



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, com- pany and association training pro- grammes

Deliverable D5.1 (First Version)

(Status: December 2021)

Project acronym:	SPIRE-SAIS
Project title:	Skills Alliance for Industrial Symbiosis: A Cross-sectoral Blueprint for a Sustainable Process Industry
Project number:	612429-EPP-1-2019-1-DE-EPPKA2-SSA-B
Coordinator:	TU Dortmund University (TUDO)
Funding Scheme:	Erasmus+
Due date of deliverable:	31th December 2021
Actual submission date:	31th December 2021
Project duration:	01.01.2020 – 31.12.2023 (48 months)
Work package:	WP 5 – European Industrial Symbiosis Blueprint Development
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Dissemination level:	Public



Co-funded by the
Erasmus+ Programme
of the European Union

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1 Context and objectives

The main objective of the project is to develop a Blueprint for a European Intensive Industries Skills Agenda and Strategy (SPIRE-SAIS) for an ongoing and short-termed implementation of new skills demanded for the wide implementation of Industrial Symbiosis (IS) and Energy Efficiency (EE).

A search of the internet reveals that there are many disparate trainings, databases and offers of advice related to both IS and EE. Collating this data and matching the content to requirements within a company, especially to different job roles and identified skills needs, is something that has been lacking.

For that purpose, our targets of SPIRE-SAIS are to create **mechanisms** for:

- The identification of skills demands of industry, 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.

2 Draft approach to the mechanisms to create

These mechanisms will rely on a set of different elements, aligned to the general Blueprint Prototype (see D5.1; Schröder et al., 2021), that will complement each other and are critical for the mechanisms to work. The following elements are part of the baseline that has been defined:

- A. List of skills required for the implementation of IS and EE. This will be an initial baseline that can be customised to match roles and skills level – such as management and operational, lower or higher proficiency level
- B. Tools for measuring IS skills readiness and matching skills needs with courses available in the training courses database
- C. Collection of educational resources (courses) in a database with training courses
- D. Tool for measuring company IS maturity/readiness level.

A. List of skills required for the implementation of IS and EE

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 D3.2; Sidenor, 2021), 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:

1. A **literature review** on studies about future skill needs in process industries originated a list of 60 skills.

SPIRE-SAIS: Training Framework (Deliverable 5.1)

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 1).

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 1: SPIRE-SAIS skills categorisation and prioritisation

- SPIRE-SAIS consortium members input:** As the second step, 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 deployment of IS and EE to its full potential in Process Industry. In Figure 1, the intensity of the (green) colour demonstrates the weight of the skills according to the answers of the members.
- 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 2).

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 3 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.

SPIRE-SAIS: Training Framework (Deliverable 5.1)

