **National Qualifications Frameworks**. This way it can provide a comprehensive map of all types and levels of qualifications in Europe, which are increasingly accessible through qualification databases.

The EQF was set up in 2008 and later **revised in 2017**. Its revision has kept the core objectives of creating transparency and mutual trust in the landscape of qualifications in Europe. Member States committed themselves to further develop the EQF and make it more effective in facilitating the understanding of national, international and **third-country qualifications** by employers, workers and learners.

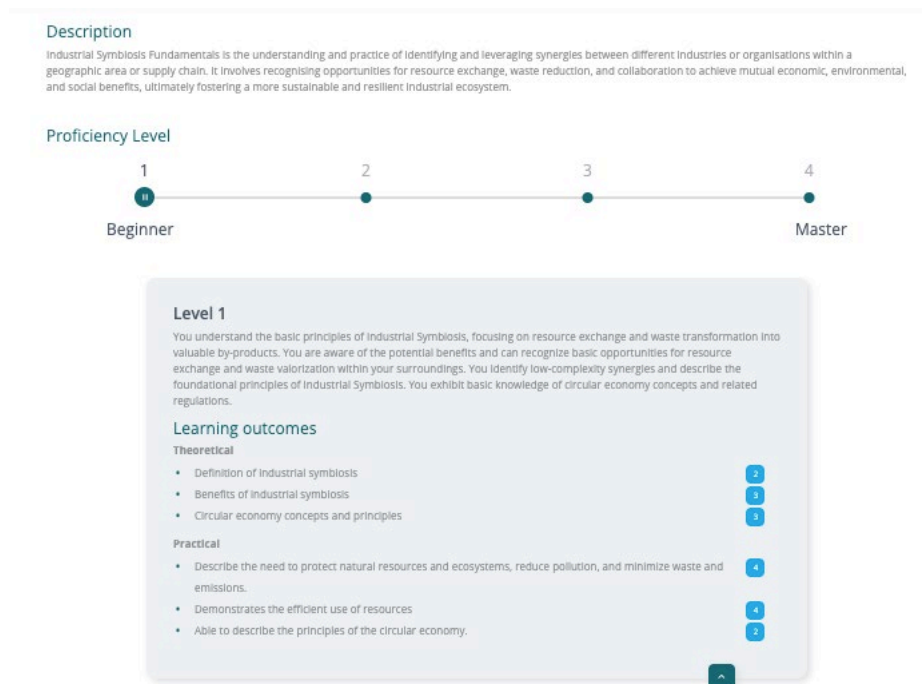


Figure 15: Competence Map View in SKILLS4Planet (Proficiency and EQF Levels)

4.4 Learning Outcome Pipeline Methodology

The Learning Outcome Pipeline methodology is a systematic approach designed to create a cohesive and structured link between industry requirements with educational institutions.

- **Organisational Flow Chart:** We start analysing Organisational Flow Chart to identify those occupations that need to be developed or updated and then creating a standard Organisation Flow Chart to help in the organisation of the information.
- **Job Profiles and Occupations:** The starting point is identifying specific job profiles and occupations. These are defined functions and roles in the company and job market with particular responsibilities and expectations, which are connected with technological innovation, changes in regulations, digitalization among others.
- **Functions:** For each job profile or occupation, we outline the primary functions or duties that the role entails. This helps to break down the occupation into manageable tasks and responsibilities. The ESCO platform offers a set of tasks for occupations to be used as a baseline.
- **Skills:** From these functions, we identify the essential skills required to perform these tasks effectively. Skills can be technical, interpersonal, cognitive abilities among others that are necessary for job performance.
- **Learning Outcomes:** Based on the identified skills, we develop specific learning outcomes. These are clear, measurable statements detailing what learners should know, understand, or be able to do after completing a learning activity. The categorizations and the format of those are writing should be in line with guideline of CEDEFOP¹.
- **Qualifications:** Learning outcomes are then mapped to formal qualifications. This ensures that the education and training provided meet the requirements defined in the project.
- **Training Resources:** Finally, appropriate training resources are selected or developed to achieve the learning outcomes. These resources include courses, workshops, online modules, textbooks, and practical training sessions, among others.
- **Skill Gap Analysis:** Identification of the difference between the skills required for an occupation and the skills that the employees currently possess, enabling organisations to pinpoint training needs, improve employee performance, enhance productivity, and ensure alignment with business goals and market demands.

By following this methodology, we ensure that there is a clear, logical progression from the requirements of a particular occupation to the specific training resources needed to prepare individuals for that role. This approach helps in creating a well-aligned and effective educational pathway that meets the needs of both learners and employers.

5 Capability Assessor

5.1 Introduction

The SPIRE-SAIS Training Framework methodology is focusing very much on the upskilling and reskilling of the existing workforce and therefore continuous vocational education and learning of adults: **adult learning as self-directed learning** (learning to learn as an increasing important soft skill). However, the SPIRE-SAIS training modules are also relevant for ap-

prentices and students of vocational schools and an integration in Initial Vocational Education and Training Programs. However, "voluntary" lifelong adult learning of workers has to be treated different than compulsory education.

Important element of the **SKILLS4Planet** is the **connection of competences with learning content**. This is a main challenge for combining industry skills demands with occupational profiles and how industry demands fit with occupational profiles and thus IVET systems (this was and will be in the centre of the ESSA rollout to the member states and regional levels).

The design, development, and implementation of an adult learning or professional learning initiative is a complex task. To be successful, organizers are required to account for a multitude of considerations, from learning content to adult psychology to applicable technologies Jimi Gipple (n.d.), ICS Learning Group. Therefore, to understand the full breadth of the learning ecosystem and to comprehend its relevance in an effective educational strategy, we need to start with a fundamental component of adult learning: self-directed learning.

Adults are self-directed learners, which is a concept introduced by Malcolm Knowles' (1975) Theory of adult learning. Garrison (1997) added elements of self-management to the model. The model proposed includes three overlapping dimensions: Self-management (task control), Self-monitoring (cognitive responsibility), and Motivation (entering and task). The self-directed learning model attempts to integrate contextual, cognitive, and motivational dimensions of the educational experience. The fundamental argument for understanding and facilitating self-direction is its potential to improve the quality of learning outcomes in both the short and long term. The self-directed learning can be understood as a process where individuals take the initiative to *diagnose learning needs*, form learning goals, identify resources, implement a learning plan, and assess their own results.

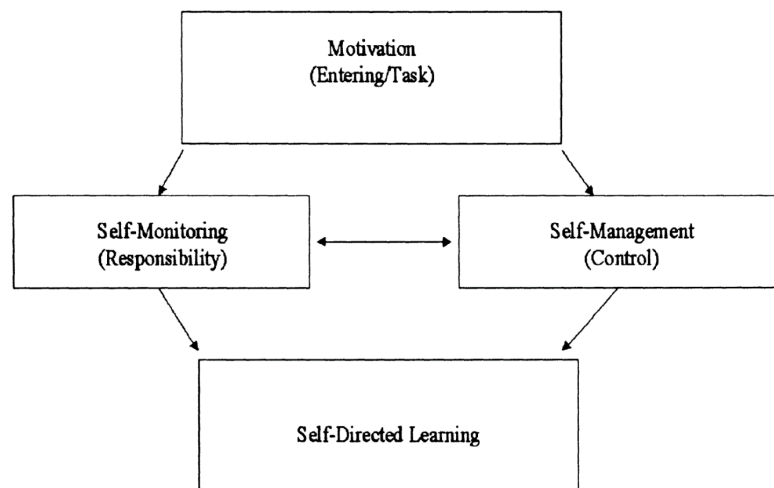


Figure 16: Dimensions of Self-Directed Learning (Garrison, 1997)

Against this backdrop, the learning experience needs to include the following elements:

1. Connection between **up to date Job Profiles and Learning Outcomes** to motivate and make sense of the training content to the learner, which is offered by Skill Directory.
2. **Self-Assessment** of the Learning Outcomes to allow the learner to identify gaps, which is offered by **Capability Assessor** module.

3. Identify the relevant learning resources from the **Learning Solution Directory**, and implement a personalised training path. To help the learner, the content needs to be curated and associated with job profiles, content and assessment; in other words, the three pillars need to be integrated.
4. **Final Assessment** to assure the quality of learning outcomes obtained and recorded: The results must prove the achievement obtained thru an objective evaluation provided by **Capability Assessor** module.

These four points are integrated into the Ecosystem Learning Arrangement and digitally interconnected into an online platform to allow the massive access and self-management of the learning experience, based on subjective self-assessment and objective assessment of the online training system.

To measure **organisationorganisation skills readiness**, the Skills Directory in SKILLS4Planet will allow companies to do the inventory of skills they already have internally and compare them with the list of skills necessary to implement industrial Symbiosis. In this way, they can also make a list of skills they need and link them to the training offers existing in the Learning Solution Directory in SKILLS4Planet and internally. This will give companies a sense of their **skills readiness** for IS, even if they have not start implementing it yet. Coupled with these specific skill areas modules are related to more generic skills such as business, regulatory, professional/technical, transversal and individual. Finally, there would be trainings (or links to existing trainings) associated with basics for different industry sectors.

Organisations will then be able to identify the courses they can direct their employees to, to obtain the missing skills, as skills from the initial list (see Figure 9) will be tagged in each course. This match may also be possible automatically, depending on the features of the online database/matching tool. This matching tool could be based on key words, relating contents of the courses and skills needed.

Against the results of a workshop with companies and training providers about training measures and upskilling schemes, an integrating training platform as a one stop and open system space (instead of standalone solutions of specific modules) is foreseen: Centralising and systematising existing training offers and integrating new ones on a sustainable platform addressing specific sector needs. Challenging is a wide range of thematic issues to be addressed, providing the training offers and materials in different languages, and combining online and theoretical learning with on the job training. Even more challenging is to ensure updating and sustainability of the platform after the project life span via an accepted and supported business model.

Decision has been made in the direction of a SAIS Online Training Platform: *SKILLS4Planet*. Possibilities of aligning or integrating such a platform in existing European structures will be discussed, e.g. with SPIRE and in the European Community of Practice for Urban Industrial Symbiosis (ECoP U-IS) which was awarded funding.

5.2 Self-Assessment (Subjective Assessment)

Self-Directed Learning, refers to a learning approach in which individuals take primary responsibility for planning, organizing, and executing their own learning process. In this context is very important to measure the level of the learning outcomes and evidence to help the

learner to identify skill gaps and propose a customised training program to close this gap. In this sense, the assessment is a key element in the Adult Learning.

The capability assessor is a module of SKILLS4Planet that assesses the capabilities or competencies of individuals or organisations. It evaluates the knowledge, skills, and abilities of the target audience and provides insights into their current capabilities and areas for improvement.

The capability assessor module is built upon a well-defined Skill Directory that outlines the specific skills and knowledge to perform a particular, job or task. Skills and knowledge are described in terms of evidence and Learning outcomes. The skills to be evaluated can be customized according to projects, team and company needs.

The module incorporates assessments that align with the Skill Directory. The assessments are designed to capture different dimensions of capabilities and provide a comprehensive evaluation. A *learner subjective evaluation* was implemented, which relies on subjective judgments, opinions, or interpretations of the learner. This assessment involves gathering qualitative data, perceptions, and subjective assessments to evaluate a person's skills and knowledge.

The module incorporates performance analytics and reporting capabilities. It generates detailed reports and insights on individual or organisational capabilities, highlighting strengths, weaknesses, and skill gaps. Performance analytics include visual representations, such as graphs or charts, to provide a clear overview of the assessment results. The report is shared with the manager to review skills gap and define a training program based on priorities of the company.

Besides, the module is integrated with Learning Solutions Directory in SKILLS4Planet to create a seamless learning and development ecosystem. The assessment results support the automatic list of personalized learning pathways, recommend relevant learning resources or training programs, and track progress over time. Integration enables a targeted and tailored approach to capability development.

Finally, the module is designed to be accessible and user-friendly. It is compatible with different devices and accessible to individuals with diverse needs. User-friendly interfaces, clear instructions, and intuitive navigation, which enhance the usability of the module and encourage engagement from the target audience.

Even though a subjective evaluation was implemented in this first instance, functional tests were carried out to tested objective evaluations in the infrastructure of SKILLS4Planet. In this evaluation measurable and quantifiable criteria as learning outcomes in the Skill Directory are used. The aim is to provide a standardized assessment following an Evidence Centered Design Methodology (ECD) of some of the skills, for instance for the Continue Casting Operator using simulations and interactive tools.

Overall, a capability assessor module plays a crucial role in assessing and evaluating the capabilities of individuals or organisations. It provides valuable insights for personalized skill development, informs decision-making processes, and contributes to the overall effectiveness of learning and development initiatives.

5.3 Final Assessment (Objective Assessment)

To come to an objective valuation, it is relevant to connect the assessment with competences, skills and knowledge. It is crucial that the range of knowledge, skills and competences identified are translated into standardised, recognisable, and acknowledged outcomes. This is the objective of the **Learning Outcomes Pipeline Methodology**. This connection allows for the construction of assessments to measure the level of knowledge, skills and competences in relation to the individual learners. Behrens et al. (2012) addresses this problem with the implemented Evidence Centred Design (ECD) (Mislevy et al., 2003) as a conceptual framework for assessment. They have been using this approach for over 10 years to undergird the delivery of 100 million exams in over 160 countries, along with development of innovative simulation-based curricular and assessment tools (e.g., Frezzo et al., 2010). For each of the major sections of the ECD framework, they offered thoughts about how emerging technologies will influence the future of assessment and the alignment of those with training tools.

A quotation from Messick (1994) neatly summarizes the core idea of an assessment argument:

A construct-centered approach would begin by asking what complex of knowledge, skills, or other attributes should be assessed, presumably because they are tied to explicit or implicit objectives of instruction or are otherwise valued by society. Next, what behaviors or performances should reveal those constructs, and what tasks or situations should elicit those behaviors? Thus, the nature of the construct guides the selection or construction of relevant tasks as well as the rational development of construct-based scoring criteria and rubrics. (p. 17)

The following image describes key parts of the ECD framework as end-to-end processes in several conceptual layers (Mislevy, 1994; Mislevy et al., 2002, 2003). The first step in starting the assessment process is considering those aspects relevant to the assessment one wishes to construct. This is represented by the top layers of the ECD model, as illustrated in the following Figure 17(adapted from Mislevy & Riconscente, 2006). The first layer is marshalling facts and theory about the domain. It is defined by the Industry Skills Requirements of SPIRE-SAIS, regularly updated by the Foresight Observatory. The second is organizing the information in the form of assessment arguments. The middle layer, the Conceptual Assessment Framework (CAF), specifies more technical models for task creation, evaluation procedures, measurement models, and the like - in essence, blueprints for the pieces and activities that instantiate the argument in the real world. The next layer concerns the manufacturing of the assessment artefacts and the specifics for their usage. The lower layer describes a process architecture for understanding assessment delivery.

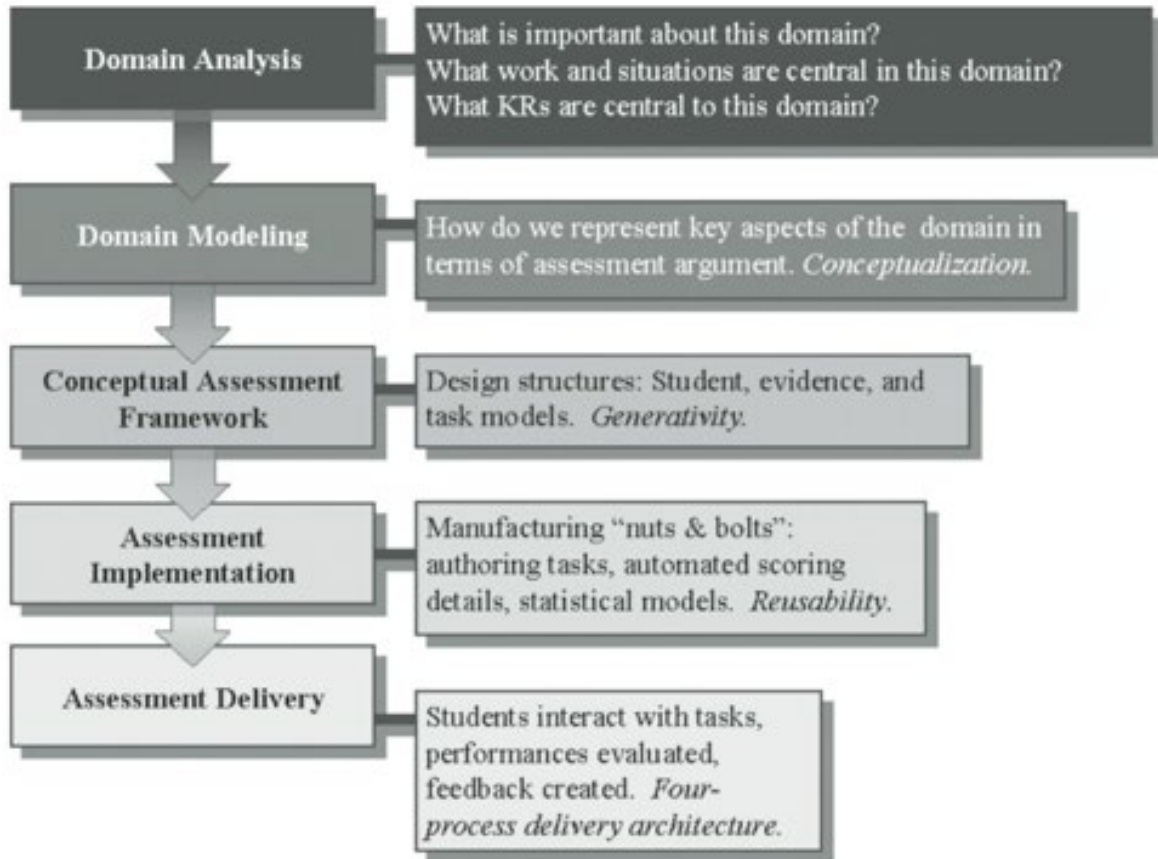


Figure 17: Layers in Evidence-Centered Design KR = Knowledge Representations (adapted from Mislevy & Riconscente, 2006)

As an example, Shute et al. (2010) describe an approach for modelling key competencies and developing valid assessments embedded within an immersive game. In their work, they used a consolidate version of this flow chart which has three particular steps: (1) define the claims to be made about students’ competencies, (2) establish what constitutes valid evidence of the claims, and (3) determine the nature and form of tasks or situations that will elicit that evidence.

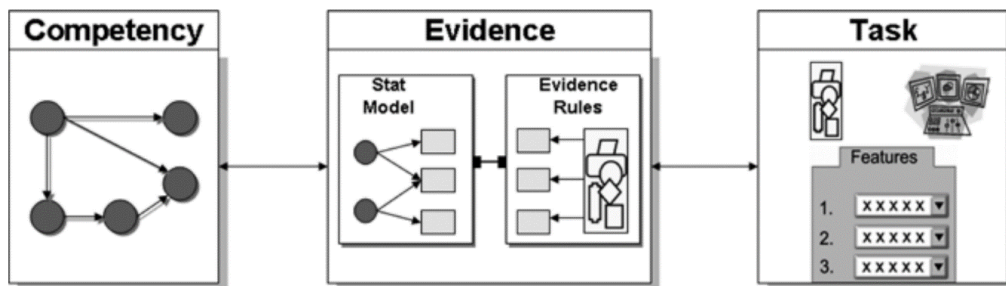


Figure 18: Main modules of an Evidence-Centred Design (Source: Shute et al., 2010, p. 139)

Competency Model: What collection of knowledge, skills, and other attributes should be assessed? Variables in the competency model (CM) are usually called “nodes” and describe the set of person variables on which inferences are based. The term “student model” is used

to denote a student-instantiated version of the CM, like a profile or report card only at a more refined grain size. Values in the student model express the assessor's current belief about a student's level on each variable within the CM. For example, suppose the CM for a science class that valued the general competency of systems thinking contained a node for "Create a causal loop diagram." The value of that node - for a student who was really facile at understanding and drawing causal loop diagrams - may be "high" (if the competency levels were divided into low, medium, and high), based on evidence accumulated across multiple, relevant contexts.

