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

Piloting and Implementing the Blueprint

Deliverable D6.2

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Abbrevia-tion	Meaning
AI	Artificial Intelligence
ART-ER	Attractiveness Research Territory Emilia-Romagna
CEDEFOP	European Centre for the Development of Vocational Training
CEFIC	European Chemical Industry Council
CEPI	Confederation of European Paper Industries
CO2	Carbon dioxide
CoVEs	Centres of Vocational Excellence
CSP	Corporate social responsibility
ECEG	European Chemical Employers Group
ECoP	European Community of Practice
EcoSD	Eco-conception de Systèmes pour un Développement durable
ECTS	European Credit Transfer System
EE	Energy Efficiency
EFRE	European Regional Development Fund
EII	Energy-intensive industries
EQAVET	European Quality Assurance in Vocational Education and Training
ESCO	European Skills, Competences, Qualifications and Occupations
ESF+	European Social Fund Plus
ESSA	European Steel Skills Agenda
ESTEP	European Steel Technology Platform
EU	European Union
FG People	Focus Group People
FP6	6th Framework Programme for Research and Technologyical Development
FP7	7th Framework Programme for Research and Technologyical Development
H2020	Horizon 2020
H4C	Hubs4Circularity
IEOOC	Industrial Ecology Open Online Course
IS	Industrial Symbiosis
ISCO	International Standard Classification of Occupations
I-US	Industrial-urban symbiosis

KPIs	Key Performance Indicators
LMS	Learning management system
LSP EII	Large-scale skills partnership for energy-intensive industries
NGOs	Non-governmental organisation
PWG	Permanent Working Group
RFCS	Research Fund for Coal and Steel
SET Plan	Strategic Energy Technology Plan
SMEs	Small and medium-sized enterprises
SRIA	Strategic Research and Innovation Agenda
SRL	Societal Readiness Levels
SWOT Analysis	Strenghts Weaknesses Opportunities Threats Analysis
VET	Vocational education and training

1. Introduction

In addition to the Implementation Plan of the Blueprint (Schröder et al. 2022, SPIRE-SAIS Deliverable D6.1) this deliverable focuses on testing the Blueprint framework, results, tools and measures developed so far, including alliances and governance structures, the connectivity at the European level, and the sectoral-national-regional rollout as a basis for the exploitation plan (Deliverable D6.3). Piloting implementation and testing started already within a *social innovation process by the industry and for the industry* integrating all the relevant and willing stakeholders on the European, national and regional level right from the beginning in the proposal phase. Beside the European governance structure of SPIRE-SAIS, the implementation of the European Technology and Skills Foresight Observatory including the development and running of an online training platform (SKILLS4Planet) is outlined. Additionally, the sectoral-national-regional rollout and the initiation and further development of sectoral-national-regional Training Ecosystems are described. Finally, an implementation roadmap gives an outlook of the further development of the Blueprint, alliance and strategy.

2. Conceptional Background

Economic, digital and technological developments, as well as increasing energy and resource efficiency and environmental requirements (e.g. decarbonisation and reduction of emissions and waste), present European and global energy-intensive industries with numerous challenges. These include the continuous updating of training and qualification profiles, knowledge and skills of the workforce. Against the background of multi-faced, cumulative and constantly changing economic challenges and technological development, human resources policy could only be successful by integrating all the concerned and relevant actors and stakeholders. Therefore, the Blueprint strategy for human capital development through the **SPIRE-SAIS Cross-Sector Skills Alliance on Energy Intensive Industries (EII) (including related process industry** sectors) was developed and run as a **social innovation process**. This process started with the challenge of adjusting skills supply in time, answering the constant change of skill demand with the intervention of setting up a Skills Alliance and developing a Blueprint, to be implemented and tested, and finally institutionalised (see chapter 5.1). One important element of the intervention is involving a broad range of key stakeholders from the concerned sectors: such as companies, associations and social partners, education and research institutions, policy and civil society organizations.

The SPIRE-SAIS Blueprint is based on two principal objectives supported by an underpinning strategy framework:

1. Proactive identification of skill needs and demands for building appropriate training and curricula, including new vocational education content and pedagogies across the sectors (thus enabling mutual recognition of skills and training), within both, companies and education and training institutions.
2. Identification, development and promotion of successful sectoral recruitment and upskilling schemes, including a training framework for efficient management of knowledge towards high skilled workers, and tackling recruitment difficulties (e.g. industry attractiveness) for widening the talent pool and establishing a more diverse workforce.

These two objectives are reinforced by the following procedures:

1. Establishing a database of industry occupations, job roles and skill requirements for facilitating recruitment, job-seeking, skills and training provision at the local, member-state and EU sector level, and skill needs analysis.
2. Securing political support measures through the Skills Alliance for mobilising and integrating (sector) stakeholders and policy makers at the EU, member-state and regional levels.
3. Developing Key Performance Indicators (KPIs), within the remit of an established Skills Alliance, for monitoring success continuously in respect of objectives (1) and (2), as well as the proactive adjustment of SPIRE-SAIS for addressing emerging challenges, including monitoring issues.

In order to reach these objectives, the work programme of SPIRE-SAIS (see Figure 1) is based on the analysis of the technological and economic developments and related current and future skills demands in the involved industry sectors. Against this backdrop, a reliable and up-to-date setting is guaranteed for the following work packages on industry skills requirements and VET system contexts and support. These three building blocks are feeding into the Blueprint development which has to be transferred and implemented. On the background of the results of all the building blocks (mainly the blueprint and its implementation) also policy recommendations and dissemination activities are planned and conducted. Within a social innovation process including two iteration cycles the Blueprint *Prototype* was implemented and tested in 2022, 2023, and 2024 involving all the represented stakeholders of the partnership and beyond. Based on the practical insights of the Prototype testing, the underlying subject areas (technological development, skills requirements, and VET system support) were updated with new developments, all in all leading to an improved concluding Blueprint.
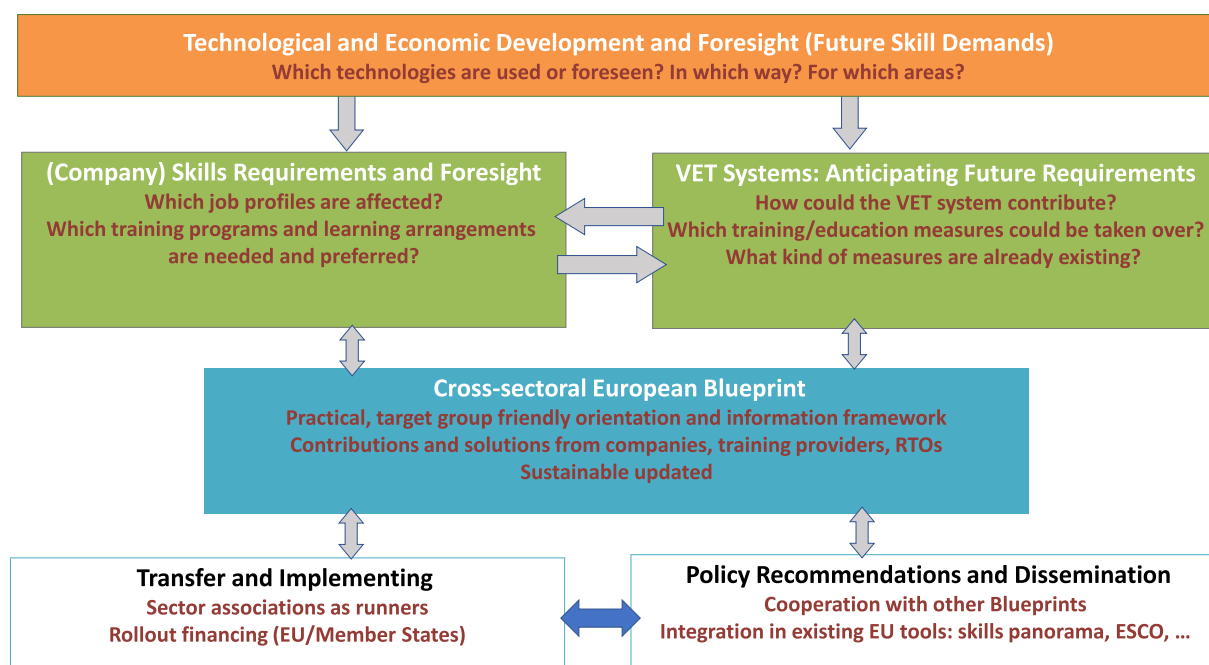
Figure 1: Structure and Work Programme of SPIRE-SAIS

Against this backdrop, the main elements of the Blueprint identified are shown in the following Figure 2. Based on new technological, economic, and societal developments and demands recent and future skills requirements are detected. The related skills needs are classified in

line with affected job profiles and cross-checked with the given support of the vocational education and training (VET) systems in place. Strategies and measures so far are mainly characterised by a Foresight Observatory and a Skills Intelligence Hub with an online training platform (SKILLS4Planet). Alliances and leadership and the implementation and rollout of the Blueprint are central elements for ensuring the sustainability.
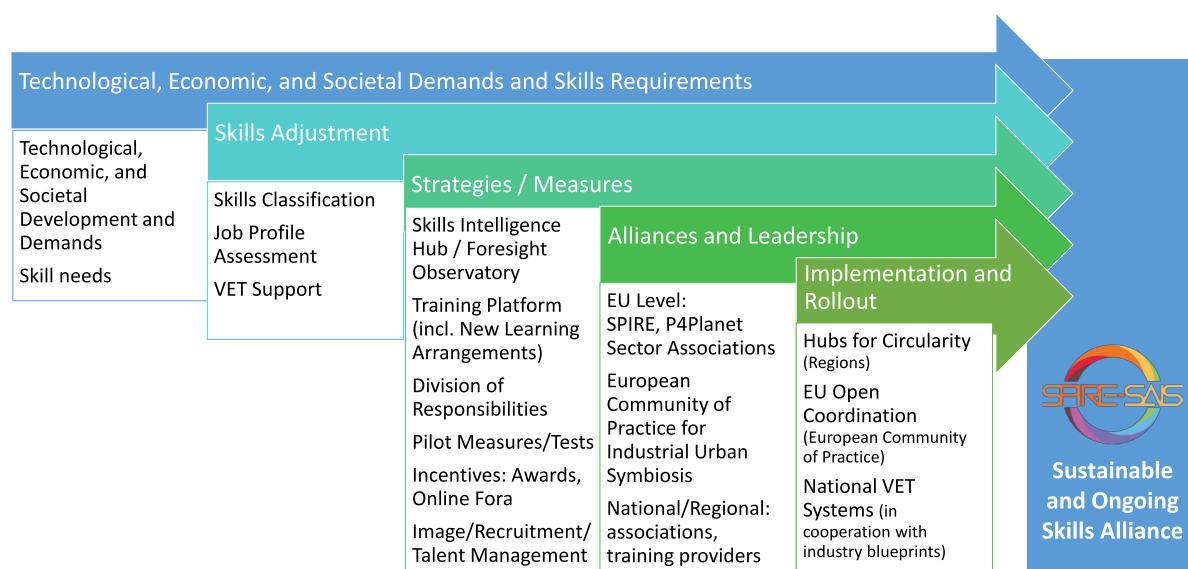
Figure 2: SPIRE-SAIS Blueprint Framework (Schröder et al. 2021, p. 13)

Additionally, the implementation of the Blueprint was monitored annually (see Deliverables D8.2) against the background of surveys, SWOT Analyses, and Project Performance Indicators as described in the Monitoring Strategy and Evaluation Plan (Deliverable D8.1). Especially the chosen 13 Key Performance Indicators (see Table below) are measured to ensure not only the quality but also the sustainability of the Blueprint implementation.

KPI	KPI identification
1	Number of new and updated job profiles that are relevant for the SPIRE sectors
2	Number of professional profiles included in the Database of professional profiles
3	Percentage of stakeholders claiming that they are familiar with the existence of the cross-sectoral skills matrix created in the SPIRE-SAIS project.
4	Percentage of stakeholders claiming that they are planning to use/endorse cross-sectoral skills matrix in their organisation.
5	Percentage of partners and stakeholders in the eight sectors who agree that the SPIRE-SAIS project is likely to contribute significantly to solving the key skills challenges of Industrial Symbiosis in the EU
6	Percentage of partners and stakeholders in the eight sectors claiming that their organisation is planning to endorse the Skills Alliance for Industrial Symbiosis (or its updated versions) for at least five years in the future
7	Level of adequateness of the developed strategies, training tools and methods to implement the Blueprint
8	Percentage of industry stakeholders claiming that they have used the Blueprint in their activities during the last year at least once (e.g. training programs modified following Blueprint guidelines, talent management strategies that integrate the Blueprint)
9	Percentage of industry stakeholders claiming that they are planning to use the Blueprint in their activities in the near future
10	Percentage of "National institutions relevant for VET system roll-out" which have expressed their interest in considering the Blueprint in their activities in the near future
11	Representativeness of each type of stakeholder in the project's final event (political, industrial, research and academia)
12	Adequacy of the policy recommendations to the existing VET systems in Europe
13	Number of Member States reached

Table 1: Key Performance Indicators (KPIs)

3. Blueprint Development (Skills Alliance and Strategy)

Against the conceptional background described above, a Blueprint Prototype (see Schröder et al. 2021, SPIRE-SAIS Deliverable D5.2) was developed. Beyond piloting and implementing this prototype, leadership and alliances (project partnership, cooperation with external organisations and programs), an integrative governance structure, including related strategies and measures, and the ecosystem approach of linking European-sectoral-national-regional cooperation are central elements of the Blueprint leading to a permanently running and coordinated skills alliance.