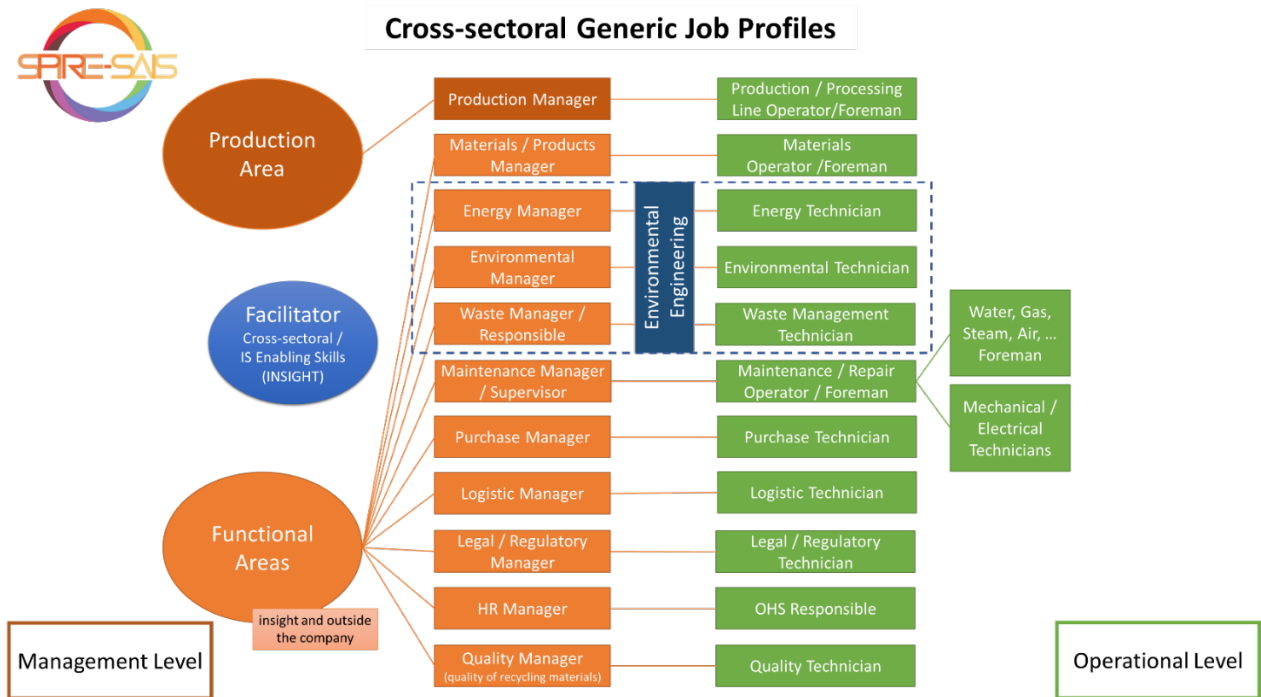


Figure 2: Generic Job Profiles across the involved sectors

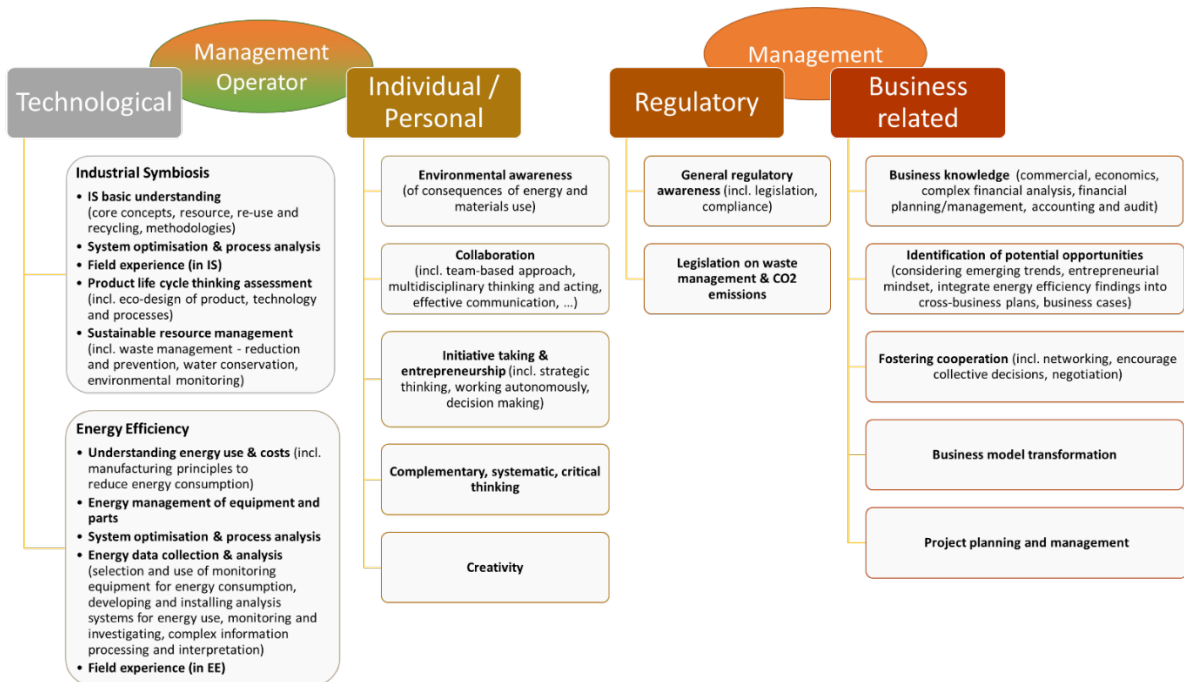


Figure 3: Industrial Symbiosis and Energy Efficiency Skills Classification

Sustainable anticipation of new skills demands is foreseen within a Foresight Observatory (see D5.1; Schröder et al., 2021), closely aligned with the development of new technologies: For instance through a close cooperation 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.