Evidence Model: What behaviours or performances should reveal differential levels of the targeted competencies? An evidence model expresses how the student's interactions with, and responses to a given problem constitute evidence about competency model variables. Basically, an evidence model lays out the argument about why and how observations in a given task situation (i.e., student performance data) constitute evidence about CM variables. Using the same node as illustrated in the CM section above, the evidence model would clearly indicate the aspects of causal loop diagrams that must be present (or absent) to indicate varying degrees of understanding or mastery of that competency.

Task Model: What tasks should elicit those behaviours that comprise the evidence? A task model (TM) provides a framework for characterizing and constructing situations with which a student will interact to provide evidence about targeted aspects of knowledge or skill related to competencies. These situations are described in terms of: (a) the presentation format (e.g., directions, stimuli), (b) the specific work or response products (e.g., answers, work samples), and (c) other variables used to describe key features of tasks (e.g., difficulty level). Thus, task specifications establish what the student will be asked to do, what kinds of responses are permitted, what types of formats are available, and other considerations, such as whether the student will be timed, allowed to use tools (e.g., calculators, dictionaries), and so forth. Multiple task models can be employed in a given assessment. Tasks are the most obvious part of an assessment, and their main purpose is to elicit evidence (which is observable) about competencies (which are unobservable).

This methodology has been used in the SKILLS4Planet pilot test to connect the skills and knowledge defined as part of skills requirements for the ESSA Continuous Casting Operator job profile and occupation, connecting with the learning objectives and learning outcomes that need to be made evident thru assessment. The following image shows a flow chart as an example for the definition of the "Competency Model". From a particular "Job Profile" tasks are defined, in this case two different tasks. Each Task requires some skills and those skills need some basic knowledge. We connect the knowledge with Learning Objectives which are the basis to define the Evidence Model. These Learning Objectives are used to connect the competences with training content offer. The following flow chart shows a codification of each Skill, Knowledge and Learning Object to be organized and connected into a Database.

The following diagram show the connection of learning outcomes defined for each proficiency level and skill with the different evaluation methods categories in CEDEFOP.

SPIRE-SAIS: Training Framework (Deliverable 5.1)

Skill Definition	Proficiency Level	Learning Outcomes	European Qualification Framework	Instrument and Tools for validation according European guidelines Evidences Center Design Methodology (ECD)
Hydrogen Combustion and Heat Transfer Hydrogen Combustion and Heat Transfer involves understanding, managing, and optimizing the combustion and heat transfer processes associated with the use of hydrogen as a fuel in industrial applications. It encompasses knowledge of combustion dynamics, heat transfer mechanisms, safety protocols, and system optimization techniques to ensure efficient and safe utilization of hydrogen for heat generation and industrial processes.	1			
	2	Proficiency in numerical methods and computational tools for simulating fluid flow, combustion, and heat transfer.	Theoretical 5	<input checked="" type="checkbox"/> Self-assessment <input checked="" type="checkbox"/> Multiple choice <input checked="" type="checkbox"/> Written tests <input checked="" type="checkbox"/> Interviews <input checked="" type="checkbox"/> Portfolio <input checked="" type="checkbox"/> Simulation <input checked="" type="checkbox"/> Job practice <input checked="" type="checkbox"/> Peer Review
	3	In-depth knowledge of thermodynamic cycles and advanced heat transfer phenomena.	Theoretical 5	<input checked="" type="checkbox"/> Self-assessment <input checked="" type="checkbox"/> Multiple choice <input checked="" type="checkbox"/> Written tests <input checked="" type="checkbox"/> Interviews <input checked="" type="checkbox"/> Portfolio <input checked="" type="checkbox"/> Simulation <input checked="" type="checkbox"/> Job practice <input checked="" type="checkbox"/> Peer Review
	4	In-depth understanding of regulatory requirements and environmental standards related to hydrogen-based processes Predict the impact of changes in combustion parameters on heat transfer efficiency and combustion stability. Validate computational models of hydrogen combustion and heat transfer against experimental data.	Cognitive 4 Cognitive 4	<input checked="" type="checkbox"/> Self-assessment <input checked="" type="checkbox"/> Multiple choice <input checked="" type="checkbox"/> Written tests <input checked="" type="checkbox"/> Interviews <input checked="" type="checkbox"/> Portfolio <input checked="" type="checkbox"/> Simulation <input checked="" type="checkbox"/> Job practice <input checked="" type="checkbox"/> Peer Review

https://www.cedefop.europa.eu/files/3093_en.pdf

Figure 19: Learning outcomes defined for each proficiency level and skill

6 Learning Solution Directory

A series of educational resources and training courses was already identified and is available to be included in the Learning Solution Directory in SKILLS4Planet as a Publisher content. New training courses were developed in the training offer collection. Further publishers will be identified and integrated under the framework of a business model to assure the sustainability of the SKILLS4Planet platform.

With regards to external training course inclusion, there are various aspects to be considered:

1. List of courses offered by external entities that meet the different skills. Bear in mind that these courses will mostly be composed of several modules or subjects and they can be more or less long. Will the user be willing to follow three complete courses to cover three different skills, for instance?
2. SPIRE-SAIS team extracts the content (complete modules or chapters) of the different existing courses to offer its own, shorter and more direct course for each skill.

It is likely that the final offering would be an amalgamation of these options, with partners contributing their expertise and external courses complimenting. For each course, an identification of the skills, they will cover, will be done, in order to allow the match between the skills companies/workers are searching for and the courses that provide it. Of course, for a more targeted identification (e.g. in terms of level) of the required courses and a higher transparency, a clear statement of the learning outcomes and the European Qualifications Framework level associated to each course will be done.

6.1 Publishers and SPIRE-SAIS Solutions

Beside the already described Skills Directory and the Capability Assessor, the Learning Solution Directory is expanding in two keyways. Firstly, it is growing with the valuable content provided by various publishers. This publisher-provided content ensures a diverse and rich array of learning materials available to users. We get content from European Projects, trainer providers, companies, among others illustrated in the following logos.



Figure 20: Training providers SKILLS4Planet

Hydrogen oriented trainings and trainings for sector newcomers were and will be further developed with the support of Publishers (up to now for steel, ceramics, cement, minerals, water and chemical sectors). For example, American Institute of Chemical Engineers (AIChE) provide 12 courses that cover basic concepts of Hydrogen, production, storage and safety. The following image shows all the courses available in the platform.

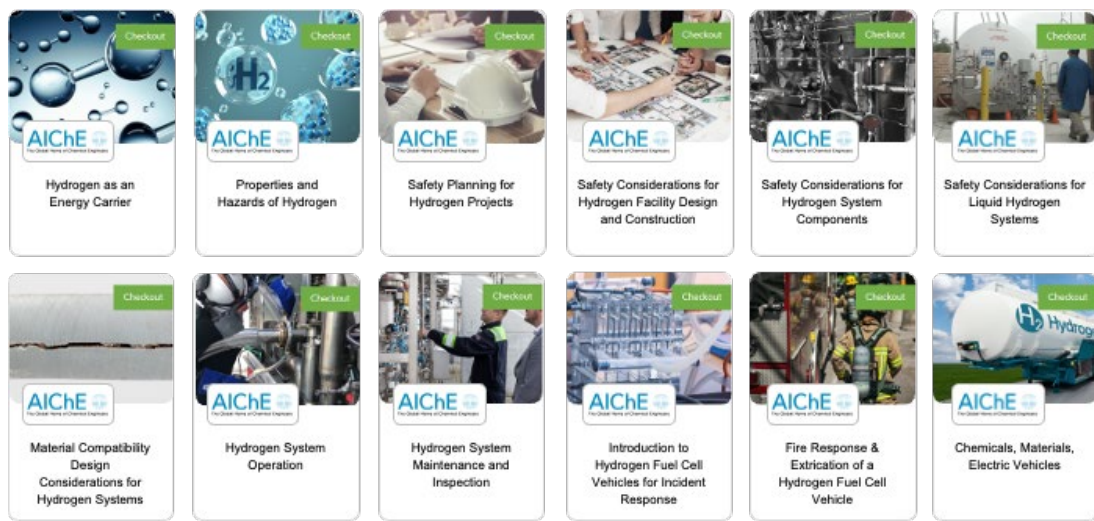


Figure 21: Hydrogen Learning Solutions from The American Institute of Chemical Engineers

Secondly, the directory is also incorporating content developed specifically for the SPIRE-SAIS project. These contents are tailored to meet specific educational goals and requirements of the sectors, enhancing the overall quality and relevance of the directory's offerings. Up to now there are three learning solutions developed in the project.

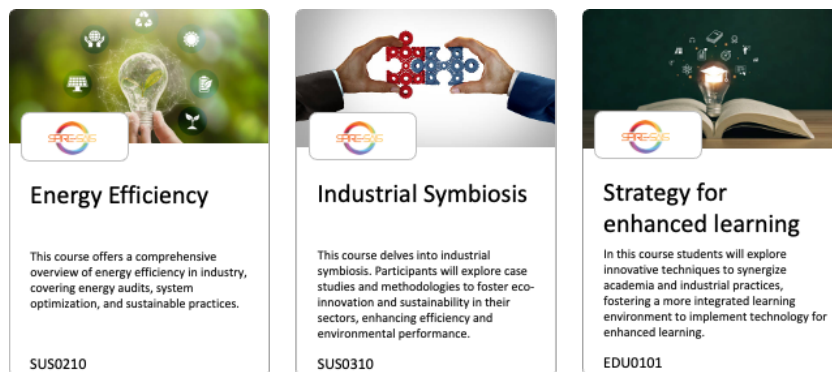


Figure 22: Learning Solutions Developed by SPIRE-SAIS project

6.2 Introductory Learning Solutions for IS and EE

There are two solutions SUS0210 and SUS0310 for newcomers to the Energy Intensive Industries sector(s), both upstream and downstream, to introduce the main characteristics of these types of industry, as the intensive industries are positioned in many value chains and play a key role for both industrial symbiosis and beyond, circular economy. Company/sector induction training would form the basis for such training with the option to adapt such training into more generic forms, coupled with new training methodologies, being explored during the final two years of the project.

Thus, the initial suite of trainings to be made available through the project becomes:

- generic training courses that impart basic understanding and skills – such as the introduction to industrial symbiosis module
- job profile related courses
- skills topic related courses: business, regulatory, professional/technical, transversal/individual.

The courses will be potentially collated in a database consisting of two distinct yet connected areas:

1. existing courses to be collected and distributed
2. additional courses development if relevant, not existing and capable of being developed by consortium members.

Figure 23 illustrates how these areas would connect and interact.



Figure 23: Generic and in-depth training

Based on or integrated in a generic training module setting the scheme to manage and act for IS and EE

- thematic in-depth and advanced training courses (e.g. for an assessment of financial benefits),
- sector specifications and illustrations (ensuring the practical workplace integration and perspective), and
- job profile and function related courses

will improve the skills and qualifications in line with specific needs and interests of the learners/companies.

One of the newer important topics currently being developed is related to critical raw materials (CRM). (Newer) courses covering CRMs usually touch on the subject of industrial symbiosis and circular economy, even if this is not the main focus. With this in mind, we will consider the inclusion of such courses within the database.

Examples from University of Delft and EIT Raw Materials have been developed, also considering the pressure of renewable energy technologies:

1. Critical Raw Materials: Managing Resources for a Sustainable Future
Course provider: Delft University
2. RMManager
Course provider: AGH, supported by EIT Raw Materials Academy.

The vision of SPIRE-SAIS and its Online Training Database ISSI is to combine on the job training and on line, targeted training in the areas of IS and EE. During the development of the database and courses, a *business model* for sustainably running the training platform will also be developed. This will also consider the need to ensure that linked training courses are checked continuously for their actuality. Here, the risk would be that linked courses ceased support and the SPIRE-SAIS database faces an ever-increasing problem of dead links, thus undermining both the effectiveness and credibility of the database's standing. This has to be solved via an accepted business and/or governance model, supported by the stakeholders.

6.3 ***Train the Trainer Programm***

The important role of teaching professionals and trainers for transformation processes in the energy-intensive industries is beyond question and is also expressed in a high demand for training personnel (cf. e.g. Cedefop's skills forecast, 2020). Because no education and training system is better than its teachers and trainers, SPIRE-SAIS recognises this by integrating train the trainer programmes as part of its SKILLS4Planet that include the following solutions.

- Job Profile and Skill Gap Analysis of the "Corporate Trainer Profile".
- Learning Solution for Specific and Technical skills in IS and Energy Efficiency.
- Learning solutions for Cross-Sectoral and Transversal Skills, like Technological proficiency and pedagogical effectiveness as well as Coaching/Mentoring skills.
- Access to a Source of Digital Resources to create engaging training programs and support learners thru their journey.

6.3.1 **Job Profile and Skill Gap Analysis.**

Even though the corporate trainer profile was developed in the ESSA project for ESSA's online platform, its focus is on trainer skills that are relevant not only for the Energy Intensive industry, but for the process industry in general – so that the profile can now also be incorporated into SKILLS4Planet. Originally, the Train the Trainer skills were taken from ESCO's Corporate Trainer Profile and adapted to the needs of energy-intensive sectors with the help of expert assessments from the ESSA and SPIRE-SAIS projects. The individual, altogether 30 functional skills of the Corporate Trainer thereby reflect such skills that are important for trainer staff in modern learning environments in energy-intensive industries.

Because of the fast-changing technologies and the more incremental upskilling, new leadership (Kopp et al., 2021) of managers in different production and functional company areas

(see Figure 10) becomes increasingly necessary. Thereby middle managers take the role of "trainers" of their subordinated operators, foremen, and technicians. The challenge for trainers and managers is to combine the implementation of new technologies and pedagogics with the necessities and demands of the specific workplaces (workplace innovation). This aspect are reflected in the Job Profile.

Figure 24 present functions and transversal and cross sectoral skills required for a teaching professionals and trainers.

Teachers, Professors and Internal instructors		Digital Literacy	Educational Technology Tools	Pedagogical Expertise	Instructional Design	Management of Change	Digital Communication	Collaboration	Commitment to self-development	Learning Assessment Design & Implementation	Creative Thinking
Facilitate Learning, mentoring and advising	Guide students through personalized learning paths, adapting content and teaching methods to individual needs, preferences, and learning styles. Provides expert guidance on academic choices and career pathways, helping students navigate their futures with informed decisions. Extends support beyond the classroom, offering guidance, support, and encouragement to help students develop both academically and personally.										
Integrate Technology to Enhance Learning	Use technology to enhance learning. This includes employing artificial intelligence to provide real-time feedback, virtual reality to create immersive learning experiences, and data analytics to tailor and improve educational outcomes. Besides, integrate simulation to put in practice knowledge, hand-on exercise in learning factories as well as media resources like videos, infographics, among others.	2	2	3	3	2	2	2	3	3	2
Research, Innovate and Self-Develop	Push boundaries in their respective fields, conducting research that informs their teaching and contributes to global knowledge. Explore new pedagogical techniques to improve education delivery. Become a lifelong learners, constantly adapting to new educational tools and theories.										
Collaborate at Global and Community level Across Disciplines	Collaborate across various fields to provide a holistic education that prepares students to think broadly and contextually. Besides, engage with global and local communities. This involves collaborative projects that address global challenges such as climate change, public health, and sustainable development, as well as community-based projects that enhance the social and economic well-being of local populations.										

Figure 24: Functions and Competences of a Teacher

Using the job profile, a self-assessment for trainers was developed to identify skill gaps. Key competencies required for the role, such as subject matter expertise, Coaching and Mentoring, communication skills, instructional design, assessment and evaluation, and technology proficiency, were outlined. Trainers rate their proficiency in each area follow a 4 level of proficiency, reflecting on their strengths and areas needing improvement. This self-assessment helps trainers pinpoint specific skill deficiencies, guiding targeted professional development efforts. By aligning personal skills with job requirements, trainers can enhance their effectiveness, ensuring they meet organisational, and trainee needs more effectively.

6.3.2 Specific Technical Skills.

The sector specific and technical skills that Teacher required is addressed by learning solutions available in the SKILLS4Planet, which include Industrial Symbiosis, Energy Efficiency at sector specific levels as well as other specific aspect like Hydrogen manage and storage critical for the implementation of IS and EE in production environments. These resources are provided by publishers and developed into the project.

6.3.3 Cross-Sectoral and Transversal Skills

digital technology in education represents a transformative shift in how knowledge is imparted, accessed, and absorbed as well as how skills are developed. This technology personalize and enhance the learning experience, making it more engaging, flexible, and accessible. Digital tools allow for adaptive learning that can tailor educational content to the needs and pace of individual students, thereby improving learning outcomes. Technology also facilitates the use of multimedia resources (like videos, interactive simulations, and e-books), which

can make complex subjects more understandable and engaging. Additionally, digital platforms enable students to learn anytime and anywhere, breaking down geographical and time barriers. This accessibility not only caters to diverse learning styles but also supports lifelong learning and continuous professional development. Overall, digital technology transforms traditional educational environments into dynamic, interactive spaces where learning is more aligned with the digital age.

However, new educational landscape faces several challenges that require careful navigation. One of the most relevant is that teachers face the daunting task of adapting to new technologies; without adequate training and resources, integrating digital tools effectively into the curriculum can be challenging. Furthermore, maintaining student engagement in an increasingly virtual environment is difficult, especially as students may experience screen fatigue or feel disconnected from the learning community. Besides, assessing student performance in digital settings also introduces complexities, with concerns about the integrity of online assessments and the potential for academic dishonesty. Additionally, ensuring the privacy and security of student data as more personal information is shared online is a critical concern.

These challenges underscore the need for a balanced approach to technology integration, emphasizing both **technological proficiency** and **pedagogical effectiveness** as well as facilitate coordination, communication and collaborative partnership between stakeholders of the training and development eco-system to assure the **access to high quality digital technology tools** in SKILLS4Planet.

One important realisation is that trainers often no longer act in the traditional role of teachers in classroom training, but rather as coaches, mentors or facilitators, especially in the context of online learning.

During the duration of the project, the SKILLS4Planet online platform became the main focus for a train-the-trainer approach. After all, the online platform contains the training programmes developed in the project, which are primarily intended for use by companies. In terms of training for trainers.

The platform include the course “**EDU0101-Strategy for enhanced learning**“ developed in SPIRE-SAIS focus on the Teacher’s functions of “**Facilitate Learning, mentoring and advising**” and “**Integrate Technology to enhance learning**”.

The course include specific guidelines for trainers on how to use the online platform SKILLS4Planet. These are tutorials in video format, which are designed to enable trainers to support learners in using SKILLS4Planet in a particularly user-friendly and application-orientated way. As the SPIRE-SAIS online platform is primarily designed for self-learning, the trainers' main task is to support learners in their own learning experience and learning journey. To do this, the trainers need a deep understanding of how to use SKILLS4Planet. There is a difference here to classic "training", as facilitation does not relate to the design and development of training, rather, facilitation is about selecting the appropriate material from existing Learning Solution Directory, conveying it or merely supporting the learner.

Together, these sources contribute to a comprehensive and evolving resource for trainer, which is available in SKILLS4Planet²⁶.

6.4 Enhance Learning experience with Digital Solutions

6.4.1 3D interactive models

Interactive 3D models are increasingly being used as a powerful tool to deliver training across various industries and educational settings. These models provide a highly engaging and immersive learning experience that enables learners to visualize and interact with complex concepts and objects. 3D models allow learners to visualize objects, processes, large and complex machine and environments in a three-dimensional space. This enables a more comprehensive understanding of the subject matter compared to traditional two-dimensional images, pictures or diagrams. Learner can rotate, zoom in, and examine the model from different angles, providing a deeper insight into the subject.

Besides, this interactive 3D models incorporate multimedia elements such as audio, animations, and annotations to provide a multisensory learning experience. This engages multiple senses and helps reinforce learning by associating visual, auditory, and tactile information. For example, the model includes labels that describe more in detail each component, like is shown in Figure 25, which is a 3D model of the Blast Furnace. This 3D models have been included in e-learning courses and wrapped in SCORM 2004 4th edition and SCORM1.2 edition to be embedded into Learning Management System of companies.