3.1 Industry Driven Alliance of the Industry for the Industry

In line with the European New Skills Agenda, the Pact for Skills and the Sectoral Blueprint Program of ERASMUS+, the Blueprint "European Energy Intensive Industry Skills Agenda and Strategy (SPIRE-SAIS)" is aiming at an ongoing and short-time implementation of new skills demands and training concerning *cross-sectoral* Industrial Symbiosis (IS) and Energy Efficiency. Against this backdrop, the start of the SPIRE-SAIS Blueprint was performed already in its proposal phase as a *sectors overarching Skills Alliance of Energy Intensive Industries (social) innovation process* - involving a broad range of key stakeholders from the now ten sectors of the public-private partnership A.SPIRE (Sustainable Process Industry through Resource

and Energy Efficiency): Steel, Chemicals, Minerals, Non-ferrous Metals (Aluminium), Water, Engineering, Ceramics, and Cement. During the course of the project two new sectors joined A.SPIRE: Refinery and Pulp & Paper. This alliance of related sector associations, social partners, technology platforms, companies, training providers, and research partners is characterised by a huge amount of competence based on a long list of projects for Energy Efficiency and Industrial Symbiosis, comprising also Vocational Education and Training (VET) they are engaged in. So far, 13 associated partners have joined the 24 partners of the consortium, demonstrating the strong interest of the industries and laying the foundation for addressing the global demands and challenges of the industrial sectors. A particular focus is on people and competences needed for the implementation and improvement of Industrial Symbiosis and Energy Efficiency.
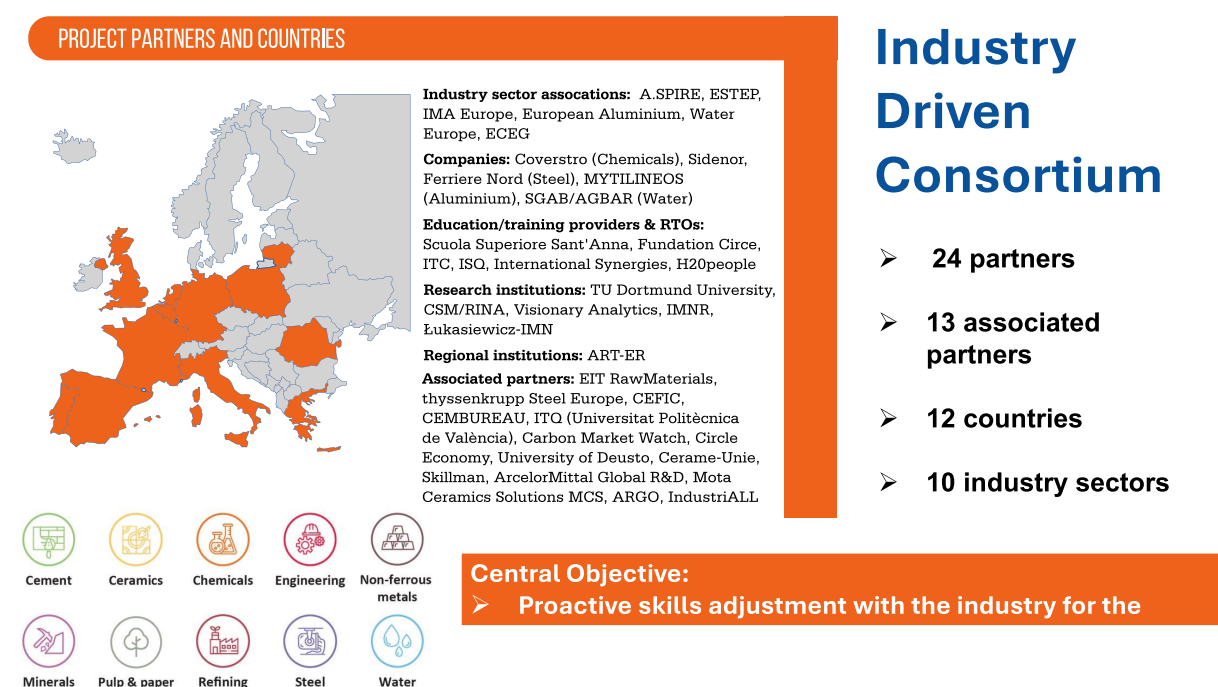
Figure 3: SPIRE-SAIS: An Energy Intensive Industry Driven Partnership

The basis for the sustainable alliances and leadership of SPIRE-SAIS is the project partnership built on and supported by existing coordination, projects and activities of the **European Association** A.SPIRE which is committed to managing and implementing the **Processes4Planet co-programmed Partnership**. A strong integration is therefore given in the A.SPIRE Community, its Processes for Planet program (P4Planet) and activities. Also, the participation of the European Sector Associations as central communication and dissemination intersections reinforced by their participation in the Steering Committee Sector Representatives is giving the ground for the sustainability of the Skills Alliance beyond the project duration.

SPIRE-SAIS is an ongoing topic of the sector associations on the European level: e.g. via the P4Planet (Permanent Working Group Societal Innovation), the European Steel Technology Platform ESTEP (Focus Group People), and the regular meetings of the involved sector associations (Industrial Minerals Association Europe (IMA), European Aluminium, European Chemical Employers Group (ECEG), EIT RawMaterials, Water Europe, Cerame-Unie, and CEMBUREAU The European Cement Association). Beside the employers' associations the European union industriALL is an important partner ensuring the workforce perspective and transfer to the different trade unions of the sectors and member states.

SPIRE-SAIS is an alliance with *divided responsibilities and leadership*, not only represented by the work packages leaders and consortium partners related to them. Furthermore, the Blueprint is linked to existing and forthcoming European governance structures of the Energy Intensive Industries. To ensure its continuation beyond the project duration and funding period, the SPIRE-SAIS governance structure is aligning its structural elements and activities mainly with:

- The activities of A.SPIRE, P4Planet, its Programming and Advisory Group (APG), especially via the PWG Societal Innovation: Integration of the skills perspective (skills as an enabler) in the Strategic Research Agenda (SRIA) (as important part of and strengthening the relevance of non-technological aspects for technological innovation)
- Integrating the skills perspective in existing (and future) sectoral programs and activities: via the involved Sector Associations (e.g. in the Clean Steel Partnership, European Water Junior Program, European Network on Silica Nepsi) and the EIT RawMaterials
- Establishing a Large Scale Partnership Energy Intensive Industries (LSP EII) under the umbrella and with support of the European Pact for Skills (together with the European Steel Skills Alliance ESSA)
- Further alignment and intensification of cooperation with other European activities and projects (esp. the ECoP H4C, Pact for Skills, BRIDGES 5.0, IS2H4C, CoP Industry 5.0), establishing reliable cooperation nodes.

Via this collaboration, the SPIRE-SAIS Blueprint is gaining European and sectoral-national *political support, funding and connectivity* beyond the project partnership. As SPIRE-SAIS was already based on the A.SPIRE membership and coordination, a strong focus was to align the Blueprint with this umbrella and the P4Planet program, mainly conducted by the PWG Societal Innovation.

3.2 Linking European-sectoral-national Cooperation

In order to establish a sustainable European Skills Alliance for Industrial Symbiosis beyond the project lifespan with a reliable leadership and governance on the European level we systematically linked the European Blueprint with the European, national, and the regional levels as much as possible. Therefore, SPIRE-SAIS is aligned with and is supporting already existing European structures of energy intensive industries. Overall activities and initiatives of the European process industries are linked to our project by participating in regular European activities and events. Via A.SPIRE (the SPIRE-SAIS co-coordinator and the coordination unit of P4Planet under Horizon Europe) and its main coordination activities (e.g. Strategic Research and Innovation Agenda, General Assemblies, Workshops e.g. on Hubs4Circularity) almost all partners are involved in these activities, not least because of their A.SPIRE membership.

On the sectoral level and reaching the member states, the involved sector associations have informed their members in multiple occasions, via their information channels, state of affairs and also (sometimes recurring) webinars. The associations referred to SPIRE-SAIS in presentations: e.g. IMA during an EIT-RawMaterials event addressing the brain drain and the various experiences at company or at sector level that aim to address the needs and obtain a high workforce retain rate in the sector; ESTEP via its FG People, and Cerame-Unie by establishing a Skills Working Group are mirroring continuously the SAIS development. Close cooperation took and takes place with ESTEP and ESSA (the ongoing European Steel Skills Agenda and Alliance), presenting the SAIS Blueprint in the regular meetings and external events. In all the

activities the innovative approach of SPIRE-SAIS was highly appreciated, recognised and valued as an approach to improve awareness for Industrial Symbiosis.

Additionally, presentations or panel participations within the Year of Skills, the Pact for Skills networking events, CEDEFOP Skills Intelligence, Circular Economy Stakeholder Conference, the European Innovation Days, Vocational Skills Week, Citizen Engagement Festival, the cooperation with Circular Economy Initiative (advisory board, discussion papers) and sector specific events (e.g. Steelmaster, steelTECH, Skillman International Forum, ESTEP Annual Event "A Circular Economy Driven by the European Steel", Society and Materials - EcoSD 15th International Conference 2021) show the high engagement of SPIRE-SAIS also outside the inner process industry activities.

As already outlined, the Skills Alliance has a governance structure (see next chapter) that is aligned with main European coordination units, such as:

- **European**: On the one hand via the LSP Energy Intensive Industries and its integration in the European Pact for Skills with its other industry partnerships. On the other hand by continuing the cooperation with A.SPIRE and its outreach to the Sustainable Process Industry through Resource and Energy Efficiency (SPIRE) and its recent activities, namely "Processes for Planet" (P4Planet) (see A.SPIRE, 2021), and its governance structures and working groups (esp. the Permanent Working Groups Societal Innovation and I-US/H4C)
- **Sector/National**: Via the "Steering Committee Sector Representatives" to the European sector associations of all ten sectors involved: Industrial Minerals Association Europe (IMA), European Aluminium, European Chemical Employers Group (ECEG), The European Chemical Industry Council (CEFIC), EIT RawMaterials, Water Europe, Cerame-Unie, CEMBUREAU European Cement Association, ESTEP/EUROFER, European Petroleum Refiners Association Concawe, Confederation of European Paper Industries CEPI
- **Regional**: Via the European Community of Practice for Industrial-Urban Symbiosis (ECoP H4C) with the Regional Hubs for Circularity and Industrial Urban Symbiosis, completed by involved regional associations and platforms (such as ART-ER and our associated partner ARGO). Additionally, via the LSP EII, cooperation with the Regional Pact for Skills ecosystems and the relevant Centres for Vocational Excellence (CoVEs), European Cluster Collaboration Platform and their sector related clusters (steel, ceramics, water and engineering) will be initiated.
- **Multi-sectorial**: Via the LSP EII in the European Pact for Skills to the broader community of different sectors and the other sectoral Blueprints
- **Social Partnership**: Via the sector associations and the union industriALL to the different industry sectors and member states.

These links are reflected in the first rollout activities during the project phase (see chapter 5.4). The main objective is a deep and mutual involvement of SPIRE-SAIS in the European, national and regional sector governance and activities, in two directions: (1) informing the different sectors by SPIRE-SAIS results, tools and activities, and (2) informing SPIRE-SAIS by recent sector activities on Industrial Symbiosis and Energy Efficiency on the European, sectorial, national, and regional level. Within this multi-stakeholder approach, new activities will be initiated and launched, as well as internal integration of skills adjustment within the activities of the associations, unions, companies, and training providers.

3.3 Governance Structure

The implemented and tested Blueprint Prototype (Schröder et al. 2021) encompassed a first SPIRE-SAIS European governance structure which was endorsed during the final stage of the project and became part of the final Blueprint (Deliverable D5.3, Schröder et al. 2024b). The underlying Skills Intelligence approach includes a Foresight Observatory, the online training platform SKILLS4Planet and the foreseen establishment of a European Industrial Symbiosis Training Community as core coordination elements. In more detail the Blueprint governance comprises (Figure 4):

- Technology and skills foresight on a regular basis, e.g. via an (bi)annual conducted survey "Industrial Symbiosis Technology and Skills Radar"
- Technological and economic development and skills needs in related projects listed in a Project Repository, continuously updated and run
- Identification of cross-sectoral job profiles and skills for Industrial Symbiosis and Energy Efficiency
- Training Framework including the different sector perspectives.

Other elements addressed during the implementation phase were:

- Recommendations, self-assessment tools, indicators and incentives pushing the focus on qualifications, competences and skills for Industrial Symbiosis and Energy Efficiency
- Pilot measures and test options for skills adjustments, including looking for (European and national) funding schemes
- The Online Training Platform SKILLS4Planet giving immediate answers to the industry skills demands
- Industry image measures for recruitment and talent attraction focusing on Industrial Symbiosis and Energy Efficiency skills and qualifications
- Leadership defined in an Open Coordination way, dividing responsibilities between the main and willing actors.
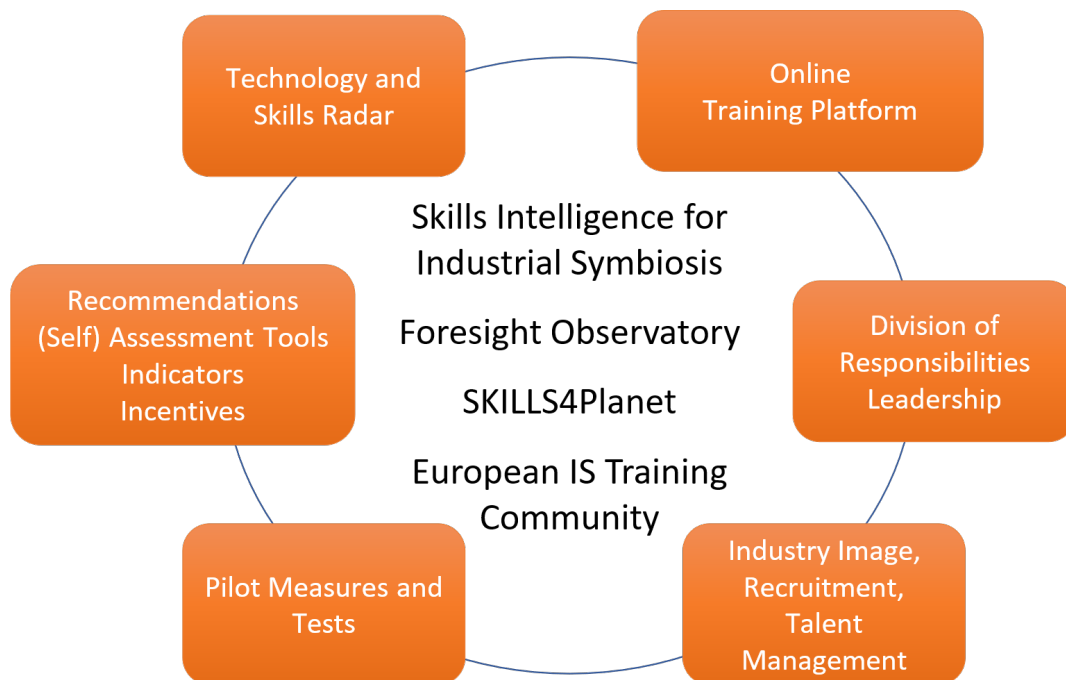
Figure 4: SPIRE-SAIS-Core Governance Elements

The holistic and industry-driven approach is represented on the demand side by a *Technology, Economy, Environment, and Societal Driven Skills Adjustment* as the genuine driver of new applications (implemented with specific company objectives) and collaboration measures, leading to organisation implications. With these governance elements we serve the following topics:

(a) the skills **demand side** by:

- Observing continuously (within a an (bi)annual survey) the *technological and economic demands and its related skills requirements;*
- Ensuring an industry-driven and defined skills adjustment by a generic *skills and central job profiles classification;*
- Aligned to existing *VET system occupations* as much as possible;

(b) the **supply side** by setting-up *strategies and measures* to ensure proactive and sustainable skills adjustments across and in the different industry sectors by:

- Establishing a Foresight Observatory and Survey (Industrial Symbiosis Technology and Skills Radar);
- The sustainable training platform for training offers and appropriate learning arrangements (SKILLS4Planet), including:
- a repository or exchange platform of training courses for Industrial Symbiosis and Energy Efficiency;
- possibilities for pilot measures and tests (by taking advantage of European and national/regional funding opportunities: Horizon Europe, Processes for Planet, Erasmus+, ESF+, EFRE, and others);
- incentives and/or awards for generating good/best practice;
- Initiating and fostering image, recruitment, talent management strategies and campaigns to attract especially more young people and women for the process industry;

(c) the **coordination side by**:

- Sustainably running the Blueprint: *alliances and governance structures* are *aligned with existing Energy Intensive Industries European coordination and sector structures* (A.SPIRE, sector associations, social partnership), assigning leadership for the specific elements of the Blueprint on the European (cross-sectoral and sectoral) and national/regional level (sectoral, Hubs for Circularity).
  This is improving the level of cooperation between associations and social partners, companies, training providers and other stakeholder groups for fostering the perspective of Human Resources as an enabler for technological development, implementation and exploitation (at the workplace).
- For the further implementation and rollout of the Blueprint a close and ongoing cooperation with the European Communities of Practice (ECoP H4C, ECoP Europe) for Industrial Symbiosis and Hubs for Circularity was established, by bringing in our Human Resources and Skills perspective. With this collaboration we are looking for combining the European SPIRE-SAIS activities with the most important Hubs for Circularity on the regional level.
- Additionally, we integrated the Blueprint in relevant activities on the European level (New Skills Agenda, Pact for Skills, Cedefop's Skills Panorama and Skills Intelligence Platform, and others). **The Blueprint activities will find their progress also in the**

Large Scale Partnership Energy Intensive Industries (LSP EII) and common actions with other Pact for Skills Ecosystems and other sectoral industry Blueprints (chemicals, hydrogen, batteries, steel, automotive, construction, and others).