B. Tools for measuring IS skills readiness and matching skills needs with courses available in a training courses database

The initial list of skills will allow companies to do the **inventory of skills** they already have in the company 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 online database. 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.

Companies 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 1) 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.

Discussion up to now is going in the direction of a SAIS Online Training Platform: *Industrial Symbiosis Skills Intelligence (ISSI)*. 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) (call of HEU to be decided beginning of next year).

C. Online collection of educational resources (courses) / database with training courses

A series of educational resources and training courses was already identified and is available to be included in the training courses database. If necessary, new training courses will be developed to meet any possible gap in the training offer collection. Further courses will be identified and integrated during the course of the project.

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.

External training course considerations

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.

Option 1 is simpler for us and involves less work, but may not be very attractive and straightforward for the user.

It is important to consider that, the courses offered by others should be open and available. We will need to consider how we guarantee that they will remain in force and available at least during the project and for a reasonable time afterwards.

On the other hand, option 2 involves more work for the project but offers a more direct course that is more suitable for the user's needs and the availability to the user will depend on us. Independently of these two options, SPIRE-SAIS can offer a list of entities and courses offered at the moment, similar to <https://www.katche.eu/knowledge-platform/other-resources/situation-analysis/>.

It is likely that the final offering would be an amalgamation of these options, with partners contributing their expertise and external courses complimenting.

An open training platform like the steelHub was already discussed with worldsteel and A.SPIRE. We postponed the decision for a suggestion until 2022 when the ECoP for Industrial Hubs for Circularity decision is made, because an integration in the ECoP is necessary in our view.

As a complementary feature of the online database of training courses, there will also be available training courses for newcomers to the process 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.

Figure 4: External training course considerations

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 5 illustrates how these areas would connect and interact.

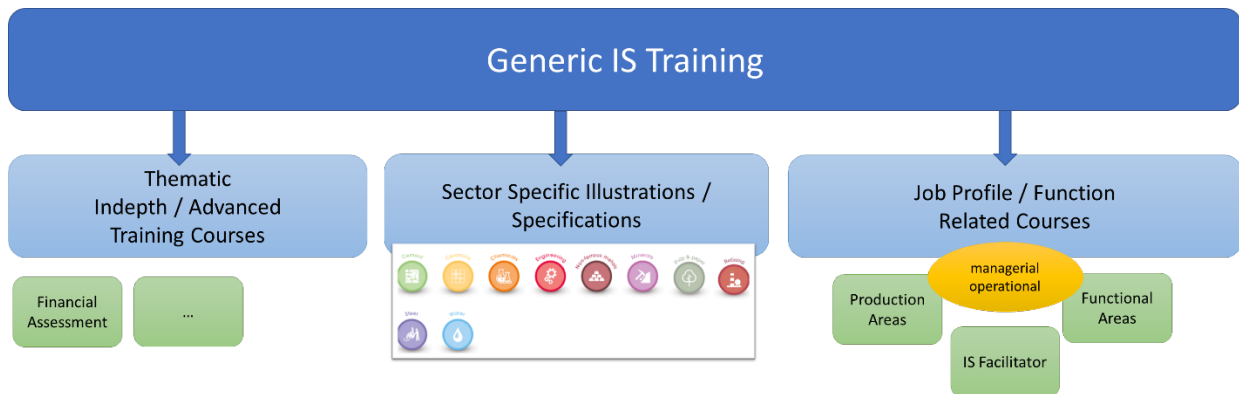


Figure 5: Generic and in-depth training

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.

D. Tool for measuring site IS maturity/readiness level

An alternative way to identify the Human Resources skills requirements for a robust implementation of IS comes from a broader approach to how well prepared a company is –using a tool that allows the identification of the company maturity level in Industrial Symbiosis. An existing instrument has been identified and will be available for such purpose: the CircLean Self-Assessment Module which will go live January 2022 (see its central elements in Figure 5/6). The general idea is that it may be presented in a self-explanatory way or, as an option, that a service offers to support its use.

The identification of the company’s IS maturity level (see Figure 6) can then link to courses in the database that will facilitate progression in that company maturity level – through the offering of specific courses for both management and operational levels as required.