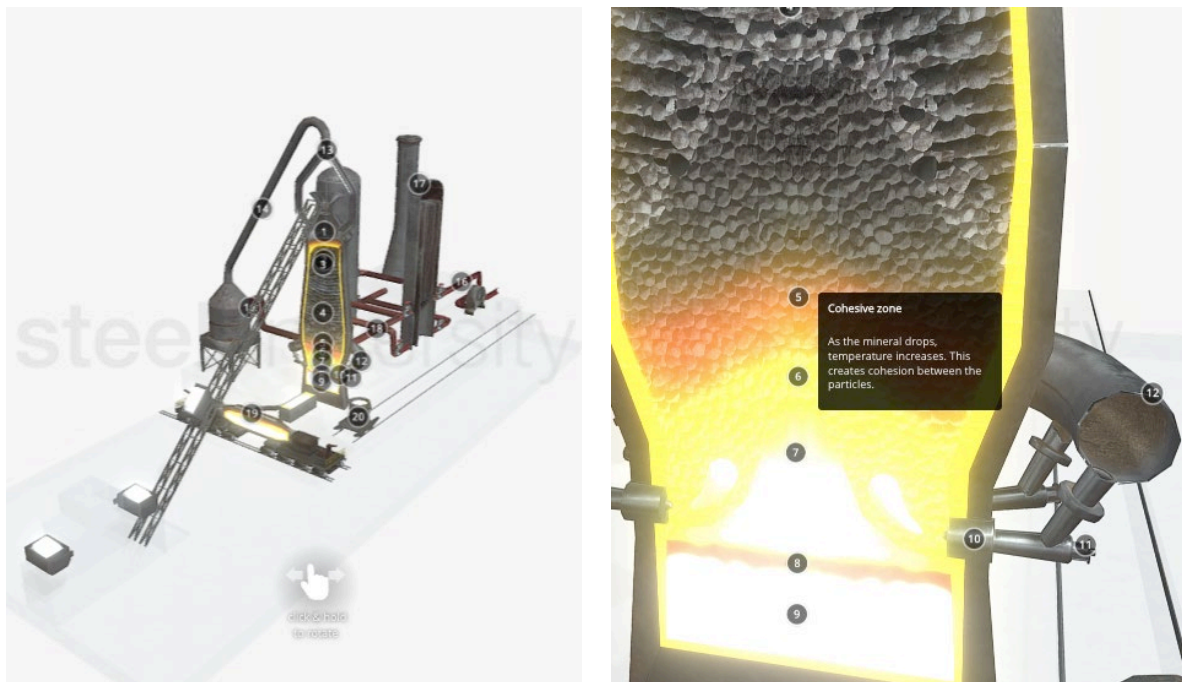


Figure 25: 3D interactive model of a Blast Furnace (38,600 views) <https://skfb.ly/DVTJ>

Interactive 3D models can simulate real-world scenarios, enabling trainees to practice skills and decision-making in a safe and controlled environment. For example, in risk identification

²⁶ <https://hub.skills4planet.eu>

in working at high temperature activities inside of a steel plant, the 3D models replicate the scenario of two workers changing a cooling panel inside of an Electric Arc Furnace.

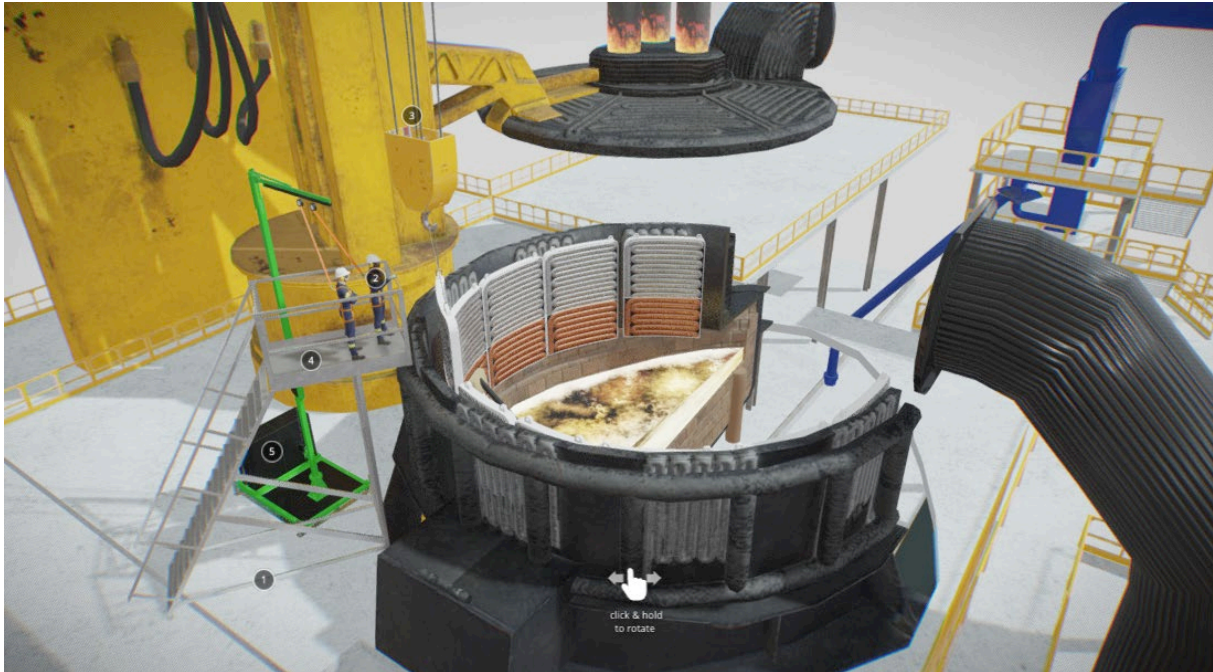


Figure 26: 3D interactive model of Maintenance scenario in an Electric Arc Furnace

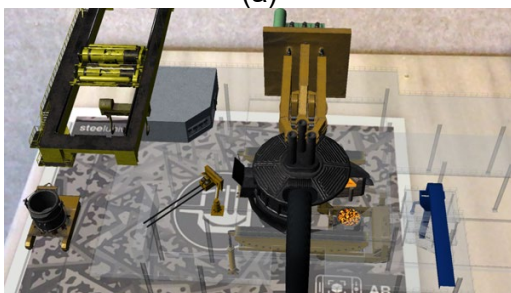
Finally, 3D model accepts the use of hands-on interactivity. Learners can actively interact with the 3D models, manipulating objects, disassembling and reassembling parts, and performing virtual experiments using Virtual Reality or printing the model in plastic. This hands-on experience fosters better comprehension, retention, and application of knowledge. Figure 27 is showing the example of a threading machine for steel pipes used in Oil and Gas Industry, in order to show the different components of the shredder and to train risk identification.



(a)



(b)



(c)



(d)

Figure 27: Threading Machine Model : (a) and (b) 3D printing plastic model, (c) AR of Electric Arc Furnace and (d) VR environment for risk identification

6.4.2 Simulations

Simulations offer several advantages for the learning process, such as increased engagement, active participation, risk-free experimentation, and the ability to visualize and manipulate complex systems. They can be used in a wide range of educational settings, from classrooms to professional training programs, to enhance learning outcomes and bridge the gap between theory and practice.

SKILLS4Planet include a library of simulations of the steel production process that includes elements from the entry of raw materials to the finished steel product. They allow to design, produce, test and use steel for specific applications considering time and costs.

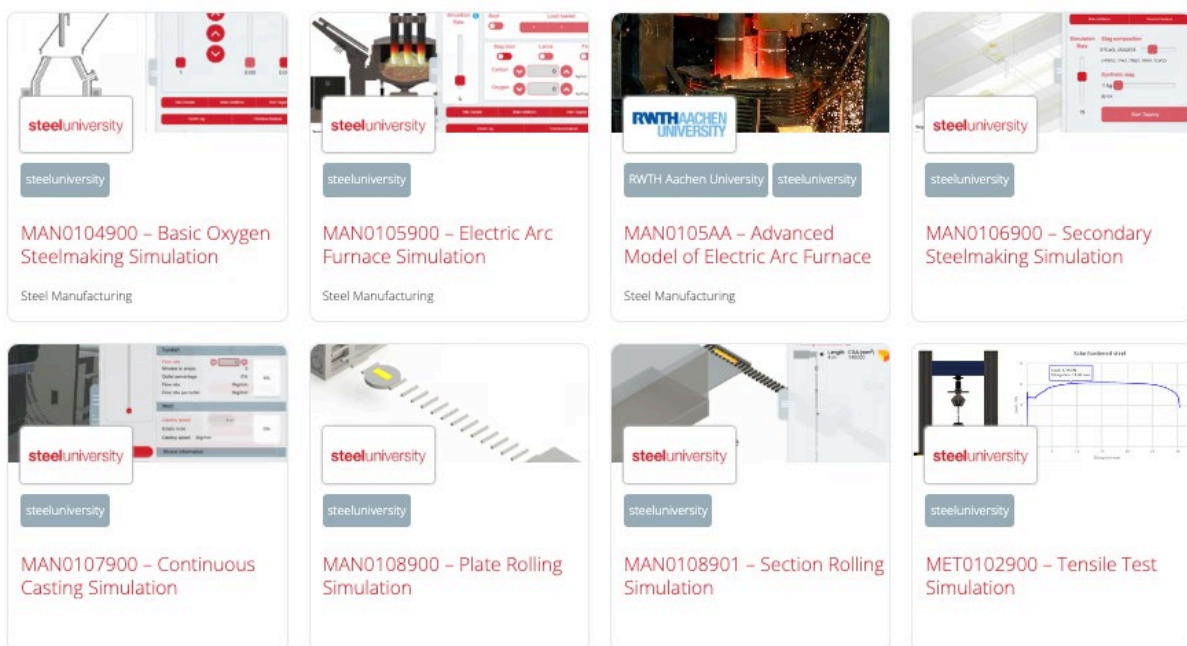


Figure 28: Process Simulations (Examples)

7 Qualification Directory

Besides the training courses available in the planned online database, the **identification of formal VET qualifications** that include the critical skills for the implementation of IS was done, taking advantage of the analysis of industry requirements and VET Support. Qualifications were identified, one for each job profile, if applicable, in three countries: Germany, Italy and Portugal. This allows a connection of the SKILLS4Planet platform to formal national VET systems qualification offer, ideally in a two-ways dynamic:

1. National VET systems authorities will be able to communicate the creation of new qualifications that will fall within the scope of Process Industry (in general) and Industrial Symbiosis (in particular). This will provide a wider visibility to national VET systems' efforts towards contributing to a more sustainable society, and it will constitute a platform for disseminating the qualifications they have made available. The side ad-

vantage will be that companies will be able to see these new qualifications when navigating the platform with training courses, as the courses may be available there, or they can potentially have an indication of who is providing it in a specific country.

2. The SKILLS4Planet offer the possibility to pinpoint existing qualifications offer in formal VET systems that may help suppress the lack of skills for IS in the labour market (or even in the companies themselves). A challenge here, of course, is how to address language, and, for that, indications of which language the courses are presented are specified.

As a consequence of this interaction, companies can find the link between existing (or new) qualifications and the skills (and professional profiles) they are looking for, in order to facilitate the most suitable hiring of new personnel or the possibility of up-skilling/re-skilling current staff through formal VET qualifications.

Given the work developed in the SPIRE-SAIS project, where the inclusion of new skills for the selected job profiles was fostered by existing occupations of the ESCO database, it is possible to better and more easily match the occupational profiles with the company demanded skills relevant for IS and EE implementation

In this sense, valuable information was obtained from the developed and defined job profiles (see Figure 10) that are focusing on an incremental upskilling or complementation of existing skills. Moreover, this allows a harmonisation of the job profiles of the different industry sectors into one common template in order to reduce complexity and achieve an effective match of occupations and skills profiles. In this sense, SPIRE-SAIS generated a common ground combining the industry demand and VET (system) perspective. The relation between the European job profile and the skills assessment can be used to implement an effective skills and competence taxation process in the companies. Defining and implementing an internal assessment process enables verification of an organisation's existing job roles and aids identification of competence gaps.

The work developed under WP4 "VET Systems: Anticipating Future Requirements and Regulations in the national VET Systems" aimed to identify how Vocational Education and Training (VET) systems and frameworks at national and EU level currently deliver skills concerning IS and EE to the energy intensive sectors involved. It also identifies where non-formal company level VET attempts to close skills gaps in formal (state) provision. Specifically, the task 4.1 "Mapping of current VET provision for IS and EE skills of the energy intensive sectors in selected member states" identifies aspects of the national VET systems in partner countries that are important and form the context of the Blueprint.

The matrix of cross-sectoral IS and EE skills elaborated identifies how IS and EE related skills needs are addressed in relevant VET programmes. Key gaps and challenges concerning the provision of relevant skills remaining after the formal VET provision are identified - addressed by the Blueprint and its training tools. Additionally, SPIRE-SAIS has developed a database of good case studies for training provision across several countries (see Annex C). These cases will be included in the training course database, if permitted. Therefore, all courses included in the SKILLS4Planet will go through a validation process to ensure that they are translated in a VET European language, using the current reference language, such as learning outcomes (LOs) and an associated EQF level.

The alignment of the courses in the platform with the VET European language will facilitate recognition of achievement. Having a certificate of achievement, or a learning certificate, also

adds value to a worker’s portfolio/cv, so certificates, diplomas, badges or even micro-credentials should be considered.

Additionally, Europass is working on the acceptance of diplomas and also wish to integrate more informal or online learning – this should be an avenue to be explored in the future as well.

8 Delivery in Learning Environments

A key element for the successful implementation of SKILLS4Planet is its flexible integration using the international standard of communication (SCORM). The following diagram show how SKILLS4Planet-HUB²⁷ and SKILLS4Planet-LMS²⁸ are connecting the training offers with the different target and user groups.

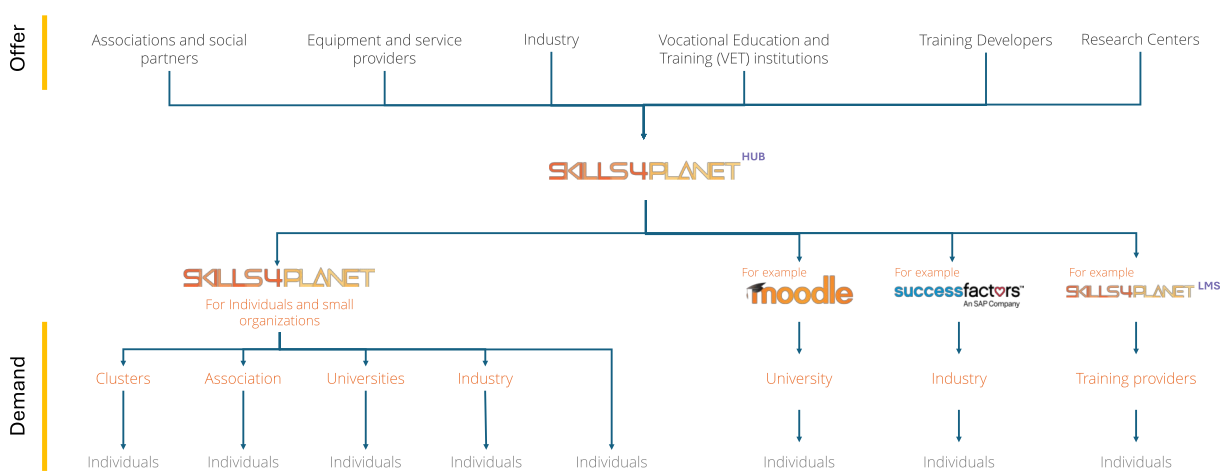


Figure 29: Information flow-chart in SKILLS4Planet that connect Offer and Demand

The solutions of SKILLS4Planet can be integrated at different stages of the particular framework that companies use to develop their training programs. To have a common ground to identify key steps to improve communication and integration of SKILLS4Planet solutions, SPIRE-SAIS selected and implemented *ADDIE Model* (elmlarning, n. d.; van Vulpen, n. d.) adapted to our skills-based development program. The ADDIE model is a widely used instructional design framework that provides a systematic approach to developing effective training programs.

SKILLS4Planet offers a flexible integration in learning environments to meet the unique needs of organisations of different size and type as well as individuals. The platform provides multiple channels to cover the different stakeholders needs. For individual and small groups of students, they can access to learning solutions in the steeluniversity website. On the other hand, for those companies, universities and schools without a Learning Management System (LMS), the learning solutions can be accessed from SKILLS4Planet-LMS, which is a custom platform with the branding, logos and colors of the organisation. Finally, for those organisations with a Learning Management System, like Success Factor or Moodle, the content is embedded into their software suite thru the SKILLS4Planet solution.

²⁷ <https://Hub.skills4planet.eu>

²⁸ <https://skills4planet.eu>

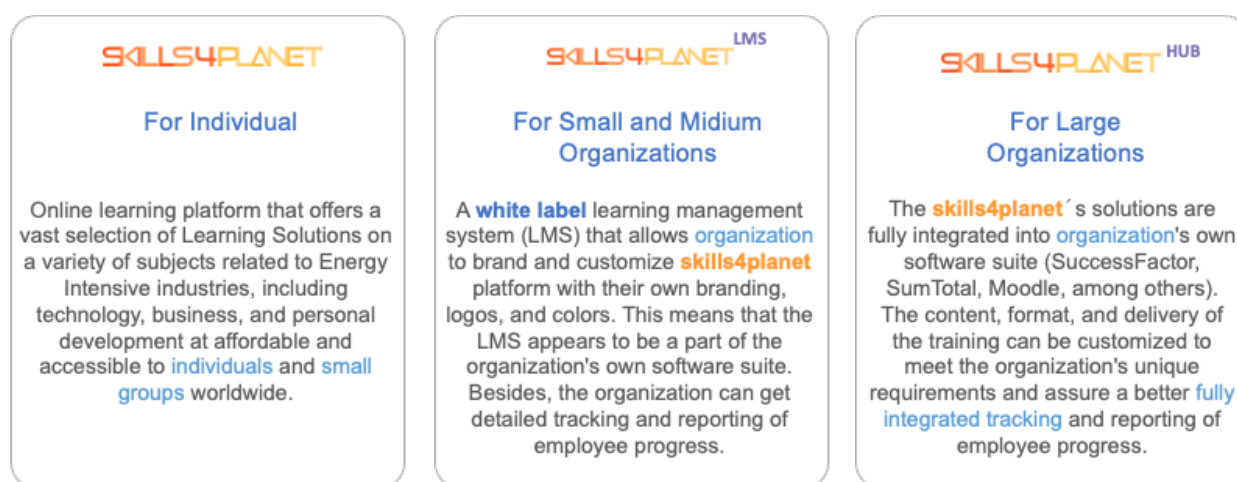


Figure 30: Integration of Training Modules

9 Quality control

A validation process will ensure that only quality resources/courses are to be included in the SKILLS4PLANET. So, an entity will apply for the inclusion of a course in the platform only after having the course validated by the SKILLS4PLANET managers. As to non-formal and informal learning courses, they will also be subjected to the validation process, as the instruments we refer to (learning outcomes approach and an associated EQF level) are to be used in such kind of learning courses as well. For this, was created a Training Course Quality Assessment Form with questions related to four dimensions: IS and EE Skills Development Identification (DI), Learning Outcomes (LO), Quality in Learning (QL) and Certification in Europe (CE). The scale and the acceptable value for recognition and certification of training needs to be further developed (see Annex E).

An important issue for including training courses in the SKILLS4PLANET is to ensure the quality of the educational materials that are part of the courses. This includes as well the use of new training methods and arrangements in training provision as one of the requirements for a course to be considered as acceptable to be included in the database.

9.1 New learning arrangements and train the trainer

Train the trainer courses and tools will also be available in the platform, to support these professionals in the use of the training courses and to promote the use of pedagogical approaches that fit the EC latest recommendations for education and training (such as EntreComp Framework, DigComp Framework, Personal, Social and Learning Competence Framework, etc.) and to use a more learner centred didactics.

New training methods and arrangements, considering new possibilities of digital learning and support (such as social media, Moodle, virtual labs, online learning, gamification, mobile apps, virtual reality) and workers participation (e.g. workplace innovation, and by using digital tools like tablets, smart phones, laptops, etc. and augmented collaboration software such as Microsoft365, GroupMap, Miro, HowSpace etc. at the workplace) will be fostered, even to support the design of new courses matching the quality requirements of the online database. Additionally, off-line augmented collaboration tools to support online course content will be

integrated. Advantage will be taken of SPIRE-SAIS consortium members involved in other ERASMUS programmes looking at areas such as digital learning platforms, gamified courses etc.