All the listed activities were already implemented, tested and adjusted in the piloting phase 2022 – 2024 leading to first reliable contours and the further running of the Blueprint and Alliance.

4. European Open Coordination

The Blueprint and its implementation and coordination are led by the European Open Method of Coordination[1]. The SPIRE-SAIS Blueprint is a practical, industry-driven orientation framework for raising awareness and supporting skills adjustments in time. This leads to an integration, alignment and cooperation with existing (and future) European industry governance structures.

During the testing phase, already started cooperation have been consolidated, new ones were established as well. As described below in detail, this includes the alignment with existing European industry governance structures, European network, projects, programs, initiatives and tools.

4.1 Alignment of SPIRE-SAIS to European Structures

As the SPIRE-SAIS Blueprint is not a stand-alone solution its strategy is led by a cooperative approach with a division of responsibilities and leadership. Therefore, already during the project phase and in the future running of the Blueprint Alliance, the Foresight Observatory and the foreseen European Community of Training Practice are aligned with and support European activities related to European Energy Intensive Industries (Figure 5), such as:

- Sustainable Process Industry through Resource and Energy Efficiency (represented by A.SPIRE) and its recent activities, explicitly "Processes for Planet" (P4Planet) and its Strategic Research and Innovation Agenda, its governance structures and working groups;
- The European Community of Practice for Industrial-Urban Symbiosis (ECoP H4C) and Industrial Parks and Clusters (ECoP Europe) and their common H4C platform (https://www.h4c-community.eu/); integrating already SPIRE-SAIS results in their knowledge platform;
- Central stakeholder groups (social partners, sector associations and unions, policymakers, education system players, etc.);
- European networks and projects: e.g. the CircLean Network, Circle Economy, IS2H4C, BRIDGES 5.0, CoP Industry 5.0;
- European programs: LSP EII and the European Pact for Skills in general; CEDEFOP Skills Intelligence Platform; European Skills, Competence, and Occupation Database (ESCO), Europass, SET Plan Action 6, and others.

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[1] https://www.europarl.europa.eu/EPRS/EPRS-AaG-542142-Open-Method-of-Coordination-FINAL.pdf
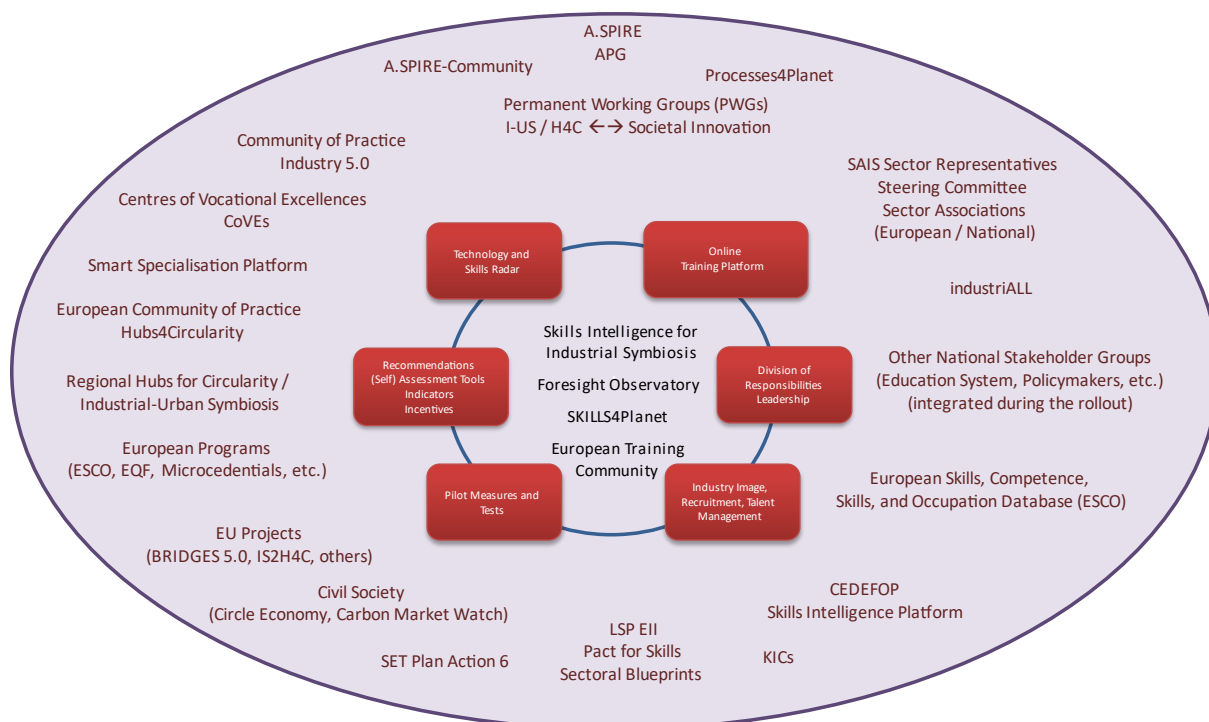
Figure 5: Alignment and Cooperation of SPIRE-SAIS with European Programs, Projects and Activities

Central alignment of the alliance is given since the proposal development by A.SPIRE, the co-coordinator of SPIRE-SAIS. Comprising more than 170 companies, associations, research institutions and NGOs, this association of energy-intensive industries encompasses ten sectors and its main players come from more than 20 EU countries. Within its Advisory and Programming Group and structure of P4Planet, SPIRE-SAIS gave and will give input and get benefit mainly from two Permanent Working Groups (PWG) (Figure 6):

- the PWG Industrial Urban Symbiosis and Hubs for Circularity (I-US/H4Cs);
- the PWG Societal Innovation (skills, jobs, training)

and the Transversal Foresight Team (analysing new technological trends.
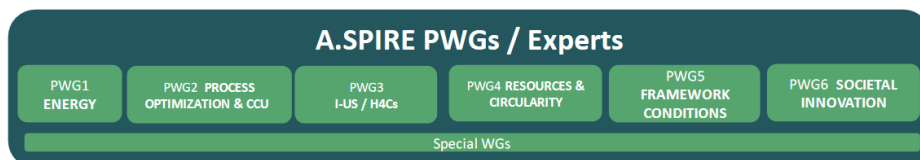
Figure 6: Alignment of SPIRE-SAIS with A.SPIRE

In order to ensure a reliable cross-sector representation, SPIRE-SAIS established a "**Sector Representative Steering Committee**" as a link to A.SPIRE and the different Energy Intensive Industry sectors, IndustriALL Europe (comprising unions of different sectors), EIT RawMaterials, and the civil society perspective (Carbon Market Watch, Circle Economy). On the one hand, this provides and important link combining cross-sectoral with the sector specific necessities and demands, being a mutual exchange and strategic platform for feeding the sectors with SPIRE-SAIS results, measures and tools. On the other hand, this is ensuring feedback and inputs from the sectors to improve the SAIS Blueprint and Training Platform SKILLS4Planet. Via this committee the sectoral-national rollout of SPIRE-SAIS was initiated and coordinated.

Ultimately, the integration, alignment, cooperation of SPIRE-SAIS with European Structures took and will take place at the following levels:

- Cross-sectoral level (European Community of Practice/A.SPIRE; LSP EII under the Pact for Skills)
- Sector level (Industry Sector Associations)
- Member State level (as part of the sectoral rollout)
- Regional level: Hubs for Circularity, Industrial Parks, Centres of Vocational Excellence, Smart Specialisation Regions, and others
- Company level.

4.2 European Networks and Projects

During the test phase of the Blueprint SPIRE-SAIS became not only an approved partner of the European Pact for Skills, a flagship initiative of the European Skills Agenda. Furthermore, in May 2023 as part of the European Year of Skills the **Large Scale Partnership Energy Intensive Industries (LSP EII)** was launched based on the two Blueprints ESSA and SPIRE-SAIS. So far, the more than 40 signatories encompass new members and sectors:

- Steel, Minerals, Water, Engineering, Logistics, Non-Ferrous Metals (Aluminium), Ceramics, RawMaterials, Welding, Chemicals, Cement, Refinery
- 8 companies (also training providers), 12 industry associations, 1 union, 1 industry park,
6 training providers, 13 consultancies and research institutions (most of them are also training providers)

As it is the only multi-sectoral Blueprint, SPIRE-SAIS is not only strongly contributing to the New Skills Agenda and the Pact for Skills, but also to the "Twin transformation: digital and green" of the European Commission. It aims at an integration and further development of ESCO from a green skills perspective of Industrial Symbiosis. Beside the cooperation with other blueprints SPIRE-SAIS is contributing with the integration of human resources (skills) needs in new (e.g. Processes for Planet, SET Plan Action 6, Clean Steel Partnership) and already existing programmes (such as Vocational Excellence, Smart Specialisation).

During the implementation and test phase SPIRE-SAIS partners were involved in the update of the Strategic Research Agendas of Processes for Planet and the Clean Steel Partnership, leading to a stronger integration of human-centricity (Industry 5.0) and the skills adjustment. As stressed in the cooperation plan, SPIRE-SAIS cooperates closely with other process industry related blueprints (esp. automotive, steel, advanced manufacturing, batteries, hydrogen). As steel is one of the SPIRE sectors, we collaborate especially with the European Steel Skills Alliance (ESSA) and the Clean Steel Partnership (CSP) of ESTEP, where skills are part of the building block "Enablers". Additionally, SPIRE-SAIS is reported in the annual sector association meetings, collaborating also with specific sector programs on skills (e.g. in the water sector with the European Junior Water Program, explicitly made to attract talented young people.

Not to forget, SPIRE-SAIS is based on the analysis of up to now 280 Energy Efficiency and Industrial Symbiosis related EU (past and ongoing) funded projects (see Branca et al., 2024, Deliverable D2.1). A repository is published at the SKILLS4Planet platform, continuously being updated.

The Blueprint is connected closely via associated partnership and taking advantage of Energy Efficiency and Industrial Symbiosis skills related networks (like CircLean, SUSTAIN and the Circular Jobs Initiative of Circle Economy) and projects (like the INSIGHT project). CircLean is inspiring our networking activities with its training program and INSIGHT results were used for establishing the profile/occupation of the Industrial Symbiosis Facilitator as part of our training platform and framework.

During our follow-up activities we will reach out to further relevant networks and projects to increase our networking and rollout activities: esp. within the LSP EII and Regional Pacts for Skills as well as with specific Centres of Vocational Excellence (see Schröder et al. 2024a, Deliverable D6.3, chapter 5) including energy intensive industries.

4.3 European Programs, Initiatives and Tools

European skills related programs are of utmost importance for SAIS, esp. the European Pact for Skills, CEDEFOP Skills Intelligence Platform, and the European Skills, Competence, and Occupation Database (ESCO). The SPIRE-SAIS training platform SKILLS4Planet is linked to EU instruments and tools related to skills and occupations such as ESCO, the European Qualification Framework EQF, European Credit Frameworks (ECTS) and the European Quality Assurance EQAVET as much as possible. **We refer to the learning outcomes approach and micro-credentials** to align our industry driven job profiles and tasks with existing and new occupations and to promote mobility of workers within the European territory. Quality assurance principles as well as instruments and indicators of EQAVET are considered in the evaluation framework setting of the SPIRE-SAIS Blueprint, thus promoting the alignment of the SPIRE-SAIS evaluation strategy with EQAVET practices (as part of Deliverable 8.1, chapter 7). A database of job profiles and occupations (see Almeida et al. 2024, SPIRE-SAIS Deliverable D5.1) related to Industrial Symbiosis and Energy Efficiency is aligned as much as possible with European and national VET structures (Deliverable D4.2/D4.3), using available classifications from ISCO/ESCO to define and inform understandings of job roles and skill content. Meetings with ESCO representatives took place in the implementation and testing phase in 2023, based on the outlines of the job profiles and occupations and their alignment with the ESCO database.

First inputs were made to the Strategic Energy Technology (SET) Plan, recognising within its Action 6 non-technological issues (incl. skills) as important part for a successful innovation policy and considering to set-up a task force for this topic. Horizon Europe proposals for Processes for Planet, Clean Steel Partnership and Horizon Europe Clusters 4, 5, 6 were inspired and informed by SPIRE-SAIS partners and results continuously, ensuring the social and skills perspective and their integration in the calls; e.g. in Horizon Europe Calls Cluster 4 2023/2024 TWIN-TRANSITION 01-32/33/34/41/42 and Cluster 5 2023 D2-01-07 concerning climate neutral, circular and digitised production via an energy efficient and climate neutral as well as circular and zero pollution process industries.

Not at least the uptake of the Industry 5.0 concept of the European Commission in its integration in the update of the <u>Strategic Research and Innovation Agenda of P4Planet</u>, emphasising the central relevance of human centricity beside sustainability and resilience, was pushed by and done in the merit of SPIRE-SAIS (partners).

5. Strategies and Measures

The main strategy was and is to run a growing alliance for a proactive adjustment of skills demands within a *Social Innovation Process*. It aims at integrating the main stakeholders of Energy Intensive Industries, considering impact and sustainability right from the beginning (starting already in the project proposal phase, continuing during the project duration and beyond). Along with the sector overarching approach, a commonly accepted and supported alliance and its measures were implemented, consolidated and institutionalised during the implementation and testing phase.

5.1 Alliance and Strategy Building as a Social Innovation Process

The comprehensive project partnership (see chapter 3.1) stresses the *industry-driven* Blueprint developed *by the industry for the industry*. The social innovation process started with (1) the *challenge* of new skills demands and a short-term training needs answered by (2) setting-up the cross-sectoral Blueprint (*idea*). With the involved stakeholders (3) new solutions (*inventions/interventions*) were developed to be (4) implemented and tested, finally (5) achieving impact and being institutionalised (*institutionalisation/impact*) (Figure 7).