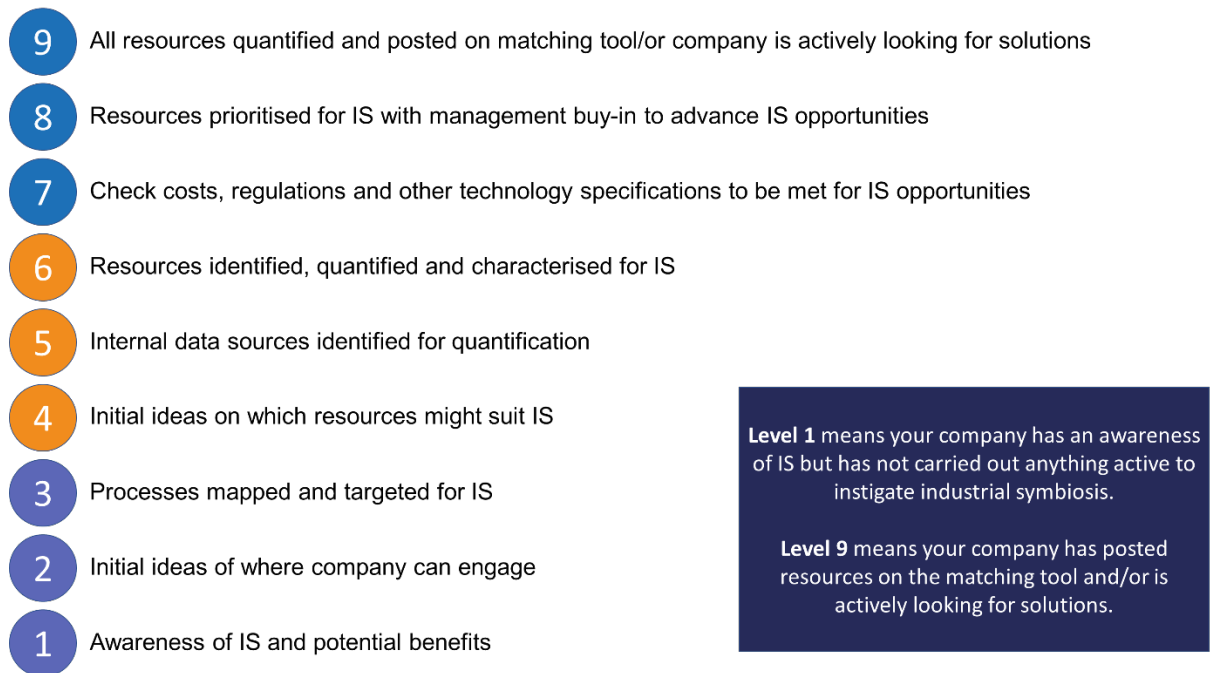


Figure 6: IS Readiness Levels

(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)

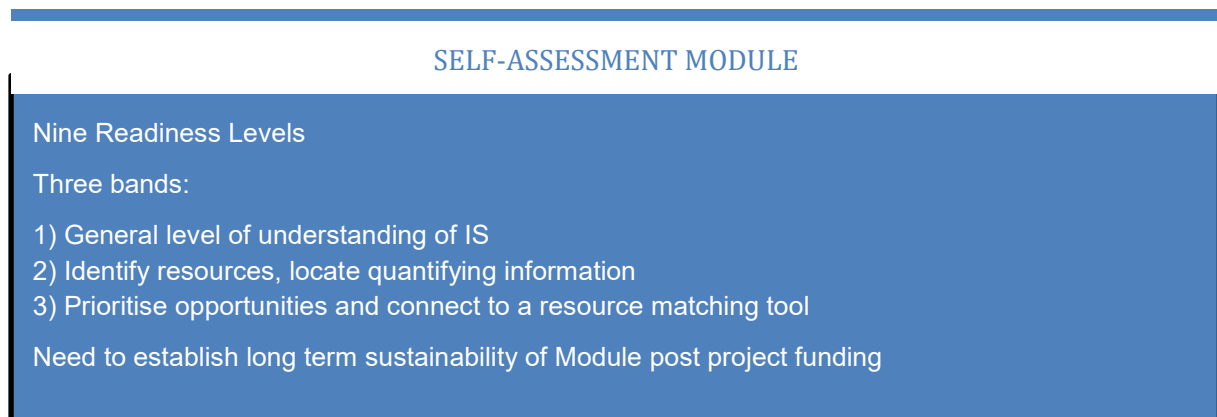


Figure 7: Self-assessment module



SPIRE-SAIS: Training Framework (Deliverable 5.1)

Coupled with the readiness levels listed above, the project is considering new tools for measuring IS skills readiness and matching skills needs with courses available in the training courses database.