From the WELDONE project, a *train the trainers' course* was prepared with seven Competence Units (short-term courses), to be provided in a face-to-face setting, using the workshop model in the implementation:

- Competence Unit 1 | Multiple Intelligences and Learning Styles
- Competence Unit 2 | Learner Centred Didactics: Problem Based Learning, Critical Thinking
- Competence Unit 3 | Gamification
- Competence Unit 4 | Digital Competence and using digital resources
- Competence Unit 5 | New Media Didactics: The use of social media, micro-learning
- Competence Unit 6 | Personal, social and learning competence
- Competence Unit 7 | Entrepreneurship competence.

Concerning *games* to teach financial performance of process industries and their relation to assessing the financial implications of industrial symbiosis opportunities, some partners have already developed such training modules that can be adapted (ISL, H2O) connecting different sectors for this topic.

As an example, H2O People's SMARTEN project focuses not on financial integration, but on aspects such as the teaching of NEXUS (software) integration – dealing with complexity in education and digital readiness / use of digital tools and games in educational water sector. They will provide a toolkit to use the tools, a workshop to be used in education and lifelong learning and at the end an inclusion in curricula of higher education.

9.2 Relation to EQAVET

Not at least, the alignment of the Training Framework and its mechanisms with the EQAVET quality cycle and indicators (as detected in Deliverable D8.1; Almeida & all WP leaders, 2020, pp. 14) was ensured by considering the EQAVET indicators (esp. indicator 3, 6, and 9).

Indicator 3 (number of participants in VET programmes, according to the type of programme and individual criteria) relates to lower secondary school/compulsory education in IVET programmes and entering CVET programmes (which lead to recognition). As an input/process/output indicator it may

- assist in obtaining basic information at VET system and VET provider levels on the attractiveness of VET and in targeting support to increase access to VET;
- be used for the planning, implementation, evaluation and review phases of the quality cycle. It may also be used to set up reward schemes and budget target setting.

This indicator will be verified in the Training Course Quality Assessment Form (question 5QL).

The interest in contributing to **indicator 6** (utilisation of acquired skills at the workplace), in terms of the “satisfaction rate of individuals and employers with acquired skills/competences”, is also considerable, for instance for:

- Employees finding that their training is relevant for their current occupation;
- Employers of a given sector who are satisfied to find VET programme completers with relevant qualifications and competences required for the workplace.

Through the question 7QL of the Training Course Quality Assessment Form (see Annex E), it is possible to ensure that the training course has a feedback survey in which the learners will give their opinion.

SPIRE-SAIS results have the potential to cover **indicator 9** (mechanisms to identify training needs in the labour market) as it relies on information on mechanisms set up to identify changing demands at different levels and the evidence of their effectiveness.

When considering the definition of mechanisms to identify training needs in the labour market, it is important to think on the type of mechanisms used to update the VET offer to the future labour market needs; and on the information on mechanisms used to provide stakeholders with the most recent information on the future needs of the labour market. Against this backdrop, indicator 9 is a context/input indicator which may:

- assist in improving responsiveness of VET to changing demands in the labour market, in supporting employability and improving quality of training provision;
- be used for mutual learning and planning;
- be used for EQF related issues, as this indicator assists in quality assuring certification;
- be used in the planning, evaluation and review phases of the quality cycle.

A more detailed and concrete analysis of possibilities will be done for the final version of this deliverable, considering the features in the online platform that is still being defined.

9.3 The need to keep the mechanism updated

A continuous update of the list of skills required to implement and run Industrial Symbiosis should be possible, taking advantage of the experience gained in testing the described mechanisms, the Blueprint Prototype and rollout, the regular technological development and skills assessment (Foresight Observatory), the release of new studies on current and future jobs and skills needs, and new research results that may even bring disruptive changes in the sectors panorama. All these have the potential to introduce additional critical skills to the list and, of course, can lead to the need for creating new training courses or include new ones, that were created meanwhile, in the online training database: aiming at *proactive updating of skills demands and training offers continuously and in short term* and the *functionality for stakeholders to track acquisition of new skills*.

Within the further development of the Blueprint Prototype this has to be considered also from a business model implementation and/or an integration in more broader governance structures of SPIRE or the planned ECoP for Industrial Symbiosis.

10 Considerations for the further development

During the implementation and test phase of SPIRE-SAIS, workshops will be implemented to test the above described Training Framework, integrate new learning content and arrangements and establish the Online Training Platform.

The development will initially focus on aspects associated with Industrial Symbiosis, as there is good knowledge and experience in delivering training associated with this topic. The focus will be on English language courses, but non-English courses will not be ruled out during the development stage.

Once the Industrial Symbiosis related process has been developed, attention will be given to replicating the process/outputs for Energy Efficiency related to Industrial Symbiosis. Nevertheless, there are likely to be opportunities for those consortium members experienced in this area to begin their contributions in parallel.

Due to recruitment problems of the energy intensive industries, the SPIRE-SAIS online database – in spite of provided resources - could be also used to match people to job openings in the sectors. The **lack of suitable applicants** in the field of Industrial Symbiosis should not only be solved by imparting skills and knowledge internally (with a focus on in-house talents). Within the Training Framework and its intended Platform, the possibility of an online database for job openings related to IS and EE in the specific SPIRE sectors could be an option too, attracting talented people and improving the mobility of workers. Combining training (e.g. for the IS Facilitator) with new job offers might attract people to energy intensive industries. However, it has to be checked if – beside an internal job platform of specific IS and EE job offers – an integration in existing or planned European Platforms, esp. the European Community of Practice of Hubs for Circularity or the European Platform EURES is the best solution.

Annex

A. Literature

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B. List of abbreviations

Abbreviation	Meaning
ADDIE	Analysis, Design, Development, Implementation, Evaluation
CAF	Conceptual Assessment Framework
CM	Competency Model
CEN	European Committee for Standardization
CVET	Continuing Vocational Education and Training
ECAR	Educause Center for Analysis and Research
ECD	Evidence Centered Design Methodology
ECoP	European Community of Practice
ECVET	European Credit System for Vocational Education and Training
EE	Energy Efficiency
EQAVET	European Quality Assurance in Vocational Education and Training
EQF	European Qualifications Framework
ESCO	European Skills, Competences, Qualifications and Occupations
ESSA	European Steel Skills Agenda
EU	European Union
FP6	Sixth Framework Programme
FP7	Seventh Framework Programme
H2020	Horizon 2020
H4C	Hubs for circularity
HE	Higher Education
IS	Industrial Symbiosis
IVET	Initial Vocational Education and Training
KR	Knowledge Representatiosn
L&D	Learning & Development
LMS	Learning Management System
MOOCs	Massive open online course

SPIRE-SAIS: Training Framework (Deliverable 5.1)

pre-VET	pre Vocational Education and Training
RFCS	Research Fund for Coal and Steel
SPIRE-SAIS	Skills Alliance for Industrial Symbiosis – A Cross-sectoral Blueprint for a Sustainable Process Industry
U-IS	Urban-industrial symbiosis
VET	Vocational Education and Training
WP	Work package

C. Database of good cases illustrating provision for IS and EE skills across the EU

Status: December 2021

Title	Country	Area(s)	Case type	Short description of the case
GENERALITIES OF LIFE CYCLE ANALYSIS OF CERAMIC PRODUCTS	SPAIN	GREEN SKILLS	Company level	This is a course requested to ITC by a VET center. The aim was to receive training in the Life Cycle Analysis methodology to be applied to the ceramic tiles it manufactures and, subsequently, to be able to prepare its own Environmental Product Declaration under the labelling programme it considers most appropriate, as well as to have the necessary information and criteria to be able to evaluate environmental improvement measures. Duration: 15 hours
ENERGY EFFICIENCY IN THE CERAMIC INDUSTRY	Spain	EE	Company Level / VET Level / Regional Policy Level	Knowing the main energy consumption that occurs in large industries ceramics, as well as being able to identify and implement the necessary measures to reduce this consumption avoiding any cross media effect (decrease of product quality). Specific objectives: identify the points of greatest potential for savings in industrial plants, as well as the key factors that determine their analysis. Knowing energy conservation techniques and the best available technologies that support them to achieve optimum performance and reduce the consumption of industrial facilities. Addressing real cases: diagnostics energy in industrial plants. Technical-economic analysis of solutions. Duration: 20 hours
Course on LIFE CYCLE ANALYSIS CERAMIC AND RELATED MATERIALS	Spain	EE & IS	Company level	OBJECTIVE: This course achieves several objectives and allow companies to assess the circular benefits gained due to energy efficiency measures adopted and/or industrial symbiosis practices applied in their processes: - To study and apply in a theoretical and practical way the fundamental concepts and methodology of Life Cycle Analysis tool in accordance with the ISO 14040 series of standards. - To define the main applications of Life Cycle Analysis. - Describe the economic and environmental benefits that the application of Life Cycle Analysis can mean for business activities Duration: 6 hours

SPIRE-SAIS: Training Framework (Deliverable 5.1)

Courses Femxa, online training supported by The Spanish Ministry of Work and Social Economy.	Spain	EE	Company level	Femxa offers online training in energy efficiency, both for active workers, and for unemployed people. References: https://www.cursosfemxa.es/
Educaweb, online platform to guide users in finding trainings	Spain	EE	Company level	It is an online platform created to guide students and professionals to find training in the selected area of expertise, including energy efficiency. References: https://www.educaweb.com/nf/cursos-de/eficiencia-energetica/
SEAS Center, platform for online training of San Valero Foundation.	Spain	EE	VET level	SEAS center offers training related with renewable energies, sustainable mobility, and energy efficiency in buildings, at different levels, from technical courses, and professional trainings to master's degree. References: https://www.seas.es/areas/energias-renovables#edificacion-sostenible
Spanish National Energy Efficiency Plan 2017-2020	Spain	EE	Policy level	It is the National Plan designed and developed by the Spanish government to fulfil the requirements derived from the European Energy Efficiency Directive. References: https://ec.europa.eu/energy/sites/ener/files/documents/es_neeap_2017_en.pdf
CREARA, private energy efficiency con-	Spain	EE	Company level	This private consultancy is very active organising webinars related with energy efficiency issues, such as new policies, new technologies or European projects. It also has a newsletter to widespread their activities. References: https://www.creara.es/

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sultancy				
Spanish Technological Platform on Energy Efficiency (PTE-EE)	Spain	EE	Policy and company level	<p>The PTE-EE is an organisation composed by official entities from the Ministry of Science, Innovation and Universities, private companies from the energy sector and research institutions, whose main objectives are to promote energy efficiency and plan the future strategies in this sector. The platform does not organise formal trainings, but they promote the dissemination of knowledge related with energy efficiency among the entities and sectors involved. Its secretary is managed by A3e.</p> <p>References: https://www.ptee-ee.org/</p>
Spanish National association of Energy Services providers (ANESE)	Spain	EE	Company level	<p>ANESE is an association focused on identify energy efficiency projects and help the companies to start them by providing financing. It is organised in working groups, and although training is not a specific objective of the entity, they have published several guides related with energy efficiency.</p> <p>References: https://www.anese.es/</p>
Training programmes of Association of energy efficiency companies (A3e)	Spain	EE	Company level	<p>A3e is a private association of companies, with more than 100 associates. It provides trainings related to energy efficiency focused on industrial technologies, and a specific training to get the Certificate of Energy Auditor for buildings and industry. The Certificate is granted by the Spanish Quality association (AEC), an entity recognised by CERPER.</p> <p>A3e provides also a job bank for professionals seeking for a new job.</p> <p>References: https://www.asociacion3e.org/ ; https://www.aec.es/certificacion/ ; https://www.certificacion-dpd.es/</p>
Multiannual Programmes of the Federal Institute for Vocational Education and Training	Germany	IS, EE, Green skills	National/regional policy level	<p>These programmes could be described as the key drivers of sustainability learning in Germany's policy in this field under the centralised control of the BiBB. First and foremost, the programmes focus on developing curriculum on environmental awareness, green skills, sustainability and circular economy for German professional education institutions (see e.g. results of the latest pilot programme in 2). Moreover, they publish books and academic articles on these topics, didactic materials as well as sustainability assessment tools targeting various industries and sub-industries (including those from the EIs). For example, under these pilot programmes, the BiBB has released handbooks with practical guidelines on developing green skills for companies and organisations 'which systematically and continuously strive to integrate VET into their sustainability concepts' (e.g. of such a handbook for the</p>

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				<p><u>companies working in the Chemical industry)</u></p> <p>References: <u>2015-2019 Multiannual Programme Results; 2020-2022 Multiannual Programme Outline</u></p>
<p>Implementation of the UN 'Education for Sustainable Development' programme at the national level by the German UNESCO Commission (Sections for VET)</p>	Germany	EE, Green skills	National/ regional policy level	<p>The German national action plan on the implementation of the UN 'Education for Sustainable Development' programme encompasses various areas of education, not only VET. Its VET section attempts to foster integration of the key sustainability principles, circular economy concepts and green skills into the national curriculum.</p> <p>To achieve that, the programme supports and/or funds activities at regional level (in the Bundesländer) and communal level[1]. The implementation programme has been actively contributing to the development of the Germany National Education Sustainability Action Plan; publishing informational, educational and didactic materials for artisans and tradespersons in cooperation with the Ministry for Education and Research and the Federal Institute for Vocational Education and Training. Moreover, it has created a special forum for the exchange of best practices on integrating the sustainability concepts in VET curricula.</p> <p>References: <u>VET Sections of the Implementation Strategy</u></p>
<p>Educational Projects of the German Federal Environmental Foundation</p>	Germany	EE, Green skills	National/ regional policy level	<p>The foundation supports awareness-raising and educational projects on the topics of sustainability and environmentalism by providing financial and administrative assistance. The foundation also helps chambers of skilled crafts maintain 10 environmental centres throughout Germany (eight of them have been established with financial aid from the foundation). Besides being engaged in CVET activities, the foundation is also engaged in environmental consulting and research and in development and transfer of projects (Cedefop, 2018, p. 19).</p> <p>References: <u>Project databank; Foundation's website</u></p>
<p>'Environment Creates Perspectives' of the Federal Ministry of environment</p>	Germany	EE, Green skills	National/ regional policy level	<p>In 2006, the Federal Ministry of Environment started an educational initiative entitled "environment creates perspectives" in association with firms from environmental technologies/renewable energy sectors. As a result, 6 000 additional apprenticeships have been created by 2009. The initiative aims to identify the apprenticeship trades, skills and competences required by the environmental sector.</p> <p>References: <u>Symbi: Good practice guide and benchmarking guidelines on ecosystems of by product and energy exchanges</u>, p. 62</p>

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'Education for resource conservation and resource efficiency' programme	Germany	EE, Green skills	VET level	<p>The BilRes (<i>Bildung für Ressourcenschonung und Ressourceneffizienz</i> or <i>Education for resource conservation and resource efficiency programme</i>) and its network are specifically focused on resource management issues. The programme has been funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) as a contribution to the German National Resource Efficiency Programme (ProRes). BilRes covers all educational contexts and does not specifically focus on EILs (see 2, p. 16). The project's website is still available as well as its wiki-databank on resource efficiency. Its organisers regularly conduct conferences and webinars on relevant topics.</p> <p>References: Official website, Cedefop: Germany Green Jobs Report, p. 16</p>
Regional guidelines for developing qualifications and green skills in VET relevant for green jobs in the metal industry	Germany (the Federal Land of Brandenburg)	Green skills	VET level	<p>These guidelines that target companies working in the metal industry explain the relevance of green skills for the metal industry, provide basic guidelines for developing the necessary training curriculum, as well as qualification matrixes for process efficiency, resource efficiency, energy efficiency, and material efficiency (see pp. 25-28). The guidelines have been developed by the ITU Institut at the order of the Federal Land of Brandenburg's Ministry of Social Affairs, Health, Integration and Consumer Protection from European social funds.</p> <p>References: Guidelines</p>
'Junior Sustainability Experts' programme	Germany	Green skills	VET level	<p>The German Federal Institute for Vocational Education and Training - BiBB has been actively promoting the concept of training Junior Sustainability Experts in 2016-2019. The concept was developed in the framework of the ANLIN project (<i>Ausbildung fördert nachhaltige Lernorte in der Industrie</i> – Education promotes sustainable learning environment in the industry). The newly trained Junior Sustainability experts were educated from public funds on such topics as circular economy, sustainability in economy and businesses, etc. Then they were tasked with transforming the working environment in their respective companies to ensure sustainable production processes. The project largely targeted chemical and metalworking industries.</p> <p>References: Official Webpage; Programme description and curriculum</p>
NaBiKa – Sustainable Educational	Germany	EE, Green Skills	VET level	<p>Under this project the Rhein Erft Academy initiated an 'Around the Clock – 24-Hours Real Time' activity which helped fifty trainees from different vocational fields work on interdisciplinary projects. Chemical technician trainees and industrial mechanics, for example, were first trained on the topic of sus-</p>

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Careers in the Chemical Industry				<p>tainability and engaged in team work. This mainly involved organizing their work across their individual trades and interacting and communicating with each other, training them to exercise collective responsibility. The training was conducted using a standard sustainability protocol. Learning through different tasks strengthened team communication and coordination. The trained technicians have been certified as experts on sustainability and later returned to their companies with the aim of stimulating sustainability in the workplace.</p> <p>References: UNESCO Report on Greening TVET, p.61</p>
Green training of the private University of Applied Sciences BiTS (Business and Information Technology School) in Iserlohn	Germany (the Federal Land of North-Rhein Westphalia)	Green skills	VET level	<p>Training regulations for chemical technicians and four other trades in the chemical industry were revised in 2002, as the concept of responsible care was introduced. This means that apprentices continuously receive training in work safety, health and environmental protection over the whole training period to increase their awareness of these subjects. Integrating this concept into dual apprenticeship training in this sector guarantees its implementation and its internalisation at all stages of work.</p> <p>References: Symbi: Good practice guide and benchmarking guidelines on ecosystems of byproduct and energy exchanges, pp. 57-62</p>
Industrial Symbiosis Facilitator: Key study based on current knowledge, skills and qualifications regarding IS	Germany (the Federal Land of Baden-Württemberg)	IS	VET/Public education level	<p>This programme creates an opportunity to learn about industrial symbiosis skills. Besides master level courses, studying IS can be done online, e.g. with the massive open online course created in Freiburg (the Federal Land of Baden-Württemberg). The mentioned course is a collection of web content on industrial ecology background, methods, and applications.</p> <p>References: Industrial Symbiosis Facilitator Report</p>
Eco-Industrial	Germany	IS, EE	Company	<p>In Germany, (eco-)industrial areas and parks are a common instrument for economic development that helps to achieve environmental goals as well (NB: The term EIP is practically used as a substitute</p>

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Parks (EIP)			level	<p>for IS in the German academic/grey literature). There are two types of such areas in Germany: municipal industrial areas and industrial parks. For municipal industrial areas, the municipality provides the required infrastructure and utilities to attract the investment of individual companies (GIZ, 2015, p. 18). In combination with the German apprenticeship-based VET system, these parks provide an excellent opportunity to gain industry-specific green skills. The development of EIPs in Germany, however, is not guided by a specific government strategy, but rather by the industry itself (GIZ, 2015, p. 19).</p> <p>References: Report on German Experiences develop EIPs, Analysis on Resource Efficiency Potential in Industrial Areas</p>
Chemie3 Initiative Sustainability Webinars	Germany	Green skills, EE, IS	Company level	<p>The initiative Chemie3 Initiative was launched by a group of major German chemical industry associations – including the Union of the Chemical Industry; the Trade Union of Miners, Chemists, and Energy Workers; as well as the Federal Association of Chemistry Workers. The initiative aims to make sustainability concepts (and sustainable development as such) part of the industrial process in the chemical industry. The initiative conducts a number of projects, of which the project on Sustainability Webinars for the industry workers and members of the association is of particular interest.</p> <p>References: Official Website</p>
The Federal Workers' Association of Education on Nature and Environment databanks	Germany	Green skills, EE, IS	Company level	<p>The Federal Workers' Association of Education on Nature and Environment offers open-access databanks of environmental education centres and qualification programmes. The Association represents ca. 1300 institutions, initiatives, and individuals that offer non-school continued environmental education. The data banks that the Association offers for free have comprehensive lists of institutions, trainers, and further qualification programmes. This can help businesses to quickly navigate through the environmental education topics they find particularly important.</p> <p>References: Databank of environmental centres; Expert databank</p>
BASF – IS project	Germany	IS	Company level	<p>This IS project initiated by German company BASF is an example of a successful industrial ecosystem developed around one company's functions. BASF is the world's leading chemical company with sites in more than 80 countries, operating in five segments: Chemicals, Performance Products, Functional Materials & Solutions, Agricultural Solutions and Oil & Gas.</p> <p>The project was launched after BASF developed the idea of Verbund and established it as one of its strengths. The Verbund idea is based on interlinking production facilities, know-how & energy flows, customers and infrastructure in a smart way, to improve resource efficiency and reduce the production costs for all corporate participants. One of its focus areas is: "Integrating employees of participants in</p>