In order to reach these objectives, a common ground of the partnership for "intercultural" exchange between the different industry sectors and the different qualification levels (blue and white collar workers, and green skills as overarching issue) within a common social innovation process of co-creation and mutual learning was initiated and conducted, creating the ground for an ongoing alliance and its activities (finally institutionalised within A.SPIRE/P4P and the LSP EII).
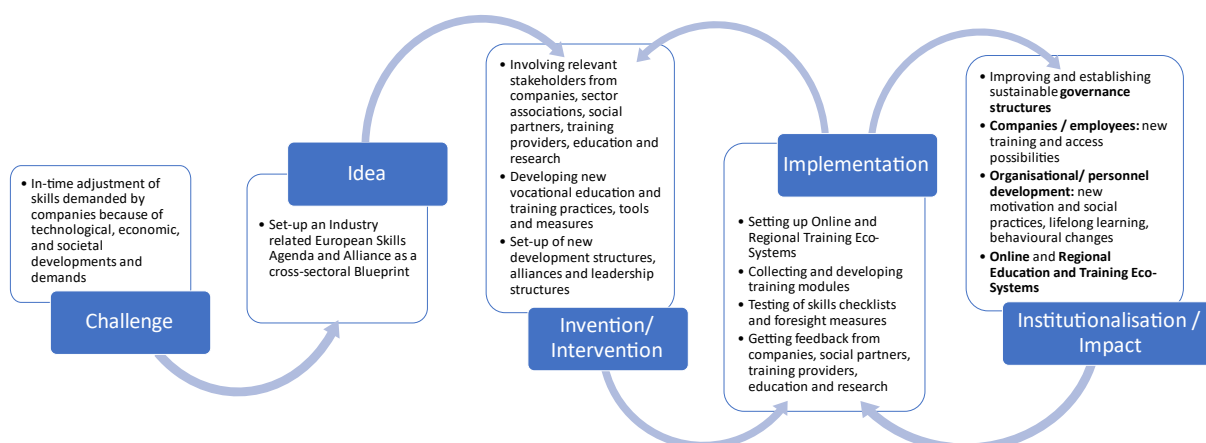
Figure 7: Alliance and Strategy Building as a Social Innovation Process

Concerning the results of the testing phase it has to be mentioned that due to unforeseeable circumstances (pandemic, energy crises) and the (dependent) lower priority of skills the degree of engagement esp. of the industry partners varied. Also, the loss of partners and the integration of new partners (esp. because of missing competences for a more advanced online training platform) led to some feedback loops, calibrating some strategies, measures and tools. Nevertheless, this was done in a common mood, constructively looking for the best solutions and without considerable impact on reaching the project objectives.

5.2 Cross-sectoral Generic Job Profiles and Skills Classification

A central starting point for the intervention and related measures was the development of **cross-sectoral generic job profiles** and a related **skills classification** for Industrial Symbiosis and Energy Efficiency (see Figures below to get an overview, and Deliverable D3.2 (Sidenor 2024 for details).
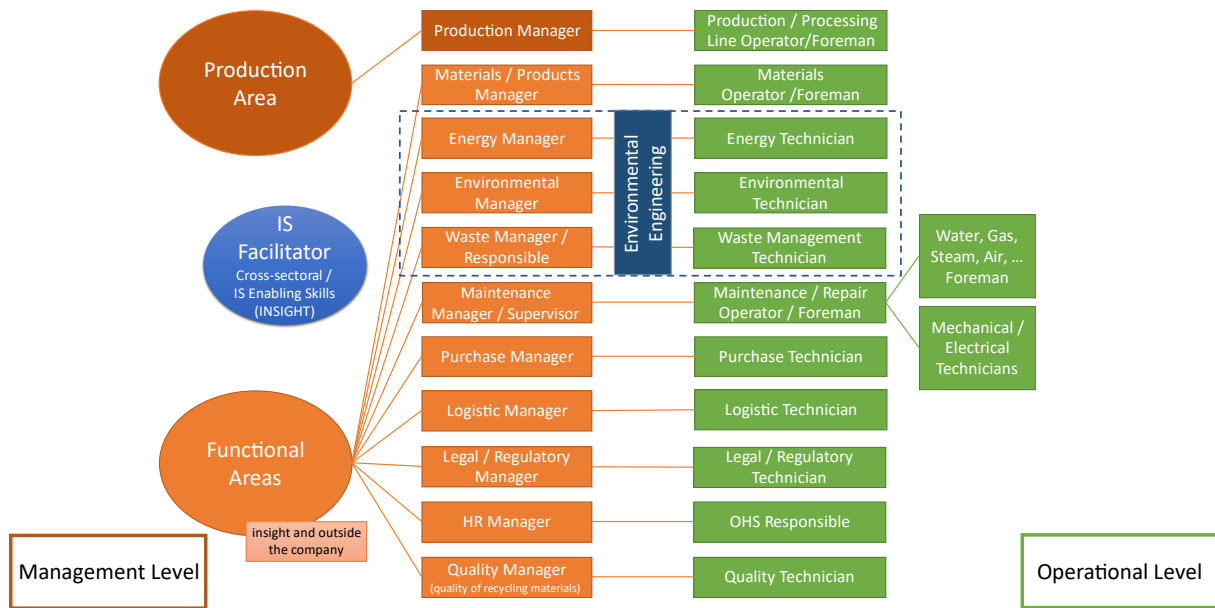
Figure 8: Generic Job Profiles Affected by Industrial Symbiosis and Energy Efficiency Skills
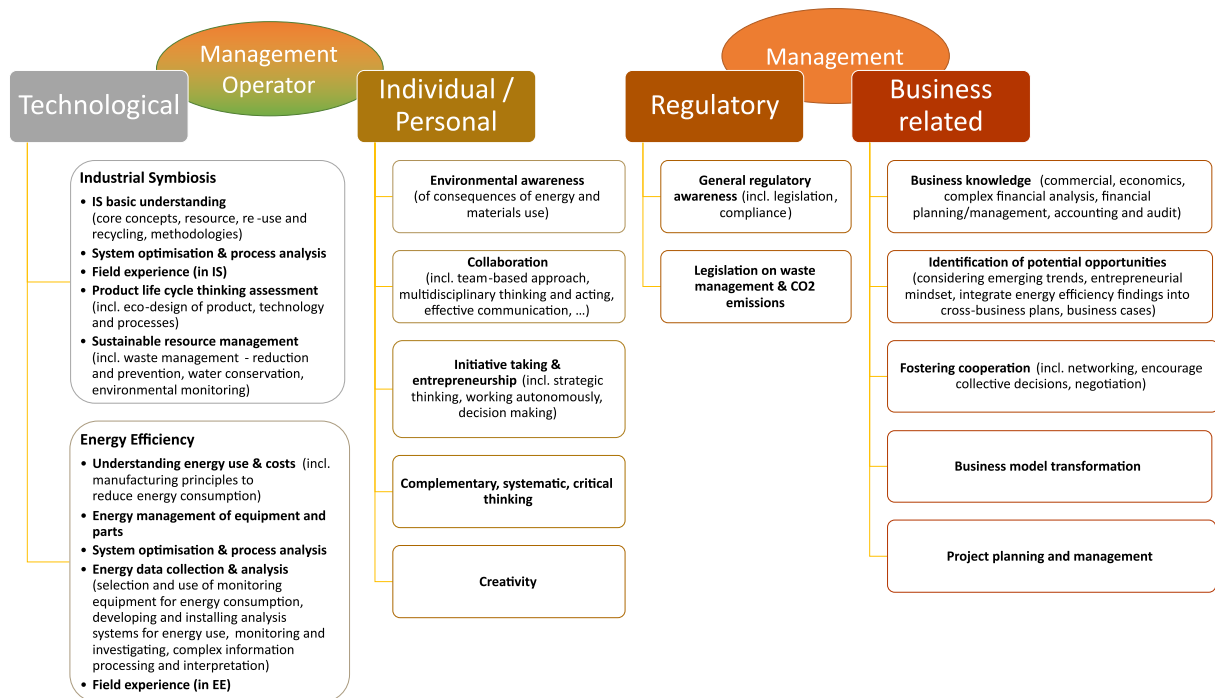
Figure 9: Classification of Skills for Industrial Symbiosis and Energy Efficiency

Beside the production area, job profiles related to Industrial Symbiosis are mainly placed in the functional areas of the companies. Management and related operational profiles are affected together. Additionally, we integrated the company external Industrial Symbiosis Facilitator of the INSIGHT project.

Technological and individual or personal skills are relevant for the management and operational level. Technological skills are differentiated by the technologies (Industrial Symbiosis and Energy Efficiency) and comprise basic understanding, system optimisation and process analysis, field experience and others. The individual and personal soft skills are about awareness, collaboration, initiative taking, systematic and critical thinking as well as creativity. Man-

agement skills are related to regulation and legislation but also business skills (fostering cooperation, business model transformation, project management). A detailed description can be found in the annex.

It was a not an easy task to establish and agree with overarching generic job profiles and a skills classification across the different industry sectors having their specific differences (e.g. ceramics is dominated by SMEs, steel by big international companies). However, the identified cross-sectoral skills classification and the related job profiles were accepted and not objected during the test phase. They became the central framework, structure, and content for the training framework and the online training platform SKILLS4Planet.

5.3 Training Framework and Online Training Platform (SKILLS4Planet)

5.3.1   Training Framework

According to defined job profiles and skills categories, a first Training Framework was outlined (see Almeida et al. 2024, SPIRE-SAIS Deliverable D5.1 and Figure 10). Based on a generic training module for Industrial Symbiosis developed by the CircLean network further elements of the framework are:

  (a) thematic in-depth and advanced courses to deepen the knowledge and competences about specific topics such as hydrogen usages and financial assessment,
  (b) sector specific courses ensuring the link to workplace related demands and specifications of the different industry sectors, and
  (c) job profile and functions related courses for production and functional areas. The latter contains also the Industrial Symbiosis Facilitator training developed by the INSIGHT project.

Generic Industrial Symbiosis training

Thematic	**Sector specific**	**Job related**
Specific to certain job roles. Not sector specific. Example - financial assessment of opportunities	Related to the industry Cement, ceramics, aluminum, chemicals, minerals, steel, water, etc. Specific to processes carried out within that industry	Generic processes that cut across job roles and industry sectors Example - Waste segregation
Very little training exists with regards to Industrial Symbiosis	Training likely to be in house and specific to role	Many trainings exist, but unlikely to specifically mention Industrial Symbiosis Themes likely to be sector cross cutting

Figure 10: Training Framework

This training framework was accepted as a ground for the development of the online training platform SKILLS4Planet and the European Industrial Symbiosis Training Community. During the implementation and test phase not every planned training element could be realised (e.g.

financial assessment) but others were added (e.g. hydrogen usage). However, generic and sector specific trainings were selected, developed and integrated in the SKILLS4Planet online training platform, related to the identified job profiles and skills.

Against this backdrop the online training platform SKILLS4Planet was created, integrating the framework and other elements (such as skills assessment and the VET matrix) in a comprehensive and open infrastructure (see in detail Deliverable D5.1).

5.3.2 Online Training Platform SKILLS4Planet

Instead of the former planned simple exchange platform for training and a separate skills assessment tool the comprehensive online platform SKILLS4Planet was established in cooperation and linked with the ESSA training platform steelHub: not only to deliver and exchange training (modules) but to facilitate communication and collaborative partnership between the all the stakeholders of the training ecosystem. SKILLS4Planet is an open system, integrating all the interested stakeholders: training providers, companies, associations, VET system players, research centres, equipment and service providers.
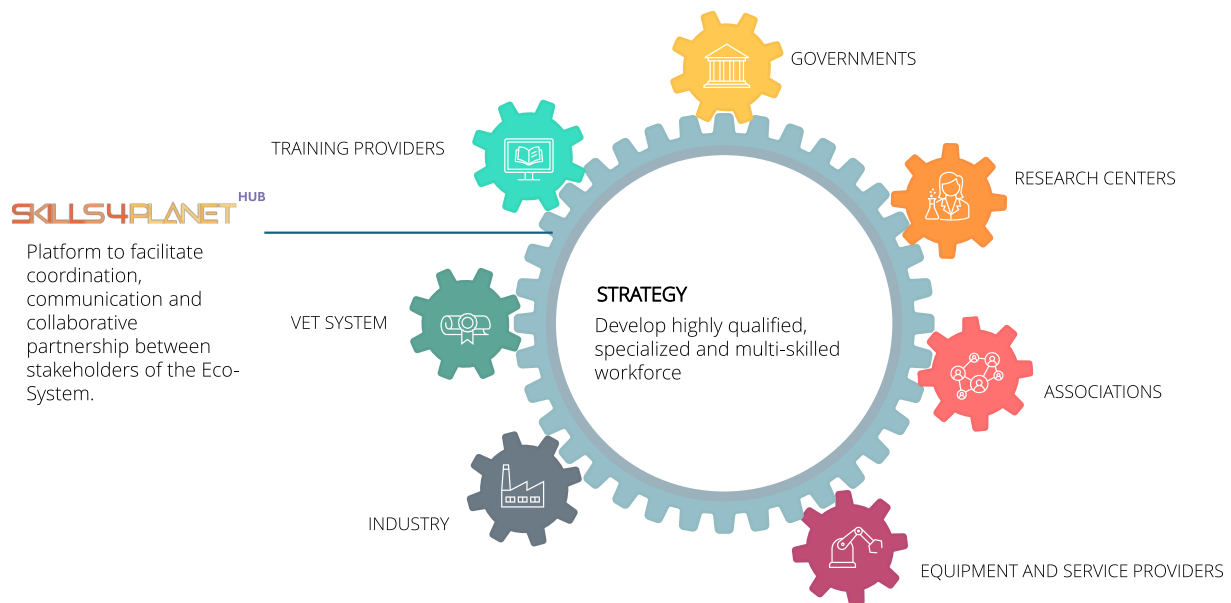
Figure 11: SKILLS4Planet Ecosystem

The main elements of SKILLS4Planet (see Figure 12) are closely linked with each other: The Skills Directory giving an overview of relevant skills, the Capability Assessor for an *individual* assessment of the current and needed skills level, the Learning Solutions provided for the identified skills gaps and (under construction) micro-credentials for the recognition of acquired skills and qualifications.

Skill Directory

Skill and knowledge directory that represent the current and future training needs of the Energy Intensive Industries. Potential Integration with ESCO

Capability Assessor

Solutions to deliver capability assessments to organization and individuals to design customized development path.

Learning solution Directory

Collection of learning solutions provided by experts and organizations into skills4planet.

Qualifications Directory

Qualifications curated with skill directory to enables detailed analysis of current skill sets versus industry requirements and support learners in finding relevant training programs.

Micro-Credentials

Enables learners to acquire, store, and share their credentials across platforms, enhancing their employability and professional development in a rapidly changing job market. Potential Integration with Europass

SKILLS4PLANET HUB

Delivery
Technology infrastructure that facilitate communication and partnership between stakeholders of the Online Training Ecosystem.

Figure 12: SKILLS4Planet Infrastructure (Central Elements)

SKILLS4Planet takes advantage of all new (digital) learning arrangements such as simulations, 3D animation, E-learning, virtual and augmented reality offering a lively and interactive learning experience.