Against this backdrop and referring to the skills classification so far (see Figure3), SPIRE-SAIS is developing a tool to be used for:

- assessing the skills maturity of companies and their employees
- prioritize and match to training topics (course contents) to achieve the necessary and important skills for the company.

In its initial stage, the proposed methodology is that a company (or several employees of the company) fill in the questions, assessing the level of knowledge in each of the skills and their importance for the company: Correlated to the skills dimension and its specific skills and related topics, the respondent has to judge the current state/level of proficiency/readiness level and the importance for the company/user (low to high). Based on these inputs the skills gap related priority to achieve the skills under consideration are automatically analysed (see Figure 8).

DIMENSION	SKILLS	TOPICS	CURRENT STATE/LEVEL OF PROFICIENCY/READINESS LEVEL	IMPORTANCE FOR THE USER/COMPANY Indicate the importance !!! !! !	Priority to achieve the skills
TECHNOLOGICAL (IS)	IS basic understanding	Do you know what industrial symbiosis is?	Intermediate knowledge	!!	Priority 2
		Do you know how IS is related to sustainable development?	Low knowledge	!	Priority 2
		Do you know how IS is related to circular economy?	Advance knowledge	!!	Priority 3
		Do you know the role of the business in IS?	None	!!!	Priority 1
		Do you know the type of resources likely to be part of an industrial symbiosis?	Advance knowledge	!!!	Priority 3
	IS core concepts	Do you know the different types of IS?	Low knowledge	!!	Priority 1
	Other skills...	etc.			Indicator or importance not scored
BUSINESS RELATED	Financial management	Do you know the implications of SI for financial management?	None	!!!	Priority 1
		Do you know the financial challenges and possible solutions?	Low knowledge	!!!	Priority 1
	Identification of potential opportunities	Do you know the main benefits arising from applying IS principles?	Low knowledge	!!	Priority 1
	Financial tools	Do you know financial tools related to IS?	None	!!!	Priority 1
	Business models	Do you know the different business models related to IS?	None	!	Priority 1
		Do you know Symbiotic Business Strategies and their relation to the resource flow?	Intermediate knowledge	!	Priority 1
Other skills...	Etc.			Indicator or importance not scored	

Figure 8: Prioritisation of skills based on current skill level and importance to the company

The skills for each dimension (technological, business, regulatory, ...) are scored from 0 to 10 showing the recent Skills Readiness Levels for Industrial Symbiosis, classifying each dimension of current skills as of low, medium and high priority for relevant adjustments. (see Figure 9).