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				<p>one company in order to share experience and knowledge and achieve good and effective networking, with the aim to have easy access to the necessary information at any time using special tablets and QR codes (digital transformation under the banner of BASF 4.0)”</p> <p>References: <u>Symbi: Good practice guide and benchmarking guidelines on ecosystems of by product and energy exchanges</u>, pp. 42-46.</p>
Training Academy and Analytical Services of the Chemical industrial Park Knap-sack	Germany	IS	Company level	<p>The services offered by the chemical park and the operator include: logistics, power and media supply, energy management, waste disposal, planning permission, information technology, personnel management, health, safety and environmental management, infrastructure services, a training academy and analytical services in the laboratory.</p> <p>Its IDCON's Public Training Seminars are designed for various industries and organisations. They help to gain knowledge and practical tactics to improve a plant's performance in work management and equipment reliability.</p> <p>References: <u>Symbi: Good practice guide and benchmarking guidelines on ecosystems of byproduct and energy exchanges</u>, pp. 104-108.; <u>Example of Reliability and Maintenance Training Schedule</u></p>
Polish Circular Economy Strategy: Education and Promotion	Poland	EE, IS, Green Skills	National/regional policy level	<p>The Polish Government adopted a circular economy strategy that has a special section on education and awareness raising. This promotional campaign largely targets the younger generation of Poles, businesses and public institutions. The educational activities are set to be implemented from 2019 to 2021.</p> <p>References: <u>Digital version of the Strategy</u></p>
SUPREME Project: Twinning for a Sustainable, Proactive Research partnership in distributed Energy systems plan-	Poland	EE	National/regional policy level / VET	<p>To help Poland convert to renewables, this EU initiative (SUPREME) connected a renowned Polish energy research centre (Instytut Maszyn Przepływowych Im Roberta Szwalskiego Polskiej Akademii Nauk, The Szwalski INSTITUTE OF FLUID-FLOW MACHINERY of the Polish Academy of Sciences) with prominent European energy institutions. The project, apart from its main focus on infrastructural changes, has also produced a number of training manuals/materials for specialists as well as curricula related to the topics of energy efficiency and micro-scale energy systems analyses.</p> <p>References: <u>SUPREME's Webpage in CORDIS</u></p>

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ning, Model- ling and managE- ment				
BFKK Train- ing for Trainers in Vocational Education Project of the Bialystok Foundation of Profes- sional Train- ing	Poland	EE	VET level	<p>The project targeted SMEs as well as training professionals, conducting seminars on such topics as energy efficiency, methods of energy saving, and use of waste for energy purposes. The project consisted of three parts - theoretical, practical, and pedagogical. The theoretical part dealt with conceptual explanations, the practical focused on case studies and experiments, and the pedagogical one - on presenting the methods of knowledge transfer.</p> <p>References: Training for Trainer Presentation</p>
Multi-Round National Training Courses of the ENSPOL by KAPE	Poland	EE	VET level	<p>The Polish National Energy Conservation Agency (KAPE) operates since 1994, continually broadening its services in the field of energy efficiency and renewable energy sources (RES). In the framework of the ENSPOL project (Energy Saving Policies and Energy Efficiency), it has targeted stakeholders in the metal, construction, and energy industries with two rounds of face-to-face trainings. The ENSPOL project ran from 2014 to 2016 with the support of European funds.</p> <p>References: KAPE Official Website; ENSPOL Project Website</p>
Urban Baltic Industrial Symbiosis through the University of Gdansk	Poland	IS	VET level	<p>The project allowed for the exchange of good practice between companies and organisations from participating Member States (Lithuania, Poland, Denmark, Sweden). Publications of the projects and its educational initiatives (according to the UBIS website) have contributed to strengthening the existing IS sites in Northern Poland (i.e. in and around the city of Gdansk). The project has also produced the so-called Decision Tool for Industrial Symbiosis, which is supposed to help companies embrace the IS concept on a step-by-step basis.</p> <p>References: Official Website</p>
The Knowledge	Poland	EE	Company level	<p>The Polish Foundation for Energy Efficiency FEWE is an independent non-governmental organisation founded in 1990. Its mission is to promote sustainable development of Poland's economy and to sup-</p>

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databases of the Polish Foundation for Energy Efficiency				<p>port protection of the environment through raising awareness on the issues related to energy efficiency. The FEWE website has a special section (available in Polish only) with experts, training websites, conference lists and other educational events related to EE.</p> <p>References: Official Website</p>
Circular economy webinars of the Polish Cleaner Production Movement Society	Poland	EE, Green skills	Company level	<p>The Polish Cleaner Production Movement Society is a non-governmental organisation (association), co-ordinating the Polish Cleaner Production Programme, which has been started in 1989 within CP World Programme of UNEP-Industry and Environment Division. It provides training and consultancy services related to the improvement of production processes in terms of sustainability and environmental friendliness.</p> <p>References: Official Webpage with information on webinars</p>
Arcelor Mittal Poland's Annual Training Plan for Green Skills Development	Poland	Green skills	Company level	<p>The Company does not have a formal training program only in environmental protection. Environmental aspects are discussed both in health and safety training and training management systems and training by their direct superior. Examples of training packages include: Health and safety periodically for persons employed as bluecollar workers, environmental protection, waste management, industrial serious breakdowns.</p> <p>Training take place officially, usually during working hours and are funded by employer. Obligatory training is conducted in health and safety but there are also formal and informal training for people whose responsibility is related to EU directives and regulations (e.g. in the field of integrated permits IPPC, Emissions Trading Scheme ETS, REACH) / National legislation / regulations at Company level. Each employee has access to the intranet, where the training takes place.</p> <p>References: VET European Framework Module: Green Skills for Mechanical/Industrial and Electrical Technicians – Training Handbook, pp. 26-30.</p>
MB Recycling's Educational Programmes on IS and Re-	Poland	IS	Company level	<p>This company has been described by the Centrum Kooperacji Recyklingu (Centre of Cooperation on Recycling), a renowned Polish environmental NPO, as one of the best examples of Industrial Symbiosis in Poland. As of 2019, its IS scheme included cooperation with six companies. MB Recycling also conducts educational and training programmes on the topics of recycling and IS in cooperation with 'Recover the Environment - ODZYSKAJ ŚRODOWISKO' Foundation.</p> <p>References: Information on the training opportunities; CKR's Presentation with References to the</p>

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cycling				<u>Project</u>
Fundacja Odzyskaj Środowisko's Educational Services on Green Skills and Recycling	Poland	Green skills	Company level	<p>The 'Recover the Environment - ODZYSKAJ ŚRODOWISKO' Foundation offers educational services on training companies and organisations about green skills and recycling. Apart from that, the foundation cooperates with cities and municipalities by helping to ensure an integrated approach to their promotion campaigns on sustainability and recycling activities.</p> <p>References: Official Website</p>
Spanish Circular Economy Plan	Spain	EE, IS	Policy level	<p>The strategic plan of Circular Spain 2030 seeks to establish the legal framework to promote the alignment of industries with the concept of Circular Economy promoted some years ago, and formally since 2015 by the European Union. The emerging action of this plan contributes to promoting the achievement of the Sustainable Development Objectives established in the Sustainable Development Agenda, adopted by the United Nations in 2015</p> <p>References: Insight Report, p. 60</p>
Emplea Verde	Spain	Green skills	Policy level	<p>The Emplea Verde Programme aims to promote employment and competitiveness of the private sector through environmental transformation and greening. For this purpose, one of its targets is to improve workers' skills. Since 2007, 1 900 courses in green skills have been provided, including diverse environmental skills, sustainability culture, new demands from the labour market and promotion of SME internationalisation</p> <p>References: Official Website of the Programme; Cedefop Report on Green Jobs in Spain</p>
Emprende Verde's Training Catalogue	Spain	Green skills	Policy level	<p>As a follow-up to the previous project, the Spanish government also developed a special network for entrepreneurs that focused on 'green' mentoring and green networking for environmentally friendly businesses (Emprende Verde). Emplea Verde is included within ESF funding for the 2017-23 period. In this period, the budget will be EUR 67 million and aims to support 50 000 persons and 3 000 companies (Ibid). The network offers a wide variety of courses on the topics of sustainability and green skills.</p> <p>References: Official Website; Cedefop Report on Green Jobs in Spain</p>

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Estrategia de Cambio Climático, Calidad del Aire y Salud de Zaragoza (Strategy of Climate Change, Air Quality and Health of Zaragoza)	Spain	Green skills	Policy level	<p>This strategy is a tool of the Zaragoza city in order to confront the climate change, the improvement of the air quality and the protection and promotion of the health. It is considered "the minimization of the waste" in order to transform them into resources. Inside this challenge, it is highlighted the potential of the industrial symbiosis and is promoted the possibility to publish the waste of each industry in order to try to find win-win strategies with other companies.</p> <p>Reference: Website of the local administration of Zaragoza; Document of the Strategy.</p>
Training Programmes of the IDAE on Energy Efficiency; Project's Knowledge Database	Spain	EE	VET level	<p>The E.P.E. Institute for the Diversification and Saving of Energy (IDAE), M.P., is a body assigned to the Ministry for the Ecological Transition. Apart from development of specific programmes and financing of technical projects which are innovative and replicable, the IDAE carries out promotional and training activities and technical consulting. For example, it runs the so-called 'Digital Classroom' project, where people can take a multitude of courses for free: e.g. an introductory course on energy efficiency, courses on energy efficiency at work, efficient driving, etc. Moreover, the IDAE regularly publishes manuals and handbooks on energy-efficiency related topics in Spanish. It's webpage contains a database of ESCOs (Energy Services Companies) and providers of Renewable Energy technologies.</p> <p>References: Official Webpage; Course List; Publications</p>
Symbiosy's Readiness Assessment Tool	Spain (Catalonia)	Green skills	Company level	<p>The tool developed by Simbiosy.Com helps to identify the level of preparation, predisposition and knowledge that developers need to successfully develop circular economy initiatives. It can be used for educational purposes when designing a circular economy project.</p> <p>References: Link to the Tool</p>
Training actions performed by SÍMBIOSY	Spain	IS	Company level	<p>In addition to the readiness assessment tool, SÍMBIOSY has provided courses about Circular economy and Industrial symbiosis for economic-promotion technicians. Furthermore, they have also provided training capsules about industrial symbiosis in the context of university studies: Postgraduate in Green Economy (University of Vic); Degree in Industrial engineering and Master Degree in Natural Resources Engineering (UPC); and Postgraduate in Industrial and Technical Management in Sarrià</p>

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				<p>Chemical Institute.</p> <p>Reference: Link to the course; Link to training capsules</p>
Practical workshop about industrial symbiosis - Viability tool	Spain	IS	Company level	<p>This workshop is a training about the use of the viability tool of industrial symbiosis projects developed by FEMPA inside the programme Dinamiza. This workshop explained (30th January 2020) the use of the viability tool to the companies. General explanation about industrial symbiosis was also performed. FEMPA is the Federation of Metal sector's Employers from the Province of Alicante.</p> <p>Reference: Website of the workshop.</p>
Training programmes of AENOR about Circular Economy.	Spain	Circular Economy	VET level	<p>AENOR is the Spanish Association for Standardization and Certification, and is an organisation focused on the standardization and certification tasks. They count with a complete list of different industrial and environmental training. Among them, we could highlight those centered in Circular economy, where we could find courses about waste management and application of circular economy.</p> <p>Reference: AENOR website</p>
Programa Ecogestión Inter-pymes of the Chamber of commerce from Cantabria region	Spain	IS; waste	Company level	<p>This project looked for (2014) increasing and promoting the incorporation of environmental good cases in the industrial waste management inside the Cantabrian industrial sector. Two workshops were performed: (1) Strategies of Industrial Symbiosis for the efficiency and the innovative management of resources; and (2) Fostering the efficiency in the management of industrial waste.</p> <p>Reference: Website.</p>
II Ciclo de Economía Circular (II Cycle of Circular Economy); organized by Chamber of Com-	Spain	Circular Economy, IS	Company level	<p>This cycle analyzed the different strategies that can be used for take advantage of the resources for a circular production model. It consisted of two session (18th and 25th May 2020). It was addressed the industrial symbiosis as a model of circular production.</p> <p>Reference: Link to the cycle.</p>

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merce of Aragón and the Coalition of Companies for the Planet (COE-PLAN).				
National Research Council's R&D Programmes (environment-focused)	Italy	Green skills, EE	National/regional policy level	<p>The National Research Council develops new aggregations of institutes for "sustainable energy and mobility", "bioeconomy", "climate change and polar science", trying to connect multidisciplinary research and technology.</p> <p>Reference: Official Website; Insight Report</p>
Industrial Symbiosis for the Sustainable Management of Raw Materials (STORM)	Italy (also partners from Poland, Hungary, Germany, Spain, Sweden, and Slovenia)	IS	VET Level	<p>This project is led by the Italian National agency for new technologies, energy and sustainable economic development (INEA).</p> <p>Within the frame of the European Initiative on Raw Materials, the Project objective is to implement a long-term self-sustainable excellence network dedicated to provide services to external customers for the implementation of innovative, sustainable business and cooperation model solutions for the all-around recycling and/or exploitation of raw materials from end of life complex products with more attention for secondary products. The STORM Network provides an opportunity for trainees and SMEs to access a coordinated group of expertise in the eco-innovation field. Moreover, the purpose of the network is to support innovative companies and to facilitate the exploitation of European secondary resources via new forms of collaboration (STORM, 2020).</p> <p>References: Project's Webpage</p>
FISSAC Italian Living Labs	Italy	IS	VET Level	<p>The FISSAC (Fostering Industrial Symbiosis for a Sustainable Resource Intensive Industry across the extended Construction Value Chain) living labs represent a debate platform that involves different stakeholders working in the Circular Economy and Industrial Symbiosis spheres. Each living lab focuses on a narrowly defined, specific discussion topic related to the aforementioned spheres. Living</p>

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				<p>Labs, thus, allow for interactive learning and networking. The main objective of the last (third) Living Lab was to evaluate the replicability potential of circular economy models and platforms in the Italian scenario.</p> <p>References: Information on the Living Labs on FISSAC's Page</p>
The Italian Sustainable Development Foundation course databank	Italy	Green skills	VET level	<p>The Sustainable Development Foundation of Italy offers general VET on a wide variety of topics related to sustainable development and circular economy (e.g. Integrated Environmental Authorization, eco-driving, etc). Most of their courses were conducted offline.</p> <p>References: Official Website</p>
ENEA Courses and Distance Education on Energy Efficiency, Environmental Issues, and Sustainability	Italy	Green skills, EE	VET Level	<p>The courses offered by the Italian National Agency for New Technologies, Energy and Sustainable Economic Development target the energy industry representatives as well as the general public. Its e-courses are available on a great variety of topics, ranging from general efficient energy management to the implementation of Agenda 21 and sustainable farming. The courses are not provided for free – the set price is €30.</p> <p>References: Official Website</p>
Pentapolis Onlus' Awareness Raising Programme	Italy	Green skills, EE	Company level	<p>Pentapolis Onlus is an association of communicators and journalists, which promotes the concepts of environmental and social responsibility as well as sustainable development; with the aim of launching an "eco-Renaissance of urban communities" on a global level. It focuses on awareness raising aimed at both citizens and the business community, with the aim of creating a new culture capable of combining ethics and profit, connecting companies, institutions and civil society in synergistic action. Its initiatives between 2012 and 2018 helped to attract the attention of the general populace and businesses to the topics of sustainability and circular economy. Its activity formats mainly included conferences, networking events and events of public interest (e.g. concerts).</p> <p>References: Official Website</p>
Patto per il	Italy – Emilia-	IS, EE,	Regional	Emilia-Romagna Regional Government is currently working on a participated process to define the

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Lavoro e il Clima	Romagna Region	Green skills	policy level	<p>Regional Policy Strategy denominated “Emilia Romagna Pact for Employment and Climate”</p> <p>The participated process will be closed in October 2020 with the signing of an action plan shared with all economic and social actors, business associations, local authorities, trade union and trade organisations.</p> <p>The Pact will contain wide-ranging objectives that will touch on issues such as the circular economy, green jobs, the relationship between fleet technological innovation and climate change.</p> <p>References: <u>Official website - news</u></p>
Smart Specialization Strategy 2014-2020	Italy – Emilia-Romagna Region	IS, EE	Regional policy level	<p>Smart Specialisation Strategy is a strategic policy document required by the European Commission for the 2014-2020 planning period of Structural Funds. It represents a basic document to finalize policies towards clear strategic innovation and competitiveness objectives.</p> <p>The Emilia-Romagna strategy identifies 5 major production areas for regional innovation policies to focus on. Among them the topic of “Sustainable development” is identified as one of the main drivers of change to orienting innovation processes of the Region.</p> <p>Currently the Region is working on the new version of Smart Specialization Strategy and the domain of green economy will be maintain and reinforce.</p> <p>References: <u>Official Emilia-Romagna website</u></p>
Le traiettorie evolutive delle competenze in Emilia-Romagna	Italy – Emilia-Romagna Region	IS, EE	Regional level (not a policy strategy)	<p>This document represents the final output of a working group promoted by Emilia-Romagna Regional Government, coordinated by ART-ER, involving the 7 Clust-ERs Association of Emilia-Romagna. The aim of the working group was to identify the key competence in the priority sectors of Emilia-Romagna Region, as included in the regional Smart Specialization Strategy (S3). Among them also Energy and Sustainable Development Sector.</p> <p>The document aims to be a useful tool in the processes of updating existing training courses and designing innovative courses, in order to increase the quality of human capital. Green skills are considered as sector specific as well as transversal to different sectors such as mechanics, life science, etc.</p> <p>References: <u>Final Report</u></p>
Junior Expert in Circular Economy	Italy – Emilia-Romagna Region	IS, EE	VET level	<p>The Junior Expert in Circular Economy is a IV EQF level VET course developed within the European Project IFTS Circular Society, coordinated by ART-ER, supported by EIT Raw Materials Academy.</p> <p>The course, which will start in January 2021, is a pilot project to transfer the Italian IV° EQF level VET</p>

SPIRE-SAIS: Training Framework (Deliverable 5.1)

omy				<p>course: IFTS (see https://www.cedefop.europa.eu/en/news-and-press/news/italy-training-and-occupational-outcomes-higher-technical-education-and-training) in a wider and international context. In fact it will train 25 European young people who are qualified with a school diploma, provide them with the necessary tools and skills needed for sustainable development and circular transition in economy and society.</p> <p>The course is taught in English and it is authorized by Emilia-Romagna Region with DD 12537-2020.</p> <p>References: <u>Official course website</u></p>
ITS TEC Foundation	Italy – Emilia-Romagna Region	EE, Green Skills	VET level	<p>ITS VET courses represent a national not academic tertiary segment (V EQF level), aiming at offering to participants the possibility to achieve specialized training, according to the needs of the enterprises and the labour market. Thanks to ITS educational paths, all students have the opportunity to reinforce their competences profile, acquiring key knowledge and capabilities for improving innovation processes and in order to manage both organisational and productive processes.</p> <p>In Emilia Romagna Region there are 7 ITS Foundations, among them The ITS TEC Foundation, specialized on green and energy efficiency skills which offers educational paths, with 2 different specialized curricula:</p> <p>HIGHER TECHNICIAN FOR SUSTAINABILITY AND ENERGY EFFICIENCY OF THE BUILDING-TERRITORY SYSTEM</p> <p>HIGHER TECHNICIAN FOR MANAGEMENT AND MONITORING OF ENERGY PLANTS 4.0</p> <p>References: <u>Official ITS TEC website</u></p>
Regional Call for Local Labs for innovation and sustainability of enterprises	Italy – Emilia-Romagna Region	EE, IS	Regional policy level	<p>The Emilia-Romagna Region intends to consolidate the network of local laboratories for the sustainability of businesses, as an integral part of its strategy for implementing the 2030 Agenda. To this end, it promotes business innovation, with the involvement of local authorities and of stakeholders, stimulating co-planning and collaboration with all the subjects that at the local level contribute to the realization of the regional strategy.</p> <p>The regional call for proposals includes support to activities aimed at integrating sustainability as a structured and integrated process into the business and facilitate the co-planning of local interventions aimed at produce widespread and consistent positive impacts with the following thematic areas:</p> <p>- CIRCULAR ECONOMY AND SUSTAINABLE MANAGEMENT OF RESOURCES</p>