Based on the existing business model of the steelHub to SKILLS4Planet is an open system for any relevant training publisher and learner/user. It is a partnership with stakeholders of the talent development ecosystem to develop a collaborative, flexible and affordable learning solutions directory in the framework of a marketplace business model to upskilling/reskilling workforce and attract new talents to enable the digital and green transformation of the industries. The developed learning solution directory is open for training offers from all the ecosystem partners and is ensuring the technical infrastructure and accessibility for any kind of users: For individual learners and small organisations via the SKILLS4Planet surface and connection; for universities, medium and large organisations as well as for small and medium enterprises there is the possibility to integrate SKILLS4Planet training modules in their own Learning Management Systems (LMS) (see in detail Figure 13).
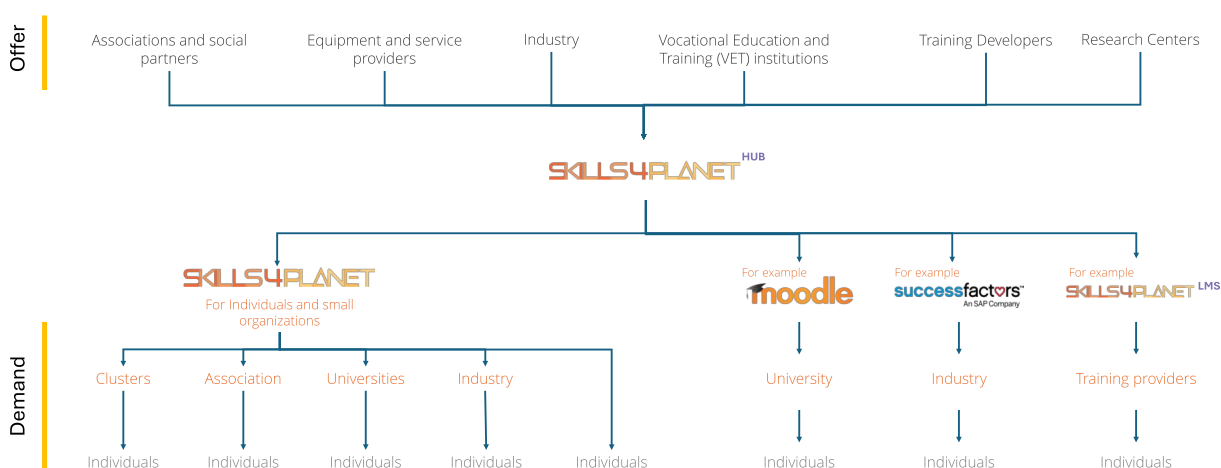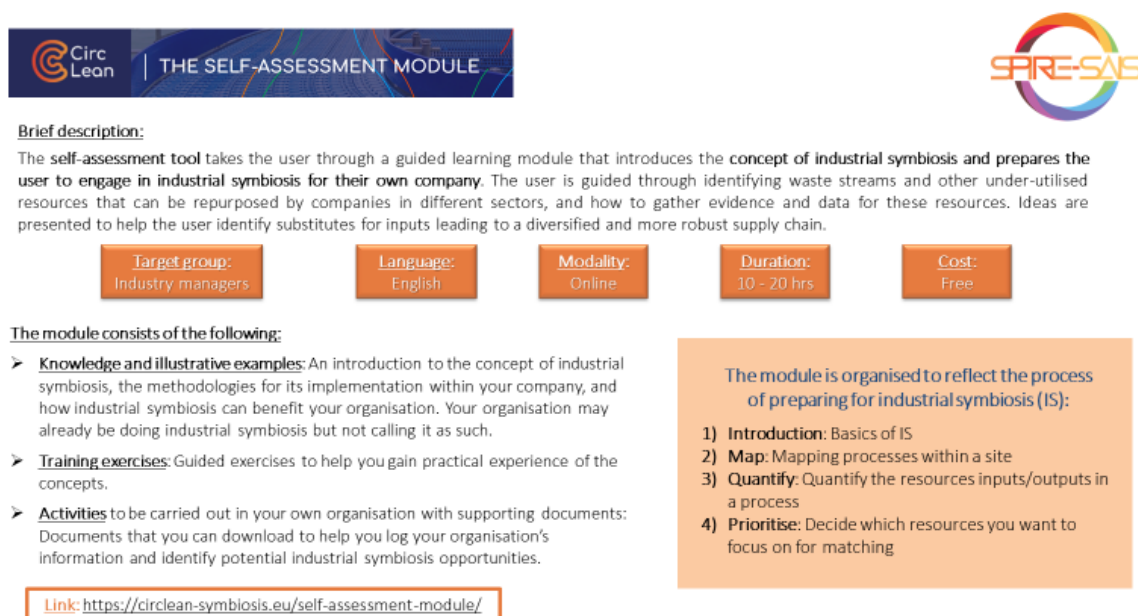
Figure 13: SKILLS4Planet Infrastructure

5.3.3 Integration of Training Offers

In the implementation and testing phase, the main parameters for a sustainable integration and alignment of SPIRE-SAIS project and its main elements with the described existing European and national/regional structures were elaborated. In particular, the focus was on the development of the Training Platform SKILLS4Planet. Beside the online infrastructure and structure, existing pilot training tools, measures and arrangements were checked for their reaching out to the target groups, and if they had be improved, adjusted or complemented by new ones. Furthermore, specific and further needed training offers were checked, such as train the trainer modules, to be integrated in the Training Platform. Training modules and offers from the sectors and training providers were collected and integrated. Also, didactical measures got examined, combining on the job, on-site training in companies and VET schools with online training.

Through the analysis of the training needs and existing educational resources and training courses for IS/EE (see Muract et al. 2024, SPIRE-SAIS Deliverable D5.1 Training Framework), training courses provide basic understanding and skills, job profile and skills topic related courses: business, regulatory, professional/technical, transversal/individual. For this purpose, training courses are collected in a database including existing courses (database of good training cases). These more than 80 courses have been analysed against different criteria (see D6.1 Implementation Plan) leading to nine selected pilot trainings for identifying training gaps: Katch-e, CircularStart, CircLean, InSight, IEOOC, Junior Expert in Circular Economy, EJWP, Water Steward Programme, Eurosteelmaster. For these pilot training modules, summarising sheets give an overview about the main characteristics (see the example of CircLean in Figure 14 and the sheets of the other trainings in Annex A2.).

Figure 14: CircLean Training Overview

Additionally, it became evident at the testing phase that the main challenge is to raise awareness of Industrial Symbiosis and related Energy Efficiency and to understand sector specialties for this. Therefore, we decided to focus much more on this topic of the training framework. Sector specific training was firstly developed for newcomers of the ceramic sector, becoming a blueprint for the other sectors. Cement, steel, minerals, and water developed and piloted

during their sector specific training during the project. With this approach there are two additional advantages appearing:

1. The trainings are helping to attract new talents, apprentices to the different sectors by showing the concept and products of a sector and their relation to Industrial Symbiosis and Energy Efficiency
2. If someone wants to get a better overview of another relevant sector than the one someone is working in, he or she will get basic information of the other sector and possible relations to Industrial Symbiosis and Energy Efficiency.

Therefore, this will be an added value that will be integrated in SKILLS4Planet in a tangible way.

The integrated training modules so far were tested and endorsed especially by the industry partners (see Deliverable D5.1). As an open system the training platform is not only open for further trainings and new learners but also for additional elements such as a communication and exchange platform for European regions (see next chapter). Therefore, the established infrastructure could be extended, also by linking with other (Blueprint) platforms and networks like the H4C Platform.

5.4 Sectoral-National-Regional Rollout

Within our social innovation process, it is of utmost importance to have stakeholders engaged within an ecosystem approach. This is not only relevant on the European level but also for the sectoral-national-regional rollout activities of SPIRE-SAIS. The implementation and running of sectoral and regional rollout processes of the SPIRE-SAIS Blueprint is looking for a smart integration in already existing (a) sector events and (b) Industrial Symbiosis Ecosystems, adding the skills perspective to the up to now mainly technological oriented topics.

5.4.1   Sectoral-National-Regional Training Ecosystems

The SPIRE-SAIS Ecosystem Approach includes not only a partnership at company level, but also possibilities and responsibilities at sector and at regional level from economy, education and research institutions as well as from the public sector and the civil society. By integrating different perspectives, possibilities and responsibilities we aim at an overarching and common development process pushing the integration of the skills and training topic at sectoral, national and regional level. A successful partnership in a sector/country/region to strengthen and develop a skills and training ecosystem should consist of small and large companies, education and training providers, public authorities, research and civil society organisations (engaged in education and training).
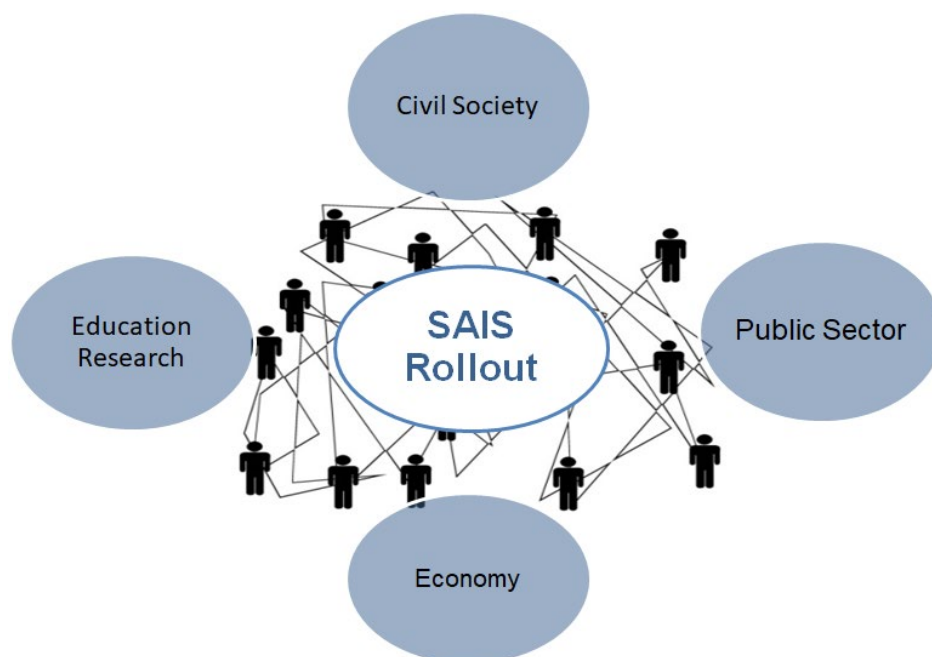
Figure 15: Ecosystem Approach

Ecosystem collaboration on the *European* level is already given by the SPIRE-SAIS partnership, which is seen as a blueprint for the sectoral, national and regional rollout.

More in detail, in order to develop a *regional* ecosystem at the place where companies are located and people work and live, a successful sectoral-national-regional partnership should include the following:

- Regional small and large companies, important for competitiveness and aiming at retaining talents at regional level. In the context of Industrial Symbiosis, more collaborations can lead to improve innovation.
- Education providers, delivering expertise in education, providing educational programs and attracting new talents to the involved sectors.
- Governments, putting on the political and economic agenda not only a strong and viable labour market but also a well-trained human capital. In addition, they can push potential partners to join and to help with subsidies and to develop activities.
- Civil society should be also integrated particularly at the regional level, to contribute to a continuous social innovation process to improve new social practices in skills adjustments.

With the Sectoral-National-Regional Training Ecosystems we aim to:

- Indicate new learning opportunities and support structures;
- Integrate industry demands as a structural the sectoral/national/regional education and training system;
- Orientate on learning outcomes;
- Emphasise the growing demand and challenge to move on the qualifications;
- Improve the quantitative and qualitative participation of lifelong learning of the workers and inhabitants at national and regional levels.

5.4.2   Pilot Implementation of Sectoral and Regional Training Ecosystems

In the context of rapid transformation of the Energy Intensive Industries, due to new technological advancements, SPIRE-SAIS project delivers a deeper collaboration not only among the different sectors but also among various national-regional actors in order to enlarge existing synergies, involving different countries and regions aiming at implementing upskilling and re-skilling strategies. For this reason, the close and continuous cooperation among companies, universities and VET providers at national and regional levels represents a way for affecting new job orientations. In this context, SPIRE-SAIS is a European orientation and support framework providing guidelines for adapting, modifying, complementing and further developing the Blueprint on the sectoral, national and regional level, within a social innovation process.

The SPIRE-SAIS rollout strategy is threefold: Beside a (1) sector specific rollout (including the national actors of the different sectors) SPIRE-SAIS added a (2) *regional* rollout strategy and (3) the rollout to the Hubs for Circularity of the ECoP H4C. During the pilot and testing phase the SPIRE-SAIS Blueprint was discussed in workshops with eight European sector associations for (a) a sector internal start of a training ecosystem development (chemicals, cement, ceramics, aluminium, steel, minerals), and (b) for cross-sectoral rollout by the water and engineering sector, linking different sectors by water usage and engineering activities. It has to be mentioned that due to the connection of the rollout workshops with regular events of the sectors, the ceramic and aluminium workshops will take place after the project duration in autumn 2024. Due to the recent status of the ECoP H4C the integration of the SPIRE-SAIS Blueprint and its skills perspective in the regions of the ECoP H4C could not be realised so far but will take place after the project funding period.

Regional rollout workshops took place in the Basque Country in Spain (Basque Industry Cluster) and the regional Pact for Skills Ecosystem of the Emilia-Romagna in Italy. This ensured the industrial cluster perspective as well as bringing SPIRE-SAIS results to an already established ecosystem for regional skills development across different sectors.

Open Coordination of the Rollout via Sectors and Regions
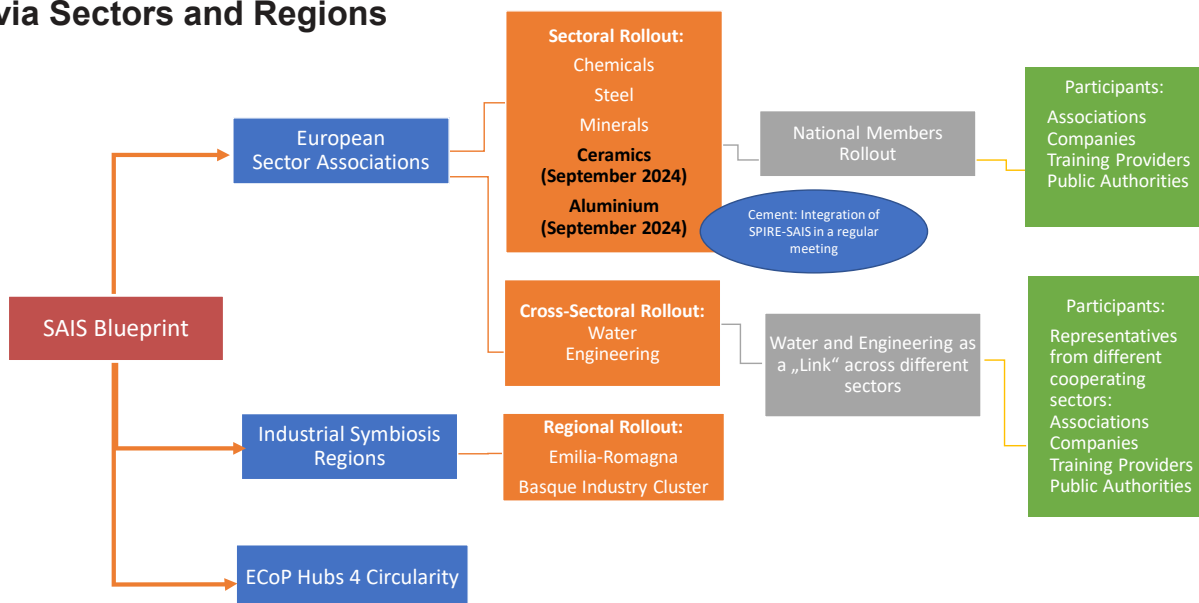
Figure 16: Sectoral and Regional Rollout of this SPIRE-SAIS Blueprint

5.4.3 Round Tables and Workshops Results

Round tables with stakeholder groups (including companies, training providers, research institutes, policy and civil society) in the pilot sectors and regions obtained information and proved the interest and the willingness to participate in European-national-regional training ecosystem development. Within the *sector-specific* workshops, sector-specific skills demands were evaluated as well as national/regional rollout possibilities within each sector. In detail, the pilot Workshops/Round Tables focused on: Information / verification of interest / willingness to participate with stakeholder groups in the dedicated sector/country/region (companies, associations, trade unions, training institutions, research institutes, policy and civil society) as well as the elaboration of specific sectoral/national/regional skills needs and possible connections to and support by SPIRE-SAIS.