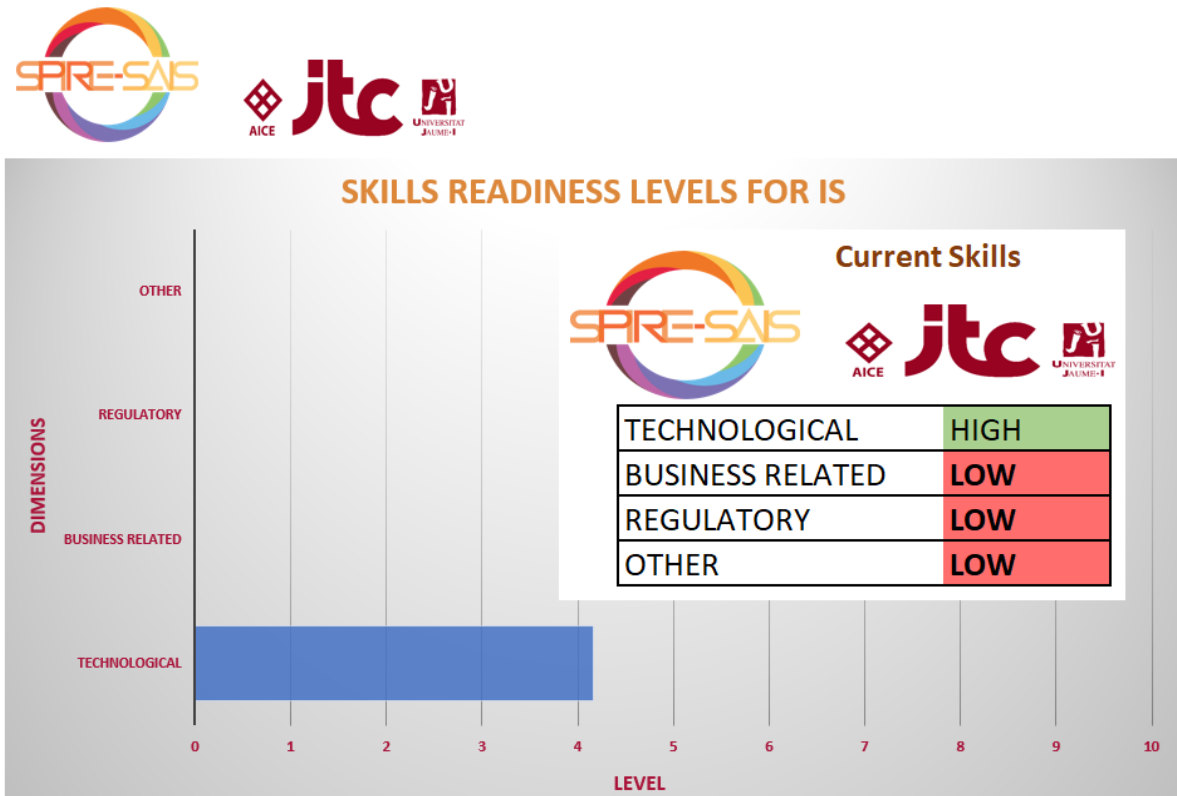


Figure 9: Industrial Symbiosis Skills readiness levels and priorities

Clearly, as this development is in the initial stages, there are several areas to be improved during the next steps, such as:

- The type of results to be obtained and how to visualize them
- Linking the tool with skills readiness levels for IS
- Linking skills with skills readiness levels for IS, symbiosis readiness levels and course contents (didactic resources and/or tools).

3 Link with formal VET qualifications and ESCO

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 will be featured, taking advantage of the analysis of industry requirements and VET Support. This allows a connection of the online database 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 advantage will be that companies will be able to see these new qualifications when navigating the online database 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 online database will 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, e.g.:
 - Indications of which language linked courses are presented in.
 - Translation of English course content into other European languages (most likely for post project resolution).

As a consequence of this interaction, companies will be able to 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 will be fostered by existing occupations of the ESCO database, a better and more facilitated match of occupational profiles and company demanded skills relevant for IS implementation will be possible.

In this sense, valuable information has been obtained from the developed and defined job profiles (see Figure 2) 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 is generating a common ground combining the industry demand and VET (system) perspective. The planned European job profile related skills assessment may also 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 "VET Systems: Anticipating Future Requirements and Regulations in the national VET Systems" aims to identify how Vocational Education and Training (VET) systems and frameworks at national and EU level currently deliver skills concerning IS an 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 "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.

A matrix of cross-sectoral IS and EE skills is identifying 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 online database 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 and an associated EQF level.

The alignment of the courses in the online database 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 as well.

4 Quality control of the online database of training courses

A validation process will ensure that only quality resources/courses are to be included in the online database. So, an entity will apply for the inclusion of a course in the online database only after having the course validated by the database 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.

An important issue for including training courses in the planned online database will ensure the quality of the educational resources 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.

4.1 *New learning arrangements and train the trainer*

Train the trainer courses and tools will also be available in the online database, 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.

4.2 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 et al. 2020, pp. 14) will be ensured by considering the potential to contribute to 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.

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.

SPIRE-SAIS strategy has 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.

5 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.