SPIRE-SAIS: Training Framework (Deliverable 5.1)

				<p>- GROWTH, SKILLS AND GOVERNANCE FOR SUSTAINABLE DEVELOPMENT</p> <p>- SOCIAL INNOVATION, INCLUSIVE, RESILIENT AND SUSTAINABLE CITIES</p> <p>References: <u>Regional call website</u></p> <p><i>One example of project financed regarding Industrial Symbiosis in the local territory of Modena:</i></p> <p><u>https://imprese.regione.emilia-romagna.it/rsi/doc/schede/scheda-cciaa-modena-v01.pdf</u></p>
Waste management and circular economy training webinars	Italy – Emilia-Romagna Region	Green skills	Company level	<p>Unioncamere and the Chambers of Commerce of Emilia Romagna, in collaboration with Ecocerved, organizes a cycle of training webinars on the topic of sustainability, waste management and circular economy, as part of the action promoted by Unioncamere at a national level, through the Equalization Fund of the Italian Chambers of Commerce on circular economy issues. Training is dedicated to small and medium-sized enterprises.</p> <p>References: <u>Official website</u></p>
Industrial Symbiosis: Guide for data collection	Africa: Burkina Faso, Ghana, Kenya, Mauritius, South Africa, Uganda	Industrial symbiosis	Company level	<p>Preparing for readiness of industrial symbiosis. Worked on a three phase principle - Map processes; quantify resources; prioritise opportunities (more to come)</p>
Waste Smart	England, Northern Ireland	Waste management	VET level	<p>Waste management processes (more to come)</p>
Portuguese National Qualification Framework	Portugal	EE, IS	National policy level	<p>The national qualifications framework (NQF), is the framework for VET in Portugal; it is coordinated by ANQEP (the National Agency for Qualifications) and comprises the main VET stakeholders. NQF has reorganised VET into a single system, it is based on a balanced relationship between VET within the educational system and VET in the labour market.</p> <p>Under the NQF, successful completion of VET programmes (qualifications) grants a dual certification. All the trainees that apply for a dual certification program in the curricula will deal with topics like Energy consumption and efficiency, Residues and recycling, Natural resources under a Competence</p>

SPIRE-SAIS: Training Framework (Deliverable 5.1)

				<p>Unit of Environment and sustainability.</p> <p>In National Qualifications Catalogue: a strategic tool to manage and regulate non-higher VET we can find qualifications as:</p> <p>Solids Waste Management Systems Operator Environmental Management Technician Specialised Technician on Energy Management and Control Technician Installer of Thermic Systems for Renewable Energies Supervisor Technician of Networks and Gas Appliances</p> <p>http://www.catalogo.anqep.gov.pt/ https://www.anqep.gov.pt/np4/home.html</p>
Portuguese National Energy Efficiency Plan 2017-2020 (PNAEE)	Portugal	EE	National policy level	<p>PNAEE is the National Plan designed and developed by the Portuguese government to fulfil the requirements derived from the European Energy Efficiency Directive.</p> <p>https://www.pnaee.pt/</p>
Training programmes of Portuguese Agency for Energy (ADENE)	Portugal	EE	VET level	<p>ADENE - Agência para Energia is the national energy agency, a private law association, non-profit and public utility, whose mission is to develop activities of public interest in the area of energy, efficient use of water and water efficiency mobility. This agency manages the ADENE Academy, which promotes specialized training in the energy certification of buildings and reinforces skills in the fields of energy efficiency, renewable energy, water efficiency and efficient mobility.</p> <p>Some trainings provided:</p> <p>Energy Efficiency in Industry Qualified Expert on Certification Building Energetics</p> <p>https://www.adene.pt/</p>
ISQ	Portugal	EE	Company level	<p>ISQ has a training, research and development laboratory - Ecotermolab - with an area of almost two thousand meters. It is certified according to the regulations for building energy certification and indoor air quality and equipped with innovative technology and solutions for air conditioning, renewable energy and energy efficiency. It is especially suited for training in the areas of thermal heating, photovol-</p>

SPIRE-SAIS: Training Framework (Deliverable 5.1)

				<p>taic, telecommunications installations in buildings (ITED) and air conditioning, heating and cooling (HVAC). ISQ ACADEMY certifies the human resources of Portuguese companies in the most diverse technological areas.</p> <p>In short, it offers tailored consulting solutions in human capital management, including 4.0 training, which allows greater efficiency in processes and product innovation, creation of added value in the value chain and support in digital technology and automation.</p> <p>https://academy.isq.pt/</p>
E-learning course on Construction and demolition waste: Prevention and valorisation	Portugal	IS	Company level	<p>The Smart Waste Portugal in partnership with Oporto University are promoting the e-learning course on Construction and demolition waste: Prevention and valorisation. This course aims to promote educational and awareness actions directed to several agents along the chain related with construction and demolition waste, for supporting their interaction in order to promote a more sustainable value chain organisation, in line with the principles of the circular economy.</p> <p>http://www.smartwasteportugal.com/pt/comunicacao/eventos/2-edicao-curso-e-learning/</p>
VET centre for the foundry industry	Portugal	EE, IS	VET level	<p>Portuguese Foundry Association - The APF is a technical and cultural association whose purpose is to foster the development of technology, to improve working conditions in foundries, to promote the improvement of manufacturing processes, from both economic and human perspectives, making companies more competitive. APF manages CINFU - Centre for Professional Training in the Foundry Industry – that is not only responsible for providing training in foundry technologies and cross-cutting areas, but also for providing assistance to companies upon request. This including local technical advice, laboratory support, environmental characterisations, prototype manufacturing, and other activities covered within the scope of the available human and material resources.</p> <p>APF is one of the major supporters of the Strategic Plan for the Portuguese Industry of Foundry, and claims that the Portuguese foundry industry is already quite eco-sufficient, given that the raw material used comes from other industrial processes and that all metal surpluses are used and recovered to reintegrate the production cycle, which avoids the waste of the natural heritage, which, as is known, is exhaustible.</p> <p>The challenge for the future is to go further and recycle not only metal, but also other materials used in the manufacture of castings, such as sand, for example, giving them the necessary properties so that they can be used by others activity sectors (ex .: ceramic sector, civil construction sector ...), in a</p>

SPIRE-SAIS: Training Framework (Deliverable 5.1)

				<p>logic of industrial symbiosis.</p> <p>https://apf.com.pt/</p> <p>https://www.cinfu.pt/pt</p>
Relvão Eco Industrial Park	Portugal	IS	Company level	<p>The Relvão Eco Industrial Park in Portugal is a project started in 2006 thanks to the jointed efforts of several different stakeholders, among which the Portuguese Government, the Chamusca Municipality Government, the Technical University of Lisbon, together with industrial companies and entrepreneurs. Current and planned development for the Industrial Park includes pulp and paper companies, agro industries, several chemical companies (mainly fertiliser producers), and waste treatment facilities.</p> <p>https://www.apambiente.pt/_zdata/Politiclas/EcoInovacao/Apresenta_WS_RES_set13/Eco%20Parque%20Relvo_Joo%20Rodrigues.pdf</p> <p>https://maestri-spire.eu/case-17-industrial-park-planned-national-level-portuguese-experience-relvao-eco-industrial-park/</p>
Specialized Technical course on Energy, Efficiency and Sustainability (EQF 5)	Portugal	EE	VET level	<p>The course in Energy, Efficiency and Sustainability of Instituto Politecnico do Porto aims to train professionals specialized in Electrical Energy Systems, paying special attention to the energy sector, the efficient use of energy and electrical machines and installations. It aims at training professionals to create, coordinate activities of operation, commercialization, use, analysis, specification and design of facilities, equipment, products and services.</p> <p>https://www.ipp.pt/ensino/cursos/CTeSP/isep/240</p>
Steelmaster	Italy	EE and IS	National/VET level/Company level	<p>The Steelmaster is an advanced Training Course for the Italian Steel Sector aimed at managers, technical staff, white collar workers, trade union officials, consultant and experts, connected with the steel industry. It has now reached its XXIII edition.</p> <p>The course is addressed to Steel sector but EE and IS are transversal to all the planned modules.</p> <p>Steelmaster is organized with the support of ESTEP, European Commission, Federacciai (the Italian Steel Producers Association)</p>
Eurosteel-master	Italy	EE and IS	European/VET	<p>The Eurosteelmaster is an advanced Training Course for the Worldwide Steel Sector addressed to managers, technical staff, white collar workers, trade union officials, consultant and ex-</p>

SPIRE-SAIS: Training Framework (Deliverable 5.1)

			level/Company level	<p>perts, connected with the steel industry. It has now reached its XI edition.</p> <p>As for the Steelmaster, the course is addressed to Steel sector, but EE and IS are transversal to all the planned modules.</p> <p>Eurosteelmaster is organized with the support of ESTEP, EUROFER, European Commission, Federacciai</p>
European Junior Water Programme	Europe		European/VET level/company level	<p>The EJWP is a training course for young professionals from the water sector which aims to develop skills and project management in the sector with a European dimension.</p> <p>https://juniorwaterprogramme.eu/</p>
Water Europe	Europe		European level	<p>Technology platform for the water sector which aims to enhance research and innovation, collaboration, exchange best practices in the European water sector.</p> <p>You can also find in its college B, several universities and RTOs providing several educations which provide skills and knowledges on industrial symbiosis in the water sector. (eg. University of Cranfield, CEW, Technical University of Dublin, KWR, University of Barcelona- UAB, Università Politecnica delle Marche, NTNU, LIST institute in Luxembourg...)</p> <p>https://watereurope.eu/</p>
Isle Utilities	Europe/Italy		Company level	<p>Consultancy providing training courses on water-related challenges including water reused and energy efficiency in the sector.</p> <p>https://www.isleutilities.com/</p>
KIWA	Worldwide		Company level	<p>KIWA offers trainings also about energy and water efficiency</p> <p>https://www.kiwa.com/en/services/training/what-can-kiwa-educate-me-in/</p>
France Water Team	France/Europe		company level	<p>French water cluster, created by the national government, in order to develop synergies, enhance research and innovation in the water sector (including industrial symbiosis)</p> <p>https://france-water-team.com/</p>
International office for	Europe/Worldwide		VET/company level	<p>International Platform which provides trainings on the optimisation of wastewater and energy</p> <p>https://www.oieau.fr/formation/spip.php?page=theme&id_article=92&id_rubrique=9</p>

SPIRE-SAIS: Training Framework (Deliverable 5.1)

Water				
Water Opleidingen	Netherlands		national level/ VET	Education provider on water-related topics in the Netherlands https://www.wateropleidingen.nl/
Let's recycle Platform	the UK		national level/ VET	Platform providing training to professional on several topics linked to Industrial symbiosis (including water-related ones) https://www.letsrecycle.com/events/events-calendar/
KIEMT	Netherlands		national level/ VET	help to accelerate energy efficiency and circular economy in the netherlands https://www.kiemt.nl
Irish Water Certified Water Steward Training Programme (CWS)	Ireland		National level/ VET	https://www.smartwater.ie/certified-water-steward/ https://www.water.ie/conservation/business-water-conservation/water-stewardship-trainin/

D. Review of chosen trainings



Brief description:

The **self-assessment tool** takes the user through a guided learning module that introduces the **concept of industrial symbiosis and prepares the user to engage in industrial symbiosis for their own company**. The user is guided through identifying waste streams and other under-utilised resources that can be repurposed by companies in different sectors, and how to gather evidence and data for these resources. Ideas are presented to help the user identify substitutes for inputs leading to a diversified and more robust supply chain.

Target group: Industry managers	Language: English	Modality: Online	Duration: 10-20 hrs	Cost: Free
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The module consists of the following:

1. **Knowledge and illustrative examples:** An introduction to the concept of industrial symbiosis, the methodologies for its implementation within your company, and how industrial symbiosis can benefit your organisation. Your organisation may already be doing industrial symbiosis but not calling it as such.
2. **Training exercises:** Guided exercises to help you gain practical experience of the concepts.
3. **Activities** to be carried out in your own organisation with supporting documents: Documents that you can download to help you log your organisation's information and identify potential industrial symbiosis opportunities.

Link: <https://circlean-symbiosis.eu/self-assessment-module/>

The module is organised to reflect the process of preparing for industrial symbiosis:

Introduction: Basics of IS
Map: Mapping processes within a site
Quantify: Quantify the resources inputs/outputs in a process
Prioritise: Decide which resources you want to focus on for matching





Brief description:

KATCH-e address the challenge of reinforcing the skills and competences in the field of **product-service development** for the **Circular Economy and Sustainability in the Construction and Furniture sectors**. The contents address students and professionals in industry and specifically focus on the development of sustainable product-services.

Target group: University students and professionals in industry of the construction and furniture sectors

Language: English

Modality: Online

Duration: 187,5 h (7,5 ECTS)

Cost: Free

Learning structure: The training framework, which contains **8 modules** and **7 tools**, is organized in 4 main areas:

- Basics:** Basic knowledge on **circular economy** that supports the understanding of the other materials;
- Business:** The **business approach**, required for the success of new, more circular and sustainable products or product-service;
- Design:** **Product and product-service system design** according to circularity and sustainability criteria; and
- Assessment and communication:** A support area with contents regarding assessment and communication in circular economy **with a life cycle perspective**.

Link: <https://www.katche.eu/knowledge-platform/>



8 Modules



7 Tools



CircularStart into Business



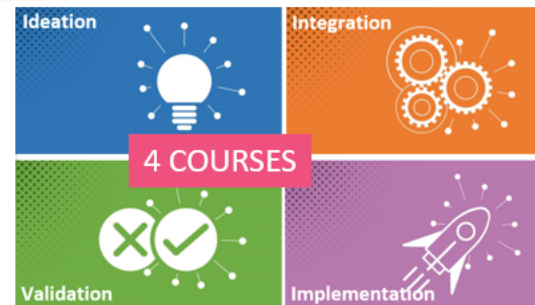
Brief description:

The objective of CircularStart is to support incubators, trainers and consultants in the sustainability and circularity training of start-ups, through the development of an **interactive guidance tool** and **eLearning training materials**, so that **start-ups increase their competences to understand, assess and improve the sustainability and Circular Economy aspects related to their Business Models**. They provide complete guidance during all stages of business model development: ideation, integration, validation and implementation.

Target group: Incubators, trainers, consultants, entrepreneurs, start-ups, training centers, universities...	Language: English	Modality: Online	Duration: 55 h	Cost: Free
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Training platform: 4 specific courses for each stage of business model development:

- Ideation:** Define the value proposition of your business through exploring and producing as many ideas as possible regarding circularity strategies.
- Integration:** Learn to analyse the circularity of the value chain of your business, in order to identify opportunities for circularity performance and therefore, to specify a business model based on a circular value chain.
- Validation:** To validate and improve your business models' sustainability and circularity performance which can be measured by specific indicators.
- Implementation:** To structure and take advantage of an entire communication strategy (based on ethical, transparency and sustainability values) and to define how to execute, monitor and innovate the business model.

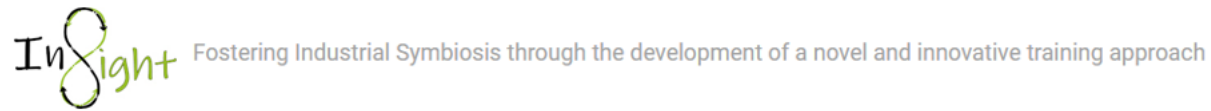


29 units	650 slides	39 exercises	60 supporting resources
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Other resources: Manual for trainers, guidance tool, Circular Business Model Canvas

Links: <https://www.circularstart.eu/> & <https://learn.circularstart.eu/>

SPIRE-SAIS: Training Framework (Deliverable 5.1)



Brief description:

This course aims to equip participants with the right skills and knowledge about **Industrial Symbiosis from today and tomorrow** and provide them with the necessary know-how to boost businesses to adopt circular economy principles. It also aims to develop a new professional profile, the **INDUSTRIAL SYMBIOSIS FACILITATOR**, who can be responsible of different tasks: to conduct analysis in its area of influence, to define and promote synergies between companies from different sectors, to capitalise on the benefits of EC principles implementation, etc.

Target group: VET students,
Business Managers & Public Bodies

Language: English & partly in French,
Italian, Romanian, Slovenian and Spanish

Modality:
Online

Duration: 150 h
(6 ECVET points)

Cost:
Free

The Curriculum's five learning modules are:

1

**IS THEORY,
CONCEPTS AND
CONTEXT**

- 1.1 Introduction to **Circular Economy**
- 1.2 Introduction to **Industrial Symbiosis**
- 1.3 Circular Economy and **IS at EU level**

2

**RESOURCE
MANAGEMENT**

- 2.1 **Source circularity**
- 2.2 Resources management: focus on **waste materials**
- 2.3 Resources management: focus on **water resources**
- 2.4 Resources management: focus on **energy**

3

IS MANAGEMENT

- 3.1 **System-thinking** approach to IS
- 3.2 Data collection and **resources flow analysis**
- 3.3 Existing circular economy and **IS platforms**
- 3.4 **Financial opportunities** for IS
- 3.5 IS **Business model**

4

SOFT SKILLS FOR IS

- 4.1 **Pitching IS**
- 4.2 **Entrepreneurship, design thinking** strategies and co-creation methods
- 4.3 Models of **collaboration** and inter-companies **team work**

5

IS CASE STUDIES

- 5.1 **Territorial** approach
- 5.2 **Industrial park** approach
- 5.3 **Company** approach

Link: <https://www.insight-erasmus.eu/> &
<https://insight.learning-platform.eu/>



Industrial Ecology Open Online Course

Online since 2018



Brief description:

The **Industrial Ecology Open Online Course (IEOOC)** is a collection of online material that documents and explains the core industrial ecology concepts, methods, data, and applications. It serves as a guide to new industrial ecology researchers by enabling them to conduct state-of-the-art science for sustainability. The course was developed for university students at all levels. It features lectures (screencasts and webinars of 15-60 minutes), exercises with sample solutions, code samples or notebooks, and reading material (papers, essays, reports, blog entries). There are now more than 45 exercises and tutorials, and these form the core of this course. All material is freely available for educational use.

Target group:
University students

Language:
English

Modality:
Online

Duration:
-

Cost:
Free

The course is divided into three broad sections:

1. **Background:** a general introduction to the topic is given and the theoretical foundations of interdisciplinary systems science in general, and industrial ecology in particular, are laid.
2. **Methods:** the core industrial ecology methods material flow analysis, life cycle assessment, and input-output analysis are introduced.
3. **Application:** a number of selected case studies and other examples are presented.

It features:

- o **Lectures** (screencasts and webinars of 15-60 minutes)
- o **> 45 exercises** with sample solutions & tutorials
- o **Code samples** or **notebooks**
- o **Reading material** (papers, essays, reports, blog entries)

Link: <https://www.industrialecology.uni-freiburg.de/teaching.aspx/>



Junior Expert in Circular Economy



Brief description:

This course will equip participants with tools and skills in sustainable development and circular economy, as well as skills in impact assessment evaluation methods, total quality management for environmental sustainability, entrepreneurship and digital literacy.