Against this backdrop, the SPIRE-SAIS rollout in the pilot and testing phase targeted both the sectoral as well as the regional level and was organised in the form of pilot workshops and round table discussions with stakeholders from the respective sectors and regions. Roughly summarised, the main objectives of the rollout were the dissemination of the SPIRE-SAIS results (including the SKILLS4Planet platform, the training courses and identified skills/job profiles), as well as the promotion of sectoral/regional cooperation and processes on skills development and training for Industrial Symbiosis (IS) and Energy Efficiency (EE). At the same time, feedback on the actual challenges of individual sectors and regions were to be obtained in order to further refine the SPIRE-SAIS tools accordingly. The individual workshops were scheduled to last around 3 hours, whereby great importance was attached to interactive elements and a lively exchange with the participating stakeholders. However, the SPIRE-SAIS rollout was intended only to be the starting point for a sectoral or regional development and a related social innovation process. The expectation is therefore that it will not remain to be just one workshop round, but that further events will follow and that the individual stakeholder groups will cooperate with each other on a permanent basis even after the project duration of SPIRE-SAIS.

The **target groups** of the SPIRE-SAIS rollout included companies (corporations and SMEs), associations, trade unions, training providers, VET institutions, research institutes, policy makers and civil society actors. At the same time, the SAIS partners of the respective sectors and regions helped organising and took part in the workshops, while associated SAIS partners as well as new interested and relevant organisations were also integrated into the rollout. In the first rounds of workshops, it was particularly important to verify stakeholder interest and ensure that the various stakeholder groups were willing to participate in events and drive processes forward. Above that, it was also important to have a reliable point of contact for each rollout sector and rollout region to provide support with invitations and the definition of key topics. Such points of contact were found, for example, via sector associations (such as ESTEP in the steel sector) or via regional organisations (such as ART-ER in the Italian region of Emilia-Romagna).

The SPIRE-SAIS rollout followed an **ecosystem approach**. The aim was to develop and strengthen a successful partnership in the respective sectors and regions. In this way, a skills and training ecosystem is to be created that integrates various stakeholder groups from different sectors of society in the sense of a quadruple helix. The focus was on the four groups of education and training providers (1), small and large businesses (2), public authorities (3) and civil society actors (4).

A **sectoral approach** for the SPIRE-SAIS rollout is useful to explore the specialised needs and solutions of different sectors. Thereby, the different energy-intensive industries face individual challenges and opportunities in terms of Industrial Symbiosis and Energy Efficiency. A sectoral approach enables the development of customised solutions that address the specific requirements of the industry, the technological processes and the regulatory environment. It is also important to gain feedback from the different sectors with regard to the developed tools of the project. At the same time, sector-specific best practices can be shared. Although SPIRE-SAIS generally pursues a cross-sectoral approach, different sector-specific training courses were also developed at the end of the project. At that, a sector-specific rollout ensures that the training is relevant and directly applicable in the sectors.

At the same time, SPIRE-SAIS also follows a cross-sectoral **regional approach**. On the basis of regional workshops, regional challenges and opportunities were thereby considered. After all, different regions have different environmental priorities, legal frameworks and available resources (such as types of waste or energy sources) that are relevant for IS and EE. A regional approach makes it possible to address these specific regional characteristics. In addition, a variety of sectors are often represented in the individual regions, resulting in cross-sectoral synergies. Regional workshops can thereby foster cross-sector collaboration and create innovative, symbiotic relationships that drive skills development and training for IS and EE. A SPIRE-SAIS rollout at the regional level also enables broader participation of stakeholders, including local governments and educational institutions, who can support and strengthen the implementation of training measures.

5.4.4 Sectoral Rollout Results

Rollout workshops have been held in 5 sectors to date: In the first half of 2023, workshops were held in the steel sector, the minerals sector and the chemicals sector. In March 2024, the rollout workshop took place in the water sector, and in April 2024 in the engineering sector.

Steel Rollout

The workshop related to the *steel sector* on Industrial Symbiosis (IS) and Energy Efficiency (EE) was organised in a hybrid form and integrated different stakeholder groups, such as universities, companies, associations and research centres. It was mainly focused on demands and on the main challenges of the steel sector related to IS and EE. In addition, the connection of sectoral and regional challenges with SPIRE-SAIS as a European project was considered. The relevance and need for instruments for the qualification of IS and EE in the steel industry was also discussed.

It was highlighted that steel companies are working on both IS and EE concepts. According to the participants, Circular Economy (CE) and IS were already issues in the mid-2010s, also in the EU context. Industrial Symbiosis is now a consolidated practice in the steel sector, in particular through by-products reuse and recycling in other sectors. In this regard, skills adjustment and training, by increasing not only technical knowledge but also transversal and soft skills can facilitate the cooperation among different sectors. A concrete example was provided by a company representative from the steel industry: slag and metallurgical gases are re-used and recycled. In particular, the granulated blast furnace slag is an input material for the cement production. Another example related to the application of the IS and EE in the steel sector was provided: the Trineck factory also uses over 90% of the metallurgical gases produced during production, namely in the blast furnace, converter and coke oven plants. They thus replace the consumption of up to 500,000 tons of thermal coal or 450 million m³ of natural gas. Due to their

chemical composition, the energy use of gases creates a lower carbon footprint than the burning of traditional fossil fuels. This is also useable in other sectors / externally, according to the IS and EE concepts. However, participants indicated that it would be good for companies to get more information on how the SPIRE-SAIS results and tools can be utilised.

Concerning skills, it was highlighted the importance of "IS skills", and, particularly, the specific job role of the IS facilitator was emphasised. In addition, it was discussed which skills can be transferred between sectors. In this context, SPIRE-SAIS can support IS collaboration by linking people, and by establishing connections to different steel-specific working groups such as the ESTEP Focus Group Circular Economy and the Focus Group People. SPIRE-SAIS also provides training examples and courses, specifically targeted at newcomers to the steel industry. In terms of training and awareness-raising, SPIRE-SAIS can also act as a link to the experts of the Processes for Planet Permanent Working Group (PWG) on Societal Innovation. The involvement of the Institut für Baustoff-Forschung e.V. - FEhS Building Materials Institute in Duisburg, specialised on steel slags management and recycling, could be a further added value.

The steel rollout workshop also made it clear that the efforts of the Blueprint projects SPIRE-SAIS and ESSA (with a dedicated focus on the steel industry) are in many ways in line with each other and that the respective results can be mutually beneficial. For example, courses offered on the SPIRE-SAIS online platform SKILLS4Planet can also be useful for the steelHub (ESSA's online platform), and vice versa. Training courses from steeluniversity, for example, can also be relevant for sectors in SPIRE-SAIS. This result was later taken up in the development of collaboration regarding the SKILLS4Planet platform.

Minerals rollout

The SPIRE-SAIS workshop for *minerals sector* mainly focused on Industrial Symbiosis and was organised in a hybrid form by IMA-Europe (European Industrial Minerals Association), integrating different stakeholder groups, such as universities, companies and associations. With the integration of these different stakeholders, the workshop served as a platform for exchanging different opinions and suggestions related not only to new developments of IS but also to identify skill gaps and to develop trainings in the sector in general. It was underlined that the minerals sector, although very specific and generally far away from industrial clustered parks, is open to learning and seeing how the workshop learnings on Circular Economy and IS can be implemented at national/site/company level.

Some activities in the minerals sectors can be considered as Industrial Symbiosis processes, but are not necessary called IS. The definitions used for IS often refer only to industrial aspects and backgrounds and not to urban symbiosis and also lack to cover CO_2 heat as a possible resource. For these reasons, there is a need to integrate CO_2 heat as possible symbiosis paths to be considered and to expand the definition of IS to include the Urban Symbiosis as well.

During the workshop the Coralis project was introduced. In particular, the ongoing pilots and demo sites that are addressing different motivations for the IS were presented:

- Regional opportunities and legal bottlenecks in Italy;
- Technical Innovation in Spain;
- New business model in Sweden.

It was also highlighted that the Coralis project is willing to develop an IS data gap analysis for some minerals sector member companies.

During the round table discussion, the following topics arose and were discussed:

- IS seems to be a new term, but for some sectors (not only the minerals sector) it is widely used when the added value has been demonstrated. In particular, although the term seems new, for some sectors the training has been available since 2003 and there are IS solutions tested to be valuable. However, there is a challenge how to capitalize and valorise them without reinventing the wheel every time. Specifically, the challenge of aggregates is to get new permits, and using IS to integrate primary and secondary raw materials for future operations as part of IS solution.

- IS is a tool/system that can help to map internally within the company but also to engage with stakeholders outside its own fence when a business model is possible. Some of the key motivators to boost the IS uptake are knowledge creation, value added for multiple partners, viable business cases. Furthermore, to make feasible to uptake and engage with external stakeholders, it is important to engage a coordinator of trust or IS facilitator that is able to bridge the ecosystem approach. Finally, companies will develop a project, when they see an opportunity or need to solve an issue. Sometimes the permitting/legal framework can be a bottleneck for a wider IS uptake .IS can be used more to address complex systems and deliver cost reduction possibilities. In this context, trainings can be a support tool to train company experts. However, there is also a need to have discussions with HR and management teams at company level.

- IS can be an opportunity, but cannot be replicated entirely as such. A thorough analysis is necessary to adapt the approach to the site/company specificities. IMA members highlighted that major challenges by the companies in the near future will need pragmatic solutions and the workshop aimed to demonstrate what the possible options/tools are. It was a valuable exchange to demonstrate with practicable examples what the theory looks like in practice. However, to move it into a business model it will take some internal discussions and follow up actions.

- There is a need to work in a symbiotic manner and integrate flows of primary and secondary raw materials. The cross-fertilization of ideas between different IS projects demonstrated their complementarity and the benefits of cooperating.

- There is a need to improve awareness on IS and simplify theory with practical examples and demonstrate applicability. Simulations maybe a good awareness and training tool. Attracting and retaining talents for IS should be considered as well, to develop and integrate IS related competences.

In the concluding remarks, it was underlined that a follow-up webinar could be considered between minerals, cement, ceramic and non-ferrous sectors to see what the progress is and what needs to be done more.

Chemicals rollout

The Workshop related to the *chemicals sector* on IS was organised in a hybrid form by ECEG's (European Chemical Employers Group) WG Education & LLL, integrating different stakeholder groups, such as universities, companies, associations. It was focused on the sector's skills needs by focusing on the following topics: a) the sectoral attractiveness and the image of the chemicals sector, based on best practices to increase the attractiveness of the sector in Belgium; b) recruitment issues and labour shortage in the chemicals sector, by analysing the cross-sectoral dimension with the Business Europe's activities on labour shortage as well as the sectoral dimension supported by a study from an ECEG's member. Above that, the Blueprint project "ChemSkills: enabling the green and digital skills transformation of the chemical industry" was presented.

During the workshop, the following topics were discussed by the participants:

- The narrative used to trigger young people and students to get a job in the chemicals sector was discussed. For this purpose, as industry is perceived as old economy, dirty and hard work, the efforts should be addressed to green and digital transitions. In addition, it should be underlined that chemical products are everywhere in the human society. The goal is to develop a sustainable chemical industry as in other sectors, focusing on the role that the chemical sector can play for a better world. This can be achieved by integrating disadvantaged labour market groups into the chemical sector as well as by introducing initiatives like "chemical influencer", which was presented in the workshop, where a contest was launched for young students.
- Concerning the labour shortage as an issue in different countries, regions or sectors, in Finland there are skills needs for the battery sector and a lot of workers needed (demand of around 7000 people). This is very challenging for Finland as a 5 million people country. As an example of the regional approach, in the Emilia-Romagna region (Italy) the situation is different. The problem does not seem to be related to skills, as there are skilled people and good training opportunities, but the sector/companies are still in the transition phase from the traditional chemical production to a more sustainable one. Therefore, the sector is in a crisis right now and a lot of people are losing their jobs. In this context, the region is trying to foster the transition from traditional production to a more sustainable one, and, currently, there are a lot of well-trained, skilled people. However, there are not enough job opportunities, so that skilled people are moving to other regions/countries.
- In the next two years, the demand will be rather low, while in the next 5 years the demand may become higher. Therefore, it is important that people are kept in the industry. In this regard, one of the main challenges is that policies are changing quicker than trainings, or put differently: the regulatory requirements are developing so rapidly that it is difficult to respond to them with training measures.
- In the context related to IS, dialogue is an important measure, not only just between the sectors themselves, but also between the sectors and the European Commission.

Water sector

The workshop for the *water sector* on IS and EE was organised in a hybrid form by Water Europe, in the frame of the Water Europe Market Place 2024 event, integrating different stakeholder groups, such as universities, research institutions, companies, associations, and public authorities. With the integration of these different stakeholders, the workshop served as a platform for exchanging different opinions and suggestions related not only to new developments of IS activities but also to identify skill gaps and to develop trainings in the water sector.

In the introduction of the workshop, it was underlined how difficult it is to define the water sector. Water is everywhere and is an essential component of our society. The challenge is to develop new skills for the next generations in the sector and, at the same time, to protect water in the natural environment. In this sense, two European projects were presented, ULTIMATE and AquaSPICE. The ULTIMATE project focused on IS and how to manage water from the industrial perspective, including different case studies, such as the Case Study 3 related to water reuse and material recovery in the chemical industry in Italy as well as the involvement of young people and the community engagement. On the other hand, the AquaSPICE project aimed at improving and increasing recycling with digitalisation, in Böhlen, Saxony, Germany in order to achieve water saving, and improvement of demineralised water quality.

The second part of the Workshop was dedicated to future skills needs in the Water sector, by presenting and discussing the topic of human capital in the water sector. The importance of the connection between circular skills and IS through an integrated approach was thereby underlined. It also outlined how developments in the labour market can be handled and how discussion and dialogue between the different generations (e.g. being able to reach out to a younger generation) can be facilitated. The main key results showed the role of the human element as we move towards the Water-Smart Society:

1. Skilled labour is a key to success of the Water-Smart Society, through reskilling programmes, lifelong learning programmes and sectoral talent attraction strategies.
2. Water educators must update study programmes to include emerging water specialisations that connect learning, research and practice.
3. Social innovation in living labs requires strong competencies: problem solving, strategic planning, negotiation, etc.

Concerning demands/main challenges of the water sector, it was underlined that the water industry has a cross-sectoral nature, which needs a cross-sectoral approach and symbiosis activities to maximize the circularity and sustainability of all processes. Three pillars should thereby be considered: the climate change (1), the energy crisis (2), and the collapse of biodiversity (3). In addition, sustainable water usage for industry concerns not only environmental aspects, but also financial, governance and social sustainability. Three main results are expected:

- from global to local: a Glocal approach towards maximized decarbonization;
- having a symbiosis among academy, policy and industry;
- shifting from Water-Oriented Living Labs (WOLLs) to symbiotic globally representative industrial show cases, to maximize circularity.

During the discussion, the importance of the collaboration between industries and associations with policy makers was highlighted. New wastewater treatments are important and the challenge is to combine individual tools, building and designing much more sophisticated systems to solve more complex problems. In addition, in the context of circular activities, individual organization should move to an ecosystem, using water, energy and materials in collaboration. Furthermore, the importance of insisting on water sources to provide drinking water was underlined. Industrial Symbiosis is an opportunity for waste management, because at local level taxes and fiscal facilitations are important to reduce waste by companies/organisations. In this context, circular water economy should be integrated in the master classes, and showing to students how water can be reused through interesting showcases based on the collaboration among companies producing purification plants. However, it was also underlined that it is not easy to focus on the regional urban level. It is easier to collaborate with large industries, but it is not so easy to collaborate with small and medium enterprises. But there are programs from universities and projects focused on the local level, and European exchange platforms should focus on symbiosis and collaboration much more on the regional level.