6 Considerations for the further development of the Training Framework

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

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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
CRMs	Critical raw materials
CVET	Continuing Vocational Education and Training
DigComp	Digital Competence Framework for citizens
EC	European Commission
ECoP	European Community of Practice
ECoP U-IS	European Community of Practice for Urban Industrial Symbiosis)
EE	Energy Efficiency
EntreComp	Entrepreneurship Competence Framework.
EQAVET	European Quality Assurance Reference Framework for Vocational Education and Training
EQF	European Qualifications Framework
HEU	Horizon Europe
IS	Industrial Symbiosis
ISSI	Industrial Symbiosis Skills Intelligence
IVET	Initial Vocational Education and Training
U-IS	Urban Industrial Symbiosis
VET	Vocational Education and Training

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

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				<p>Analysis can mean for business activities Duration: 6 hours</p>
<p>Courses Femxa, online training supported by The Spanish Ministry of Work and Social Economy.</p>	Spain	EE	Company level	<p>Femxa offers online training in energy efficiency, both for active workers, and for unemployed people.</p> <p>References: https://www.cursosfemxa.es/</p>
<p>Educaweb, online platform to guide users in finding trainings</p>	Spain	EE	Company level	<p>It is an online platform created to guide students and professionals to find training in the selected area of expertise, including energy efficiency.</p> <p>References: https://www.educaweb.com/nf/cursos-de/eficiencia-energetica/</p>
<p>SEAS Center, platform for online training of San Valero Foundation.</p>	Spain	EE	VET level	<p>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.</p> <p>References: https://www.seas.es/areas/energias-renovables#edificacion-sostenible</p>
<p>Spanish National Energy Efficiency Plan 2017-2020</p>	Spain	EE	Policy level	<p>It is the National Plan designed and developed by the Spanish government to fulfil the requirements derived from the European Energy Efficiency Directive.</p> <p>References: https://ec.europa.eu/energy/sites/ener/files/documents/es_neeap_2017_en.pdf</p>
<p>CREARA, private energy efficiency consultancy</p>	Spain	EE	Company level	<p>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.</p> <p>References: https://www.creara.es/</p>
<p>Spanish Technological Platform on Energy Efficiency (PTE-EE)</p>	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>

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				References: https://www.ptee-ee.org/
Spanish National association of Energy Services providers (ANESE)	Spain	EE	Company level	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. References: https://www.anese.es/
Training programmes of Association of energy efficiency companies (A3e)	Spain	EE	Company level	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. A3e provides also a job bank for professionals seeking for a new job. References: https://www.asociacion3e.org/ ; https://www.aec.es/certificacion/ ; https://www.certificacion-dpd.es/
Multiannual Programmes of the Federal Institute for Vocational Education and Training	Germany	IS, EE, Green skills	National/regional policy level	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 companies working in the Chemical industry) References: 2015-2019 Multiannual Programme Results ; 2020-2022 Multiannual Programme Outline
Implementation of the UN 'Education for Sustainable Development'	Germany	EE, Green skills	National/regional policy level	The German national action plan on the implementation of the UN 'Education for Sustainable Development' programme encompasses various areas of education, not only

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programme at the national level by the German UNESCO Commission (Sections for VET)				<p>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: VET Sections of the Implementation Strategy</p>
Educational Projects of the German Federal Environmental Foundation	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: Project databank; Foundation's website</p>
'Environment Creates Perspectives' of the Federal Ministry of environment	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: Symbi: Good practice guide and benchmarking guidelines on ecosystems of by product and energy exchanges, p. 62</p>
'Education for resource conservation and resource efficiency' programme	Germany	EE, Green skills	VET level	<p>The BilRess (<i>Bildung für Ressourcenschonung und Ressourceneffizienz</i> or <i>Education for resource conservation and resource efficiency</i> programme) 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</p>

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				<p>a contribution to the German National Resource Efficiency Programme (ProRess). Bil-Ress 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 Careers in the Chemical Industry	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 sustainability 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</p>

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				<p>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 Parks (EIP)	Germany	IS, EE	Company level	<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 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>

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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 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>

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				<p>References: Symbi: Good practice guide and benchmarking guidelines on ecosystems of by product and energy exchanges, pp. 42-46.</p>
Training Academy and Analytical Services of the Chemical industrial Park Knapsack	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: Symbi: Good practice guide and benchmarking guidelines on ecosystems of byproduct and energy exchanges, pp. 104-108.; Example of Reliability and Maintenance Training Schedule</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: Digital version of the Strategy</p>
SUPREME Project: Twinning for a Sustainable, Proactive Research partnership in distributed Energy systems planning, Modelling and management	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 Szewalski 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: SUPREME's Webpage in CORDIS</p>
BFKK Training for Trainers in Vocational Education Project of	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</p>