Target group European young people with at least a school diploma and university students	Language English	Modality Hybrid	Duration Annual course: 800h (4 ECVET)	Cost Free (20 places available)	EQF level IV
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Link
<https://studycirculareconomy.com/#:~:text=A%20Junior%20Expert%20in%20Circular,control%20of%20product%20and%20processes> &
<https://centoform.it/portfolio/junior-expert-in-circular-economy-2022-2023/>

	Short Description	Learning Objectives
Block A	Gaining a basic understanding of circular economy, its potential and they reflect about their own role.	Participants know how circular economy differs from linear economy, what the differences mean for sustainable economy and what opportunities and challenges exist for its implementation in industrial production.
Block B	Training in evaluating industrial production processes and making suggestions for improvement.	Participants know how to evaluate a life cycle (especially industrial production processes) for products with questions, steps and tools to contribute to optimize the environmental impact and circularity.
Internship	Applying the tools and concepts directly in the daily work of a company.	The participants can practice the application of the tools and concepts and understand how they work in an enterprise context.
Block C	Being enabled to explore chances and risks of redesign and new business models and to facilitate innovation workshops.	Participants get to know chances and risks of examples for redesign of products and new business models for services and know how to facilitate innovation with relevant questions and tools in order to improve sustainability and circularity.



THE EUROPEAN JUNIOR WATER PROGRAMME (EJWP)



Brief description:

The EJWP is a training course for young professionals from the **water sector** which aims to **develop skills and project management** the sector with a European dimension. EJWP enables development of key skills: network building, communication & diversity, technical advancements and more – to empower water-sector careers and their social contributions. EJWP development activities take place along with participants’ continued work in their current positions.

Target group Junior employee from a water-related organization

Language English

Modality Hybrid

Duration 2-year Programme, 8 weeks (1 day per week)

Cost Please contact EJWP for a cost estimate

EJWP’s specialists provide training on competences including:

- ✓ Personal & communication development
- ✓ Co-creation strategies and evaluation
- ✓ Project and self management
- ✓ Leadership and pro-active strategies
- ✓ Future century skills for sustainability

Link <https://juniorwaterprogramme.eu/>

EJWP’s 3 pillars:

- **Knowledge creation and transfer**
Masterclasses on European policies, water technology and innovations, and primary water challenges – including local water projects of participating organisations
- **European network opportunities through EJWP community building**
Integration in Water Europe, EJWP Ambassadors, and event participation
- **Personal and professional skills development in international teams**
Emphasis on cultural awareness and diversity in project exercises

The screenshot shows the Water Stewardship Ireland website. The header includes the logo and navigation links: Home, About Us, Membership, Academy, Research, Showcase. A 'JOIN US' button is visible. The main heading is 'Certified Water Steward Programme'. Below this, there are four columns of information:

- Target group:** Employees responsible for water management in their company
- Language:** English
- Modality:** Online
- Duration:** 8 weeks

Below the columns, it states: **Cost:** Funded By Irish Water and the Lean & Green Skillnet.



to Ireland and the Lean & Green Skillnet. The programme reducing operating costs while also protecting the environment

Learning Experience



Online Learning

- Module 1 – Introduction to Water Stewardship
- Module 2 – Water Mapping of your Business
- Module 3 – Water Conservation and Quick Wins at your site
- Module 4 – Developing Strategy and an Action Plan

Workshop Webinars

Online mentoring and support workshops for the development of your water charter as well as providing peer to peer learning opportunities

Link: <https://www.waterstewardshipireland.com/programmes/certified-water-steward-programme/>

 <p>Reduce Water Use</p> <p>Training on water conservation and quick wins at your site to drive behavioural change</p>	 <p>Monetary Cost Savings</p> <p>Understand and visualise your site's water lifecycle to reduce operating costs</p>
 <p>Reputational Benefits</p> <p>Accepted under Bord Bia's Origin Green Scheme and accredited by EWS</p>	 <p>Protect the Environment</p> <p>Add the latest cutting edge green credential to hit your sustainability targets</p>



EUROSTEELMASTER 2022 RIA

XIII Edition - Online course
European Advanced Training Course for the Worldwide Steel Sector



Brief description:

The Eurosteelmater is an advanced Training Course for the Worldwide Steel Sector addressed to managers, technical staff, white collar workers, trade union officials, consultant and experts, connected with the steel industry. It has now reached its XI edition. As for the Steelmaster, the course is addressed to Steel sector, but Energy Efficiency and Industrial Symbiosis are transversal to all the planned modules. Within the Master two seminars took place: ECOSLAG and ControlInSteel.

Target group Professionals related to the steel sector

Language English

Modality Online?

Duration Annual course programme – 5 days – 30h

Cost: Free?

Seminar ECOSLAG (2h)

Eco-friendly steelmaking slag solidification with energy recovery to produce a high quality slag product for a sustainable recycling

Seminar ControlInSteel (1h 40min)

Dissemination and valorisation of RFCS-results in the field of “Advanced Automation and Control Solutions in Downstream Steel Processes” and development of a strategic vision for future research

Link not available

European Advanced Training Course for the Worldwide Steel Sector

- Opening sesión (2h 15min)
- Politics, Market and Trade (3h)
- Technology (3h 30min)
- Sustainability 1 (3h)
- EU & MSs Industrial policy for the Steel Sector (3h)
- Research & Innovation (3h)
- Sustainability 2 & Steel Industry 4.0(3h 30min)
- Social Partners and the EU Green Deal (3h 15min)
- Sustainability 3 (3h)

E. *Development of new training courses*

To develop the training courses, five working groups were established. Each working group had a chosen partner act as leader.

The working groups were:

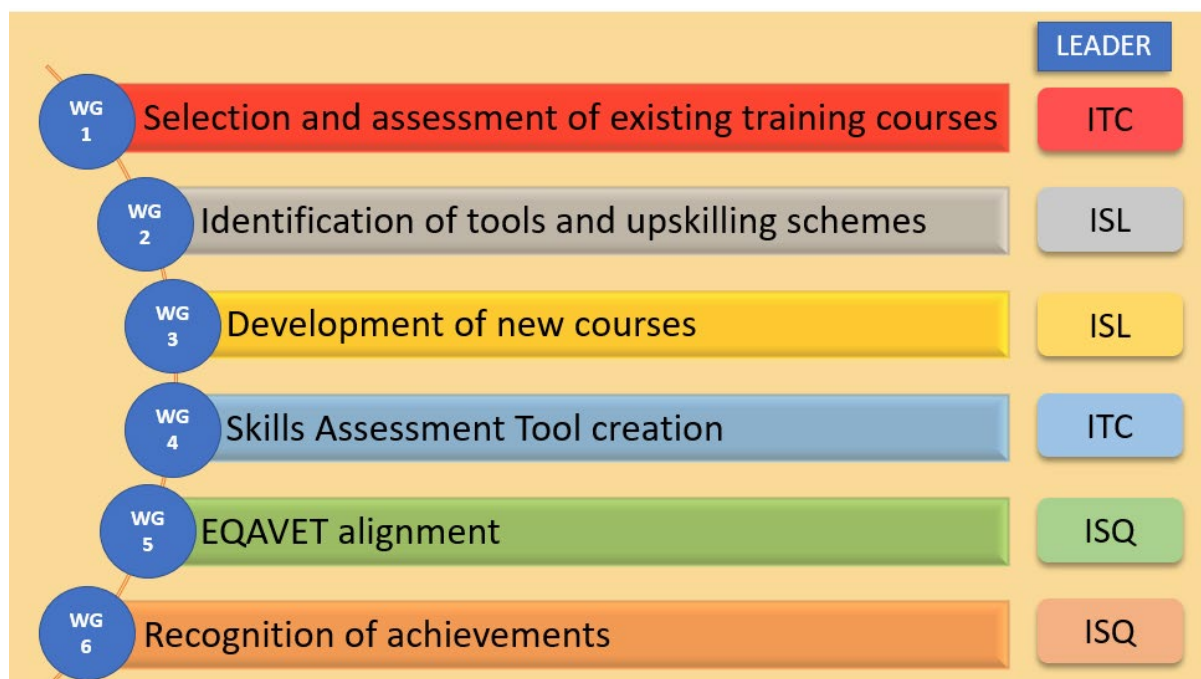


Figure 31: Work Package 5 Working Groups

Each working group established a remit for their operations:

1. Validation of existing courses – **ITC**, IMNR, H2O People, CIRCE, **CSM/RINA**, **SSSA**
What is available? What does it contain? Review of chosen courses
2. Identification of tools and upskilling schemes – **ISL**, sector associations
What skills are covered in the existing trainings against the skills required for the job roles. What new trainings are required?
3. Development of new courses – **ISL**, ITC, ISQ, H2O People, **SSSA**, **CSM/RINA**, IMNR
Develop new courses to fill gaps identified through WG 1 and 2
Short, topic based
4. Skills Assessment Tool creation – **ITC**, TUDO, ISL
Create a tool to assess an individual's skills
5. EQAVET alignment – **ISQ**, ART-ER, H2O People
Tailoring of the training courses to meet EQAVET requirements
6. Recognition of achievements – **ISQ**, H2O People, Partner X
Ensures process of recognition for the trainings that would be undertaken by an individual

The inter-relationships between the working groups were established as thus:

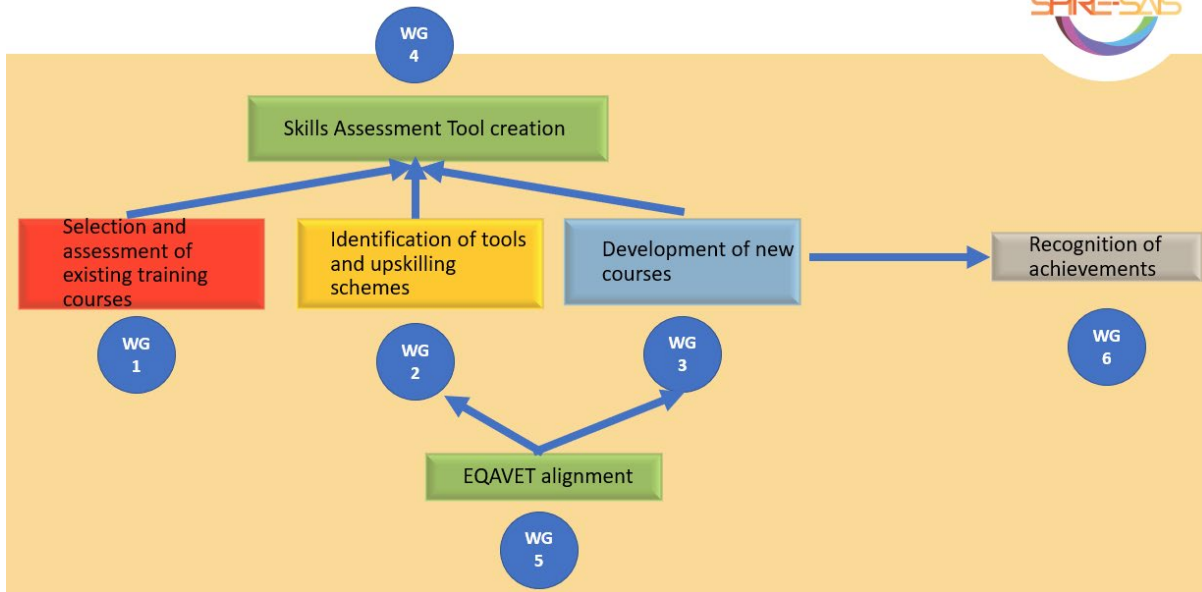


Figure 32: Inter-relationships between the WP5 working groups

It was recognised that training could be themed across various types. A generic general introduction to industrial symbiosis (similar to that developed through CircLean); thematic training that was specific to job roles, but not specific to any particular sector, such as financial training to assess opportunities that have been identified; Sector specific training to each of the EE industries, related to job roles specific to each industry sector and job related trainings, where the activities are not related to any particular job roles or sector, such as waste segregation

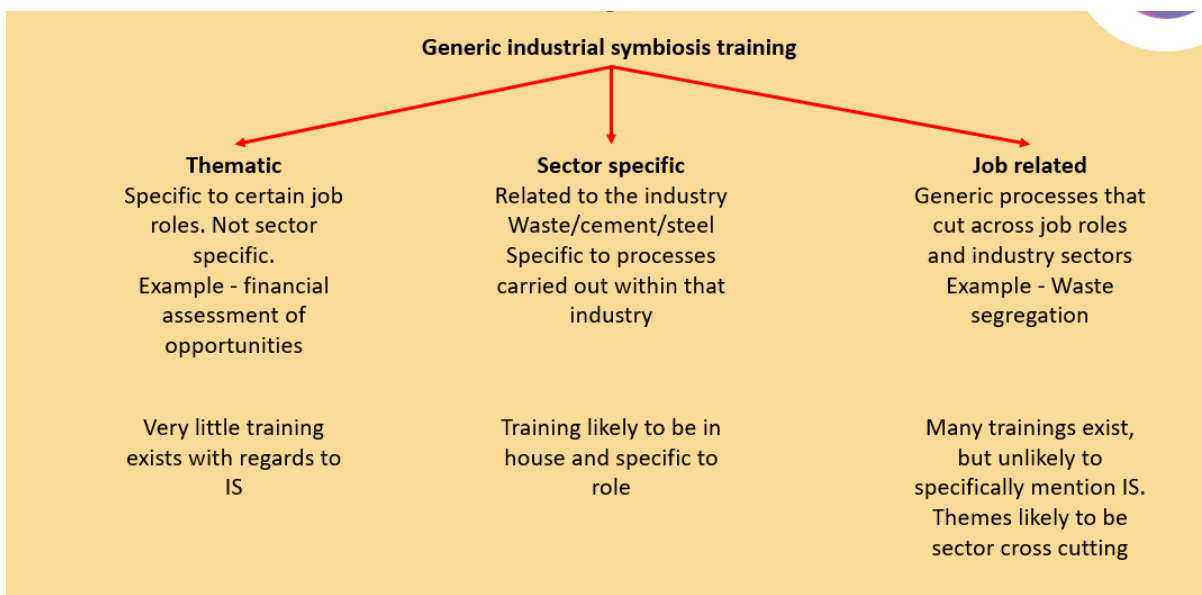


Figure 33: Examples of different types of training for IS and EE

WG1 filtered the long list of training courses to select nine that would receive in depth review. The selected courses were:

Assigned to: Training reference	
ART-ER	6. Junior Expert in Circular Economy
Water Europe	12. European Junior Water Programme
H2O People	16. Irish Water Certified Water Steward Training Programme (CWS)
ITC	18. CIRCULARSTART into Business project: Cooperation for innovation and the exchange of good practices in sustainability and circularity training of start-ups
ISQ & IMA	19. INSIGHT project - Fostering Industrial Symbiosis through the development of a novel and innovative training approach
IMNR AGBAR	& 20. KATCHE-e project - Training for Circular Economy in the Construction and Furniture Sectors
CSM/RINA	32. Eurosteelmaster
Ferriere Nord	84. INDUSTRIAL ECOLOGY OPEN ONLINE COURSE (IEOOC) Industrial Symbiosis Facilitator: Key study based on current knowledge, skills and qualifications regarding Is
SSSA & ECEG	85. The CircLean Self-Assessment Module

Table 3: Training courses selected for review

The results of the review are available in Appendix D

Working Group 2 – Identification of tools and upskilling schemes

This group was tasked with assessing the skills and training needs for each job role. Skills were defined and descriptions for levels 1 to 4 were created. Each description included Do (abilities) and Know (knowledge). These were then used to create Learning Outcomes which were then used in the creation of the training courses – to ascertain the design and assessments required in the courses.

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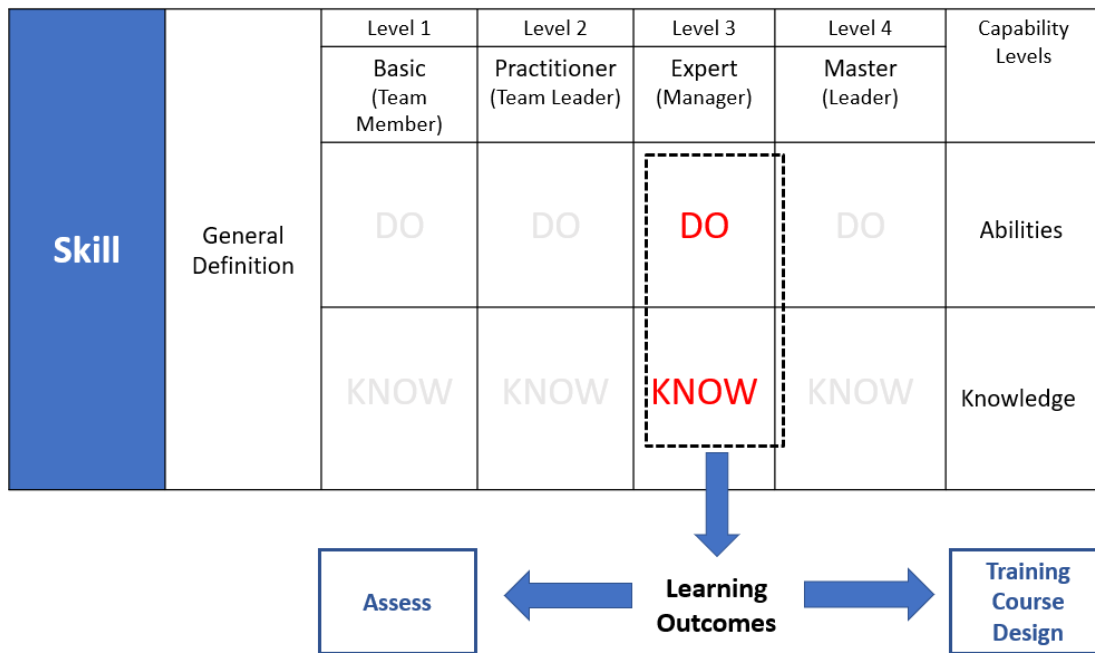


Figure 34: Skills Assessment design

Two methods were used to identify abilities and knowledge. The first was via a consensus task.

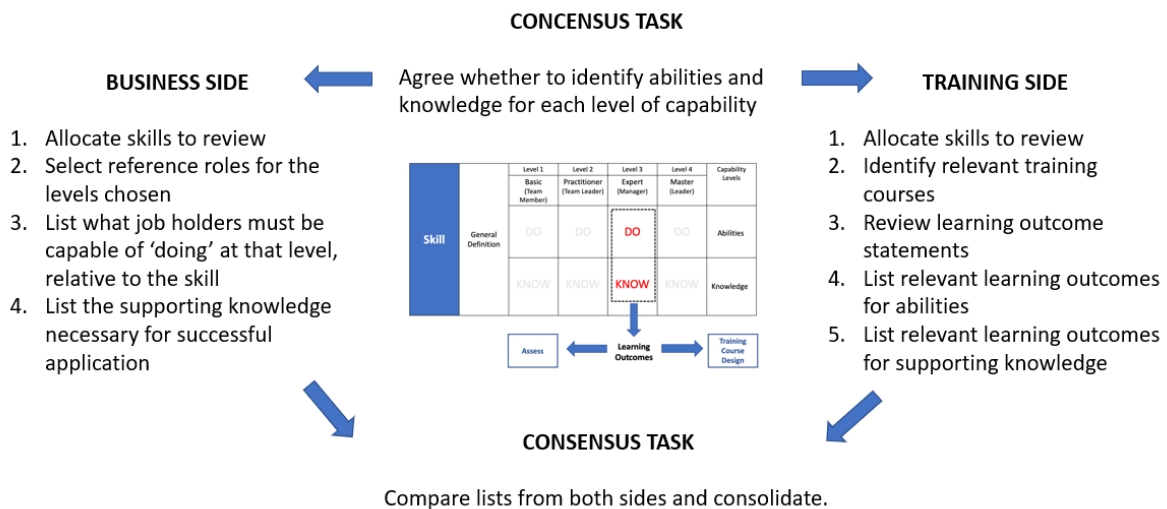


Figure 35: Consensus Task process

The second was to map the skills to the selected job roles

	Role 1	Role 2	Role 3	Role n
Skill 1	Level 3	Level 2	Level 3	Level 2
Skill 2	Level 2	Level 1	Level 3	Level 2
Skill 3		Level 3	Level 4	Level 2

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Skill 4	Level 4		Level 2	
Skill n		Level 2	Level 4	Level 2

Table 4: Mapping skills to job roles

The skills reviewed were:

- Industrial Symbiosis basics
- Industrial Symbiosis Systems
- Industrial Symbiosis Product Life
- Industrial Symbiosis Resource management
- Energy efficiency – use and cost
- Energy Management and Audit
- Energy efficiency – process optimisation
- Energy data and analysis
- Environmental awareness
- Collaboration
- Entrepreneurial thinking
- Critical and Systematic thinking
- System thinking
- Creative thinking
- Horizon scanning
- Environmental legislation
- Waste water management
- Innovation management (IS and EE)
- Trans disciplinary thinking
- Sustainability culture
- Project management
- Networking

Each job role was assessed against the skills with the results being captured in a tab named 'Skills Map'. The content was transferred to the Capability Assessment Platform. Pilot assessments were run and feedback delivered, which allowed refinements to be completed.