During a round table related to the most important industry sectors for water, the cooperation on water (re)use already in place and the leeway to improve water (re)use was discussed (see the results in Figure 17). Although the significance of Chemicals, Pulp and Paper, Refining and Minerals as the most relevant sectors was underlined. The participants added additional sectors or areas: data centres, energy, hydrogen, battery, food and beverage, agriculture, electronics, etc. are also of importance for the water sectors. In addition, it was highlighted that there are different sectors with cooperation already in place, while some room of improvements

for the water re-use are possible. In particular, improvements in water reusing depend on money and competition. Furthermore, it is important to consider and to help companies from the economic perspective as sustainability should not only consider the environmental and the social perspective, but also financial and economic issues.
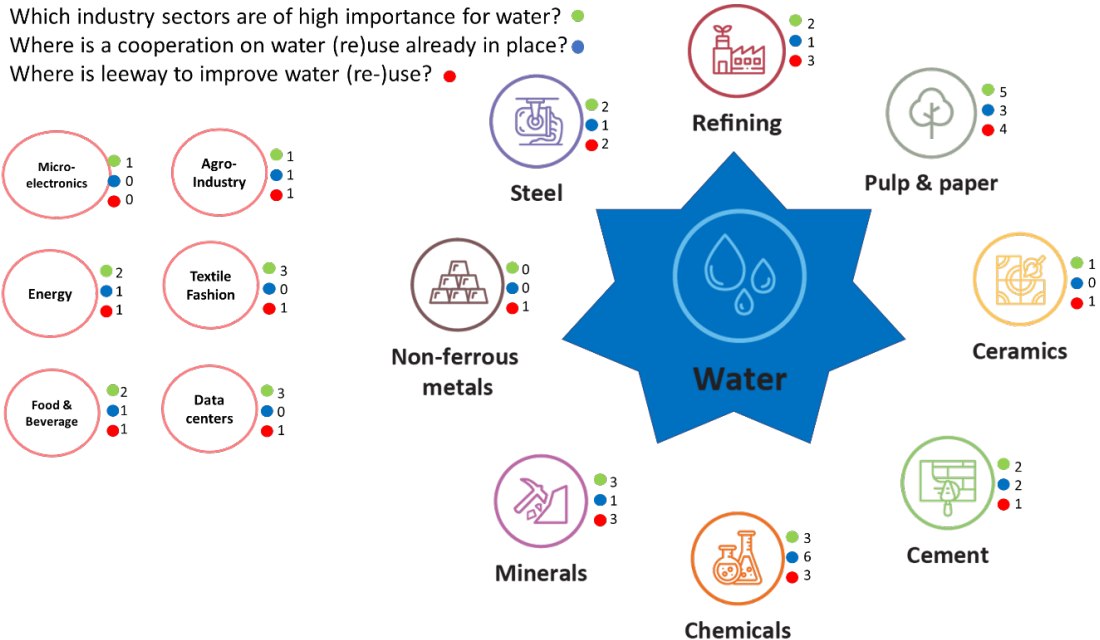
Figure 17: Water as a "Link" to a Variety of Industry Sectors

Some concluding remarks arose at the end of the workshop:

- The importance to go beyond technologies, by integrating the social dimension as much as possible, and to involve all relevant sectors.
- Tools, measures, trainings and programs should be considered also at local level.
- In Energy Intensive Industries (EIIs), it is crucial to attract young people and this aspect is linked to the image of the sectors, which should be improved. A very good example of young talent engagement was presented during the workshop.
- A water blueprint project could be an opportunity.
- The importance not only of public authorities and researchers but also of users of water was highlighted.
- Dialog between different requirements and different perspectives should be fostered.
- Increasing the actors' capacity to a more proactive collaboration as an important issue.
- Higher flexibility in the training centres and in universities needed. It is important to understand what is changing also in terms of skills development.
- Identifying challenges and priorities in order to assess the feasible work plan to achieve results.

Engineering sector

The Workshop for the **_Engineering_** sector on IS and EE was organised online by SSSA, and mainly integrated stakeholders from companies, which were able to provide the Engineering sector perspective and suggestions related not only to new developments of IS and EE activities, but also to identify skill gaps and to develop trainings in the Engineering sector.

Concerning EE, it is underlined that the EE is a topic globally consolidated in the Engineering sector as the standards of equipment are continuously increasing in terms of electrical engineering efficiency. Concerning IS, in the last few years, it has become more and more important, due to the ecological and green transition, driving particularly the heating process, traditionally using natural gas, to the electricity. And this will impact on different areas, processes, and skills as well. In this context, the close cooperation with different actors from different disciplines, by merging, discussing and designing together, will be crucial, as the electrification has to be a multidisciplinary process. Through an interdisciplinary approach, the electrification also brings together some challenges in terms of resources and technical competencies that are required. The electrification is also a key topic for the decarbonization of the steel sector as we are moving toward more intense exploitation of electrical energy compared to the past.

Concerning the human aspects related to the technological changes, in general, in the Engineering sector there is no resistance among workers as they are now convinced that is the current transitions are the future and also a big work opportunity compared to the past. In particular, the Engineering sector, compared to the other sectors involved in the rollout activities, is committed to design equipment and new systems. This is a business opportunity as this sector plays a crucial role in supporting the transformation of the plants, and, consequently, the level of skills is higher, in general, because they are the designer. For this reason, the skills adjustment and training activities are mandatory in the industrial sectors that receive new equipment, and still regularly keeping a manufacturer can contribute to this skill adjustment and training. On the other hand, this transformation might be a reason for being more attractive for younger talents. Although it is not easy to find the right people, recently companies are hiring people directly from the university, and, after a quick training course approach, young people can enter in the process. Often the equipment providers have their own internal academies for developing trainings for their workers and for young people, and also specific training solutions for their own customers to the full exploitation of the solution they provide. This also makes a very big difference with respect to other sectors.

5.4.5 Regional Rollout Results

Regional workshops were held in the Italian region of Emilia-Romagna and in the Spanish Basque Country. The workshop in Emilia-Romagna was organised in close cooperation with ART-ER, the rollout in the Basque Country was organised in cooperation with the CORALIS project and SIDENOR and incorporating the Basque Industry Cluster, also part of the Industrial Symbiosis to Hubs for Circularity (IS2H4C) project (https://is2h4c-project.eu/).

Emilia-Romagna Region

The Workshop on skills for CE and IS, focused on the ***Emilia-Romagna region*** in Italy, was organised in a hybrid form by ART-ER (Attrattività Ricerca Territorio-Emilia Romagna) in Bologna. It integrated different stakeholder groups, such as universities, public authorities, VET providers, local stakeholders and research organisations. With the integration of these different stakeholders, the workshop served as a platform for exchanging different opinions and suggestions related to the local experience and regional challenges, as well as on the SPIRE-SAIS experience and support.

The importance of competences connected with the Digital and Green Transition was underlined and how important it is to understand what is being done at European level and the future challenges on this topic.

As the workshop was mainly focused on the regional challenges concerning skills for CE and IS, following the presentation of the SKILLS4Planet online training platform by Jorge Muract from steeluniversity, some questions/comments arose from participants about the possible interaction with the platform and how it can be used in different context/projects. It has been discussed that, with the agreement of the steeluniversity, it is possible to create some new content and make content available free of charge for the SKILLS4Planet platform. It was also recognised that the platform can contribute to the sustainability of the SPIRE-SAIS project and its results (e.g. the project website) beyond the project duration. In this context, the importance of languages in the platform was underlined since most training activities of the Emilia-Romagna partners are usually developed in the local Italian language. In addition, the online training platform represents a tool which helps with the internationalisation of training activities. In this context, individual courses are fundamental to make people ready for the labour market and the platform helps to connect job seekers to the labour market. In the future, Artificial Intelligence (AI) can act as a tutor, while during the project, AI was used for the translation of the platform contents in different languages. The human input has been only used in the review and control process of the translations and this has allowed saving money.

A crucial topic arose during the workshop concerning the possible use of the SKILLS4Planet online training platform for free courses useful for other Erasmus+ projects. It was underlined that this is possible by sharing contents for free, and that the platform is already working, but at the moment of the workshop there were no participating organisations yet. For this reason, the workshop participants were invited to test the platform. In this regard, the cooperation across European regions was promoted and emphasised, showing that modules developed for the platform can be shared with other regions (e.g. in ESSA project, the German rollout workshop was focused on hydrogen use in the steel sector and a module has been developed). The cooperation among regions will be more emphasised in a next Erasmus+ proposal, which integrates partners from blueprint projects and other Pact for Skills Ecosystems into a Large-Scale Partnership for Energy Intensive Industries (LSP EII) under the Pact for Skills. As the integration of new partners into the project (after the submission of the proposal) is possible as associated partners, Emilia-Romagna region can be integrated in the new proposal, in particular for the digital, green and social topics.

Basque Industry Cluster

The Workshop for the *Basque Country* in Spain was organised in a hybrid form by Sidenor, integrating different stakeholder groups, such as universities, companies, sector associations as well as local authorities. With the integration of these different stakeholders, the workshop was focused on the situation of the industrial cluster in the Basque Country as an example of IS, also related with the Coralis project.

The Coralis project is based on IS in EIIs and was presented during the workshop. Aiming to create pathways for the decarbonisation, IS approaches with innovative technologies in the European process industry have been developed. The importance was underlined to review reform training or awareness-raising of governments and local and regional authorities to support these initiatives, through further investments by governments but also by local authorities.

Concerning the IS collaboration in the involved organizations, sectors and region, as well as challenges facing for IS cooperation, it was emphasized that there are only local and individual company-based approaches on IS. However, improving IS also in sectors where it is already in place is important, not only for the single sectors, but also at a broader local and regional level. In this regard, local funding and investments to IS as well as research activities to improve IS activities are crucial. Above that, it is also important improving industrial processes.

Overall, it was highlighted that, compared to other workshops, there is more awareness to IS from involved stakeholders, by underlining the importance to facilitate IS activities and to make available the key information about IS and EE for the potential improvement of energy intensive industries. In this sense, cooperation is crucial and connecting IS actors is a challenge.

Concerning the possibility of skills adjustment and training to facilitate such a cooperation, it was mentioned that the main challenge is related to upskilling and reskilling activities and to attract and retain talents to industries. As it is important to know the skills necessary for the industrial activities, trainings and skill adjustments are fundamental topics for IS cooperation - they must be facilitated and should be the basis for future cooperation. In addition, from the perspective of recruiting talents, the importance of higher education was underlined – also in the context of showing the efforts of energy intensive industries with regard to decarbonisation and sustainability. This is related to the need of improving the image and the public perception of these industries.

Finally, it was underlined that Basque Country can collaborate more in the future on the skill topic in other European projects. For such projects, it is important to consider the regional level because of the ecosystem approach and the involvement of different stakeholders.

5.4.6 Summary

The thematic focus of the SPIRE-SAIS rollout was, on the one hand, a general introduction to the project concept. At the same time, the results of the identified job profiles and skills, including the skills categorisations, were presented. Special attention was paid to the presentation of the online platform SKILLS4Planet and the training courses for Industrial Symbiosis and Energy Efficiency. Constructive feedback from stakeholders on user-friendliness of the SPIRE-SAIS tools was thereby not the only important issue of the SPIRE-SAIS rollout workshops. Rather, the aim was also to gain concrete insights into the actual sectoral and regional demands, challenges and opportunities with regard to Industrial Symbiosis and Energy Efficiency in general and for IS and EE skills development in particular. This made it possible to integrate industry demands for the tools and results that were developed and obtained in SPIRE-SAIS. The exchange between the stakeholders present also enabled new learning opportunities to be identified for the respective sectors and regions and new support structures to be established. The overall aim of the SPIRE-SAIS training ecosystem is to continuously contribute to improving the quantitative and qualitative participation of workers and residents in lifelong learning in European regions through the rollout workshops.

Summarised, the SPIRE-SAIS training ecosystem approach approved by the rollout and testing phase has the following objectives and characteristics:

- A successful partnership in a sector/country/region to strengthen and develop a skills and training ecosystem of education and training providers, small and large business, public authorities, and civil society
- The Sectoral/National/Regional Training Ecosystems will:
  - indicate new learning opportunities and support structures
  - integrate industry demands as a structural principal of the sectoral/national/regional education and training system
  - orientate on learning outcomes (instead of curricula)
  - emphasize the growing demand and challenge for every single person
  - improve quantitative and qualitative participation of lifelong learning of the workers and inhabitants (national/regional).

- The implementation process of the Training Ecosystems is characterised by:
  - a quick start within a "corridor of possible developments"
  - new possibilities to get hold of and mobilise potential trainings
  - an increased potential for education to become a "location factor" for integrated regional-local development.

The learnings and general results from the rollout workshops are summarised briefly as:

- The need for more awareness for Industrial Symbiosis
- Transversal skills, soft skills and technical skills (for resource management and collaboration) are needed
- Recruitment and retention need to be differentiated between sectors and regions
- Industrial Symbiosis is an opportunity, but there is also a challenge to replicate practices and apply valuable IS solutions
- EU policies often evolve and change faster than training offers.

Uptake, cooperation and awareness for IS

The important task of raising awareness for a circular approach in general and for Industrial Symbiosis in particular was among the most discussed topics in the rollout workshops. While some of the stakeholders emphasised that IS in relation to the Circular Economy has been an issue across the EU for many years, the term often seems new, even though many of the practices are already in use. In the minerals sector for example, stakeholders stated that they conduct practices that are connected to Industrial Symbiosis, while these are often not called IS. Also, training on Industrial Symbiosis has existed in some sectors in the EU for many years, but not named as such.

Although more awareness for the practice is needed, some sectors show that Industrial Symbiosis is widely used when the added value is clearly demonstrated. Aside from the added value for multiple partners, knowledge creation and viable business cases are some of the main motivators that encourage the adoption of Industrial Symbiosis. For example, stakeholders in the steel industry state that Industrial Symbiosis has been a consolidate practice in the sector for many years, in particular through by-products reuse and recycling in from different other sectors. According to stakeholders from minerals, chemicals and steel, IS generally represents an opportunity for companies, even though it is often not possible to replicate practices easily. Results from the regional rollout in the Basque country also show that oftentimes companies re-develop their own solutions instead of sharing and strategically collaborating. Results also show that many relevant companies hardly deal with the circular economy and possible cooperation in the field of Industrial Symbiosis and are sometimes not able to analyse and constantly update the changing skills and qualification requirements necessary on their own. A thorough analysis is therefore needed to adapt the Industrial Symbiosis approach to individual companies and sites. In other words, the challenge is to apply valuable IS solutions in companies without having to reinvent the wheel each time. The stakeholders emphasize that there is a need to work in a symbiotic manner and integrate flows of primary and secondary raw materials. The cross-fertilization of ideas between different IS projects (e.g. between SPIRE-SAIS and the CORALIS project) demonstrates their complementarity and the benefits of cooperating.