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the Bialystok Foundation of Professional Training				<p>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 databases of the Polish Foundation for Energy Efficiency	Poland	EE	Company level	<p>The Polish Foundation for Energy Efficiency FEWE is an independent non-governmental organization founded in 1990. Its mission is to promote sustainable development of Poland's economy and to support 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</p>

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				<p>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 Recycling	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 Project</p>
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>

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				References: Official Website
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>
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>

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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>
Symbiosi'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 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>

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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 organization 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 Commerce of Aragón and the Coalition of Companies for the Planet (COE-PLAN).	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 sessions (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>
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,	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</p>

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	Spain, Sweden, and Slovenia)			<p>to external customers for the implementation of innovative, sustainable business and co-operation 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 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>

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Pentapolis Awareness Raising Programme	Onlus'	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 Lavoro e il Clima		Italy – Emilia-Romagna Region	IS, EE, Green skills	Regional policy level	<p>Emilia-Romagna Regional Government is currently working on a participated process to define the 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 organizations.</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: Official website - news</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>

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				References: <u>Official Emilia-Romagna website</u>
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 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 organizational and productive processes.</p>

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				<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><i>Official ITS TEC website</i></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> <ul style="list-style-type: none"> - CIRCULAR ECONOMY AND SUSTAINABLE MANAGEMENT OF RESOURCES - GROWTH, SKILLS AND GOVERNANCE FOR SUSTAINABLE DEVELOPMENT - SOCIAL INNOVATION, INCLUSIVE, RESILIENT AND SUSTAINABLE CITIES <p>References: <u><i>Regional call website</i></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</p>

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				<p>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><i>Official website</i></u></p>
Industrial Symbiosis: Guide for data collection	Africa: Burkina Faso, Ghana, Kenya, Mauritius, South Africa, Uganda	Industrial symbiosis	Company level	Preparing for readiness of industrial symbiosis. Worked on a three phase principle - Map processes; quantify resources; prioritise opportunities (more to come)
Waste Smart	England, Northern Ireland	Waste management	VET level	Waste management processes (more to come)
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 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/</p>

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				https://www.anqep.gov.pt/np4/home.html
Portuguese National Energy Efficiency Plan 2017-2020 (PNAEE)	Portugal	EE	National policy level	PNAEE is the National Plan designed and developed by the Portuguese government to fulfil the requirements derived from the European Energy Efficiency Directive. https://www.pnaee.pt/
Training programmes of Portuguese Agency for Energy (ADENE)	Portugal	EE	VET level	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. Some trainings provided: Energy Efficiency in Industry Qualified Expert on Certification Building Energetics https://www.adene.pt/
ISQ	Portugal	EE	Company level	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, photovoltaic, 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. 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. https://academy.isq.pt/

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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 organization, 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 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 Govern-</p>

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				<p>ment, 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/Ecolnova-cao/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>
Eurosteelmaster	Italy	EE and IS	European/VET level/Company level	<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 experts, 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>

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				Eurosteelmater is organized with the support of ESTEP, EUROFER, European Commission, Federacciai
European Junior Water Programme	Europe		European/VET level/company level	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. https://juniorwaterprogramme.eu/
Water Europe	Europe		European level	Technology platform for the water sector which aims to enhance research and innovation, collaboration, exchange best practices in the European water sector. 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, Universita Politecnica delle Marche, NTNU, LIST institute in Luxembourg...) https://watereurope.eu/
Isle Utilities	Europe/Italy		Company level	Consultancy providing training courses on water-related challenges including water re-used and energy efficiency in the sector. https://www.isleutilities.com/
KIWA	Worldwide		Company level	KIWA offers trainings also about energy and water efficiency https://www.kiwa.com/en/services/training/what-can-kiwa-educate-me-in/
France Water Team	France/Europe		company level	French water cluster, created by the national government, in order to develop synergies, enhance research and innovation in the water sector (including industrial symbiosis) https://france-water-team.com/
International office for Water	Europe/World-wide		VET/company level	International Platform which provides trainings on the optimisation of wastewater and energy https://www.oieau.fr/formation/spip.php?page=theme&id_article=92&id_rubrique=9
Water Opleidingen	Netherlands		national level/ VET	Education provider on water-related topics in the Netherlands https://www.wateropleidingen.nl/

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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-training/