This was then used to decide priority trainings to be developed by working group 3

The full results of the Skills Review can be found in the document D5.1 addendum – SPIRE SAIS Skills Template – final descriptions

Working group 3 – Development of new courses

After assessing the skills requirement for the chosen job roles and completing the skills review, new courses were chosen to be developed. The chosen courses were:

Course name	Progress
SUS0310. Industrial Symbiosis Course	
SUS0208205. Introduction to Industrial Symbiosis	100
SUS0310210. General Introduction to Circular Economy	100
SUS0310215. Industrial Symbiosis in Cement Sector	100

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SUS0310225. Industrial Symbiosis in Ceramic Sector	100
SUS0310235. Industrial Symbiosis in Mineral Sector	On hold
SUS0310245. Industrial Symbiosis in Steel Sector	100
SUS0310255. Industrial Symbiosis in Water Sector	On hold
SUS0210. Energy Efficiency Course	
SUS0210205. Energy Efficiency Basic Concepts	100
SUS0210215. Energy Efficiency in Cement Sector	40
SUS0210225. Energy Efficiency Ceramic Sector	100
SUS0210235. Energy Efficiency in Mineral Sector	On hold
SUS0210245. Energy Efficiency in Steel Sector	100
SUS0210255. Energy Efficiency in Water Sector	On hold
EDU0101 - Strategies for enhanced Learning	80
SUSXXXX. Non-ferrous Metals Metallurgy	80
Best available technologies for base non-ferrous metals metallurgy	
Advanced materials and processes for reducing the use of critical raw materials	
Advanced coatings for reducing the use of critical raw materials	
Training for VET Teacher	50

Table 5: Training courses developed during SPIRE SAIS project

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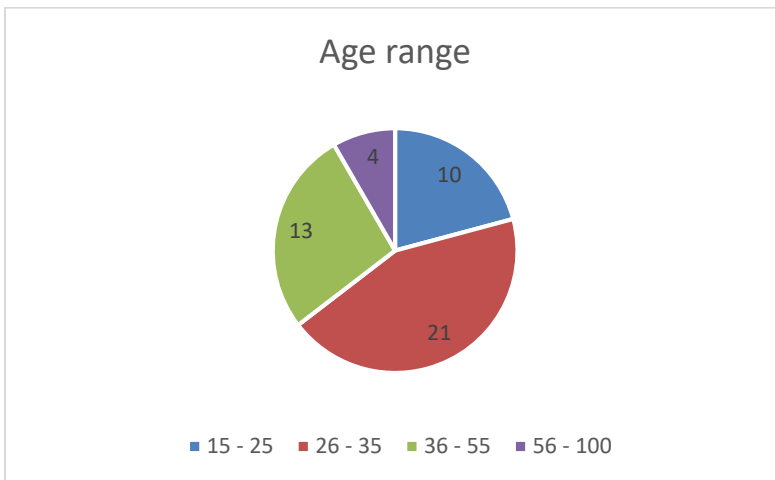
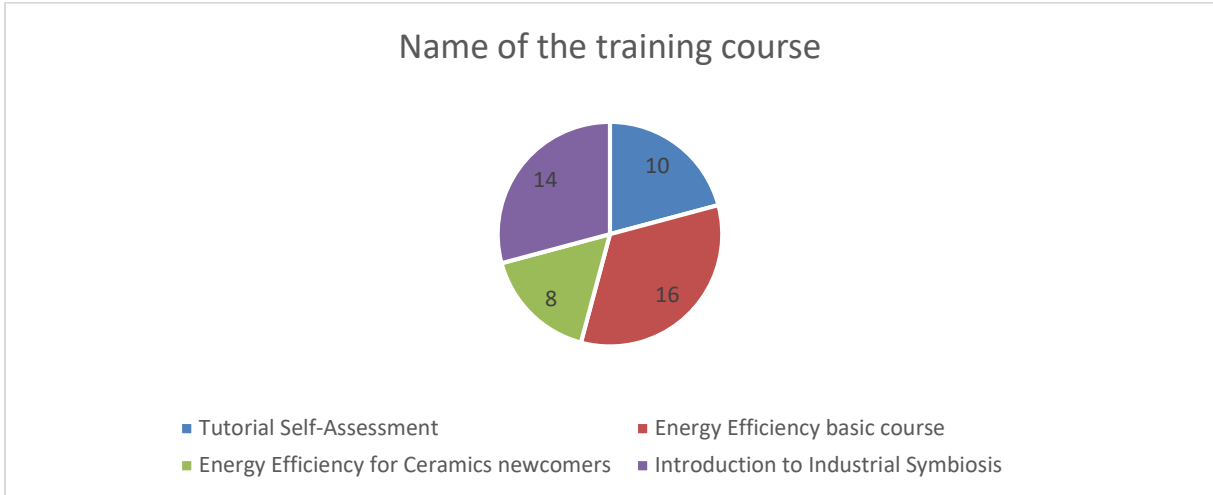
F Training Course Quality Assessment Form

Dimension	Code	Evaluation Aspects	I totally disagree (1)	I disagree (2)	I agree (3)	I totally agree (4)
IS and EE Skills Development Identification	1DI	The training course is capable of developing new Industrial Symbiosis or Energy Efficiency skills in learners.	0	0	0	0
	2DI	The training course identifies skills related to Industrial Symbiosis or Energy Efficiency.	0	0	0	0
	3DI	The training course facilitates access to instruments and resources that allow the implementation of measures that respond to the skills needs previously identified in Skills Assessment Tool.	0	0	0	0
Learning Outcomes	1LO	The learning outcomes of the training course are aligned with the course's EQF level.	0	0	0	0
	2LO	The learning outcomes clearly identify what the learner is expected to know and/or be able to do, after completing the training course successfully.	0	0	0	0
	3LO	The criteria for success or failure of the learner are clearly identified for the training course.	0	0	0	0
	4LO	Verbs from Bloom's taxonomy were used to compose the learning outcomes.	0	0	0	0
	5LO	The training course contents allow the learner to achieve the respective learning outcomes.	0	0	0	0
Quality in Learning	1QL	The training course has clear objectives, a plan to achieve those objectives, and measurable learning outcomes.	0	0	0	0
	2QL	The estimated time to complete the training course is given upfront (contact hours + workload).	0	0	0	0
	3QL	The training course has evaluation procedures implemented to ensure that the objectives and the defined learning outcomes were met.	0	0	0	0
	4QL	The learning progress and the performance of a learner in achieving the learning outcomes (evaluation) are recorded.	0	0	0	0
	5QL	There is a record of the number of participants in the training course (EQAVET indicator 3).	0	0	0	0
	6QL	There is a mechanism to keep record of the drop-out rate compared to participation rate in the training course (EQAVET indicator 4).	0	0	0	0
	7QL	There is a feedback survey for learners after completion of the training course (EQAVET indicator 6).	0	0	0	0
Certification in Europe	1CE	There is a mechanism for issuing a training course certificate (e.g. certificate of achievement, learning certificate, badge, microcredential, diploma, etc).	0	0	0	0
	2CE	The training course certificate identifies the learner and the title of the training course.	0	0	0	0
	3CE	The training course certificate identifies the country and region of the issuer, if applicable.	0	0	0	0
	4CE	The training course certificate identifies the organisation that provided the training course.	0	0	0	0
	5CE	The training course certificate identifies the issuing date.	0	0	0	0
	6CE	The training course certificate identifies the learning outcomes.	0	0	0	0
	7CE	The training course certificate identifies the estimated workload required to achieve learning outcomes.	0	0	0	0
	8CE	The training course certificate identifies the EQF level of the training course.	0	0	0	0
	9CE	The training course certificate identifies the learning regime (e-learning, hybrid, presential)	0	0	0	0
		*If the platform has a mechanism to identify training needs in the labour market, then this is aligned with EQAVET indicator 9.				
Acceptable value for recognition and certification of training = x (Minimum).						

G Results from testing the trainings

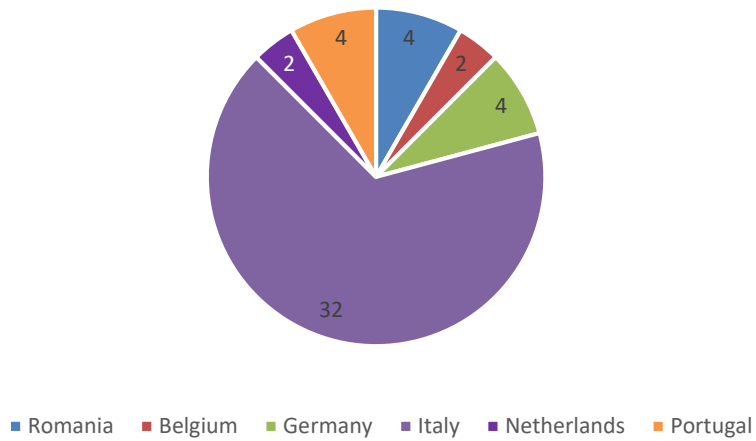
The following are a series of charts indicating the testing of courses that occurred during the project.

Four completed courses were chosen, and a total of 48 people tested and reviewed the courses.

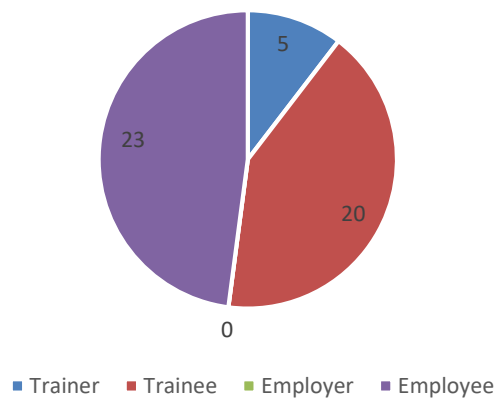


SPIRE-SAIS: Training Framework (Deliverable 5.1)

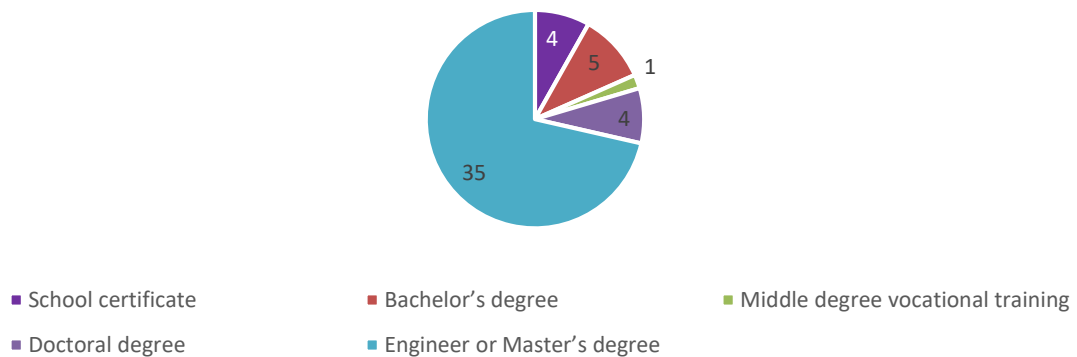
In which country are you taking this course?



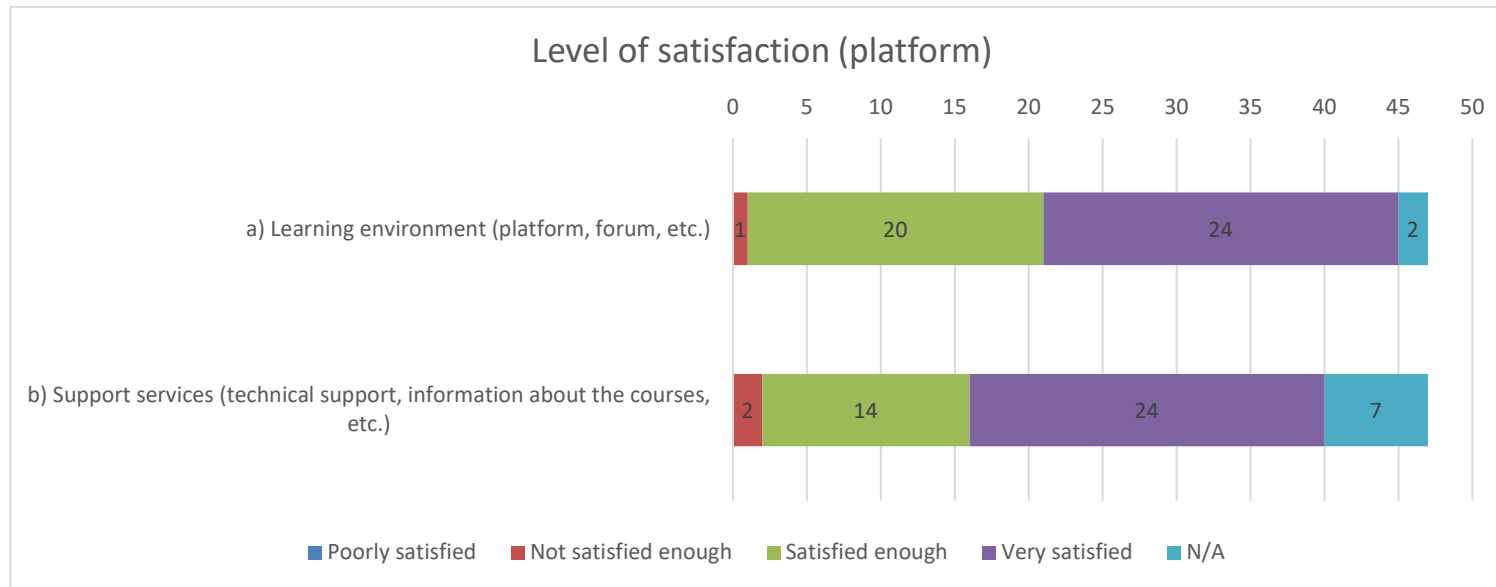
What would you say is your profile when engaging in this course?



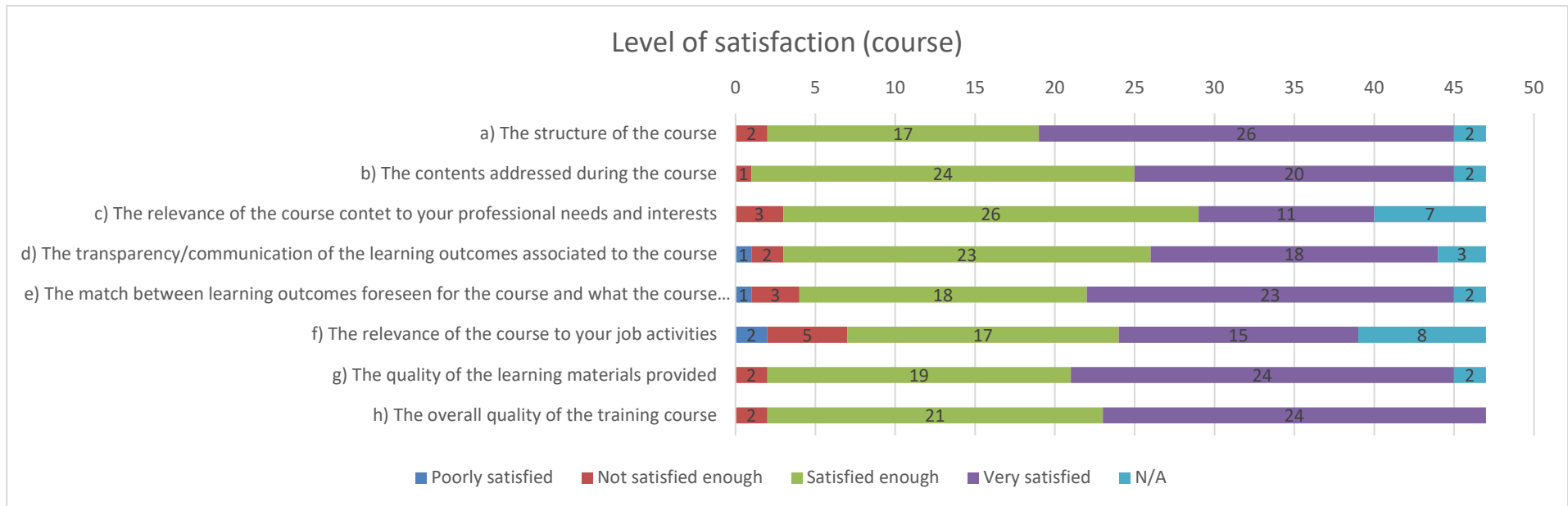
What is your level of education?



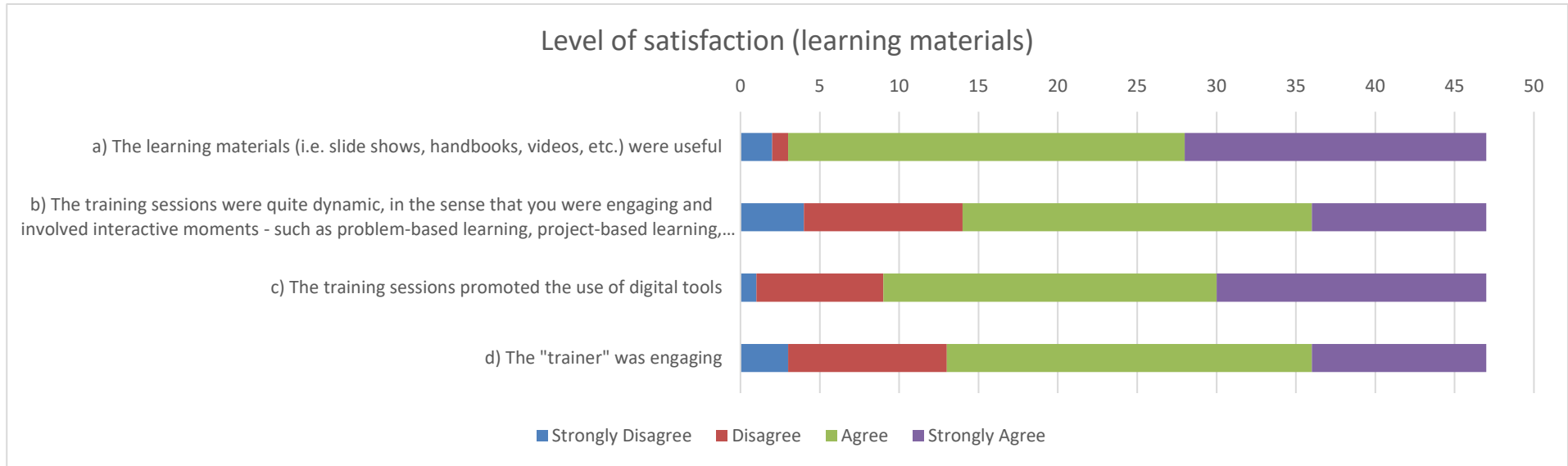
SPIRE-SAIS: Training Framework (Deliverable 5.1)



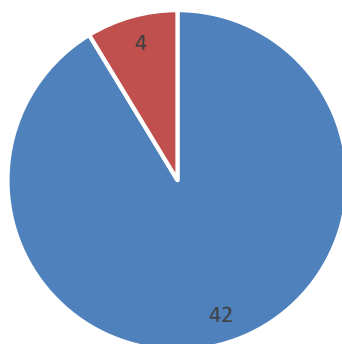
SPIRE-SAIS: Training Framework (Deliverable 5.1)



SPIRE-SAIS: Training Framework (Deliverable 5.1)

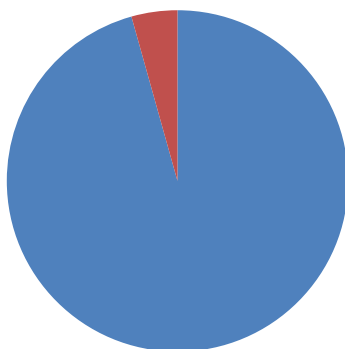


Did the course meet your expectations?



■ Yes ■ No

Would you recommend this course to others?



■ Yes ■ No