> ➢ *This results in a need to improve the awareness for Industrial Symbiosis and to simplify the theory with practical examples while demonstrating applicability.*

On the other hand, the rollout workshops showed that the partners in some regions (as in the Basque country) have very in-depth and comprehensive knowledge of the topic and are quite capable of realising projects together.

Among the **main challenges for the uptake of Industrial Symbiosis** are the lack of connections between companies, especially in terms of information and communication. There also seems to be a lack of channels and connectors. Participants in the Basque Country also emphasise the lack of a global vision for Industrial Symbiosis, as often only a local, internal company approach prevails. The task of attracting and retaining talent in order to gain the necessary skilled labour for the implementation of a circular economy and green transformations in general is also a challenge for companies in energy-intensive sectors. Worker upskilling and reskilling and student training, on the other hand, are seen as essential prerequisites for adequately preparing employees for circular economy processes. According to the participants, companies often do not seem to be aware of which skills are required for Industrial Symbiosis.

Training for Industrial Symbiosis

The participating stakeholders emphasised very clearly that skills development and training are among the most important tasks with regard to the implementation of Industrial Symbiosis and Energy Efficiency. Identifying the necessary skills is a major challenge for companies and a first step that must be taken before employee training is even possible.

With regard to training for Industrial Symbiosis, it was mentioned in the workshops that EU policies often evolve and change faster than training offers; it thereby seems challenging to quickly adapt the training offer to the increasing requirements of EU policies. In this respect, communication is of utmost importance - not only between different industrial sectors, but also between sectors and the European Commission.

The experts in the workshops also emphasised with regard to skills adjustment and training that it is not only technical skills that are important in the topics of industrial symbiosis and energy efficiency. Rather, it is above all transversal skills and soft skills that can facilitate cooperation between different sectors, as is suggested by the SPIRE-SAIS skills categories. An important question is to what extent skills can be transferred between different energy-intensive sectors.

Talent attraction and retention in energy-intensive industries

The sectoral workshops show that the challenges with regard to skill needs differ regionally. For example, the Finnish chemicals sector (more specifically the battery sector) shows that there are strong skill needs and thousands of skilled workers are required, which are currently missing from the Finnish labour market. Meanwhile, the situation in the Italian Emilia-Romagna region is different - there are enough qualified workers and good training opportunities, but the chemical sector here is in a process of change, from classic chemical production to more sustainability, which currently leads to challenges in the sector; as a result, many people in the region are losing their jobs. The current regional situation in Emilia-Romagna and missing job offers tends to cause qualified workers to migrate to other regions and countries.

In the chemical sector, it can also be observed that the demand for qualified workers is currently generally lower due to decarbonisation efforts. However, the experts are certain that the demand will increase again in the next few years, so that it is all the more important to keep qualified personnel in the sector. At the same time, it is evident across all sectors that Industrial Symbiosis processes often depend on the skills of individual persons, which increases the need for further education and training. Accordingly, the topics of talent attraction and talent

retention should always be considered in order to ultimately develop and integrate IS-related competences. HR and management teams at company level should therefore also be integrated in further discussions.

The rollout workshops have underlined the efforts to improve the image of energy-intensive sectors and at the same time show that real change processes are underway in the various sectors. Efforts must continue to improve the perception of energy-intensive industries among young, qualified applicants. In particular, the green and digital efforts of the sectors should be highlighted in order to break away from the status of the old economy. Transformation processes are also taking place with regard to working conditions - away from hard, dirty work towards a more modern way of working and better integration of disadvantaged labour market groups.

SPIRE-SAIS support for Industrial Symbiosis collaboration

The SPIRE-SAIS project and the rollout workshops can help to connect stakeholders and establish important contacts. SPIRE-SAIS can act as a connector, e.g. in the steel sector, to introduce topics in the ESTEP Focus Group Circular Economy. At the same time, A.SPIRE can provide a link to experts in the Permanent Working Groups (PWG) of Processes for Planet, especially the PWGs Societal Innovation and Hubs4Circularity.

An important contribution of the SPIRE-SAIS project is the SKILLS4Planet online platform, which provides training offers, examples and opportunities. These in turn are embedded in already existing structures of the steelHub, whereby the training offered there (on the steelHub) can also be relevant for other sectors outside the steel industry. The cross-sectoral approach to the topics of Industrial Symbiosis and Energy Efficiency can also help to raise awareness for IS and should primarily promote the topics of education and training through the various offers and best practice examples.

The rollout workshops revealed specific needs and solutions at regional and sectoral level, which in turn were used to adapt and further develop the overarching European tools (such as SKILLS4Planet) for skills development. At the same time, these tools were and are applied and disseminated at regional and sectoral level. Despite the complex diversity of actors, backgrounds and organisational logics, this enables a process of joint social innovation that efficiently and effectively promotes the decarbonisation and circularity of European industry.

Therefore, the pilot rollout workshops are only a first step. They have to be continued and extended. As the rollouts for the aluminium sector and the ceramics sector are planned for the second half of 2024, it shows the need for continuity beyond the project lifespan. Especially the further integration of the SPIRE-SAIS Blueprint and the European SKILLS4Planet Training Platform within further regions and sectors should lead to an incorporated European Community of Training Practice (ECoP). Within regional training ecosystems (including public authorities and policy, big companies and SMEs, social partners, educational organisations and training providers, as well as civil society organisations), the SPIRE-SAIS European Training Platform could

- Serve proactive skills assessment and adjustment,
- Analyse continuously and proactively skills gaps,
- Provide up-to-date support and knowledge by collecting and developing up to date training modules and tools.

Via such a Community of Training Practice for connecting and networking of regions (with H4C) not only exchanging tools and knowledge across regions is given but also by mutual learning, not reinventing the wheel several times..

Together with the ECoP H4C further suitable European regions for the SPIRE-SAIS Blueprint and the SKILLS4Planet Training Platform Rollout will be identified reaching high Symbiosis Readiness Levels (SRL) in relation to skills, competences and qualifications. Within a comprehensive concept, an interplay between actors from different industry sectors at local, regional, national, and European level should be aimed at. Common stakeholder workshops at the regional level combining and improving technological and social readiness will set new impulses, create new industrial opportunities and overcome (social) challenges. New learning arrangements are planned for solving technical and non-technical problems and improving the capabilities of the enablers/facilitators of Industrial Symbiosis and Energy Efficiency.

Such a European Community of Practice ensures cooperation and learning between the European, sectoral, national and regional levels. This includes beside the existing regional training ecosystems of ESSA and SPIRE-SAIS the integration of Hubs for Circularity, Centres of Vocational Excellence (CoVE), circular economy centres and industrial parks, as well as new regions in underrepresented sectors in the partnership (e.g. cement).

The idea is to implement Training Ecosystem on the sector/regional level. In particular, the implementation process of the Training Ecosystems is characterised by a quick start within a "corridor of possible developments" (i.e. to start a process dedicated to the needs and demands of the participants), and therefore to get new possibilities in order to mobilise potential trainings. In addition, this process is focused on education and training as a location factor, as an increased potential for education to become a competitive factor within an integrated regional-local development strategy.

To achieve continuous improvements and adaptations of skills, competences and occupations in the Regional Training Ecosystems the strategy will be focused on:

- Displaying new learning opportunities and support structures, that can meet the increasing demands of work, education/training for companies, VET systems, and learners;
- Integrating companies demands as a structural principal of the regional education and training system, which will include the improvement of traditional structures;
- Orientating on learning outcomes and the recognising competences adopted by other ways than formal learning;
- Emphasising the growing demand and challenge for every person to deal with constant changes in the labour and society and challenge public responsibility in order to support people to maintain active learning;
- Increasing the quantitative and qualitative participation of lifelong learning of the workers and inhabitants of a region where people work and live.

The relevant regional stakeholders and institutions through their competences, responsibilities and cultures, will create synergies to cooperate for pedagogic, organisational, and sectoral-regional integration. This will lead to specific and different sectoral and regional profiles under the umbrella of SPIRE-SAIS project. The combination of the sectoral-regional (and national) level with the SPIRE-SAIS Skills Alliance will lead to an integrative cooperation by extending complementary, subsidiary or supporting cooperation with setting up a new structural framework. In the context of the social innovation process *new social practices* will be developed,

mainly focused on industry demands and the learner, including different innovation processes at the local level (depending on the recent demands and framework of the regions) within a common framework and overarching support structure. Within these rollout activities interactions with other sectoral Blueprints will exploit synergies and joint strategies (esp. ESSA).

For the SPIRE-SAIS Blueprint Rollout strategy, European regions will be identified, in order to achieve high Symbiosis Readiness Levels (SRL) (Sommer 2020) based on skills, competences and qualifications. Actors from different sectors at local, regional, national and European level will be included in order to develop common stakeholder workshops at the regional level. These workshops aim at combining and improving technological and social readiness in order to create new industrial opportunities and overcome (social) challenges. Regional learning arrangements for solving technical and non-technical problems and improving the capabilities of the enablers/facilitators of Industrial Symbiosis and Energy Efficiency will be developed.

6. Further implementation

SPIRE-SAIS brings together stakeholders from across the Energy Intensive Industries, including industry sector associations, education and training providers, research and technology organisations, public authorities, regional institutions, companies, and others. Common objective is to enable and accelerate the uptake of Industrial Symbiosis and Energy Efficiency by developing and implementing a comprehensive and sustainable cross-sectorial Blueprint for short-term skills adjustments.

This cross-sectorial Blueprint had the following central elements:

- **Skills requirements and foresight**, which include the identification of current and future skills requirements for Industrial Symbiosis (IS) and Energy Efficiency (EE);
- **Training Framework**, which include the integration of existing and the development of new training courses, measures, arrangements, tools and activities for integration within VET, company and association training programmes;
- **Mapping of current VET provision** for Industrial Symbiosis and Energy Efficiency skills of the EIIs sectors in selected member states.

The further implementation of the SPIRE-SAIS Blueprint and its main elements (see Figure 2) is directed to a **sustainable Skills Alliances beyond the project duration.** This is mainly depending on (further explored in the following chapters):

(a) a consolidated governance structure including the Skills Foresight Observatory (chapter 6.1)
(b) its integration in the Pact for Skills (chapter 6.2)
(c) the online training platform SKILLS4Planet development (infrastructure, training offers, business model) and its alignment with existing (e.g. steelHub) and to be developed platforms (ECoPs H4C and H4C EUROPE) (chapter 6.3).

Additionally, in the implementation phase existing and new training offers (chapter 7.4) as well as image and recruitment measures (chapter 7.5) will be integrated or developed. Sectoral and regional training ecosystems will be developed and established during the related rollout activities (chapter 7.6).

Last but not least, the Blueprint and its implementation will be monitored by Project Performance Indicators and selected Key Performance Indicators (Chapter 7.7)

6.1 SPIRE-SAIS Governance

The sustainable coordination of the Blueprint is guaranteed by its integration in the A.SPIRE and P4Planet governance structures (namely the Permanent Working Group Societal Innovation) and its integration in the Large Scale Partnership Energy Intensive Industries (LSP EII) of the Pact for Skills. The already described SPIRE-SAIS governance structure (see chapter 3.3 and Figure 4) is therefore integrating the three central pillars of the Blueprint:

- The **Foresight Observatory** is seen as an overarching governance element, continuously monitoring future skills demands resulting from technological and economic developments. Doing this, an innovation project repository is set-up, continuously updated (see paragraph below).
- The **SKILLS4Planet** online training platform, aligned with the already existing steelHub of the ESSA Blueprint.
- The third pillar **European Community of Training Practice** for sectoral-regional training ecosystem cooperation has still to be developed by engaging further regions and aligning further with the knowledge platform of the ECoP H4C (https://www.h4c-community.eu/knowledge-platform/) and other regional programs and activities (e.g. CoVEs, Smart Specialisation Regions).

Not to forget that all these activities will inform relevant European activities in relation to skills.
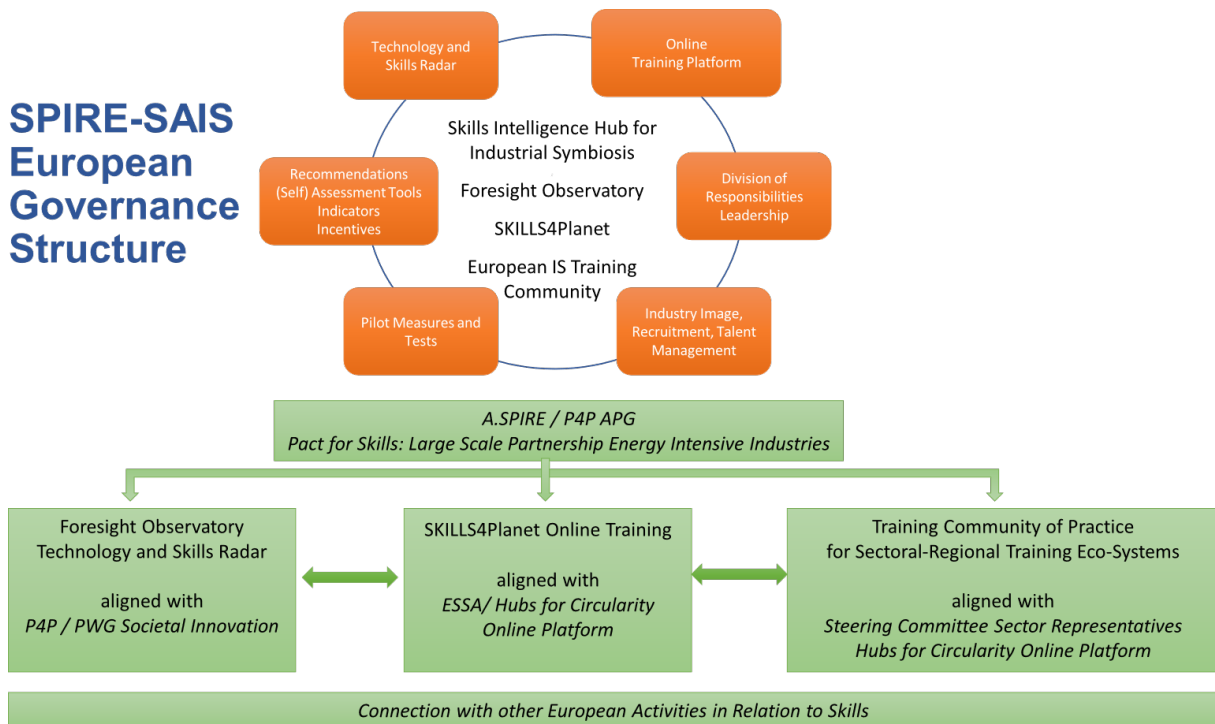
Figure 18: Extended SPIRE-SAIS Governance

Repository of Innovation Projects as Part of the Foresight Assessment was initially designed for collecting material from partners for developing the desk research (as a part of Deliverable D2.1; see Branca et al. 2024) for the technological and economic development and skills demands. Nevertheless, this repository is a good reference for disseminating innovation projects to the whole SPIRE community and the interested public. The repository is organised per sector, including the projects mainly based on Industrial Symbiosis and Energy Efficiency in the

different sectors involved in the SPIRE-SAIS project. In addition, a cross-sectoral project section is present, including l projects on Industrial Symbiosis and Energy Efficiency that are transversal across the different involved sectors. The template for collecting the projects comprises different aspects: sectors involved, funding scheme (e.g. RFCS, FP6, FP7, H2020, Horizon Europe, etc.), title and acronym of the project, main key words, start and end date, short description of the project, if the project involves either Industrial Symbiosis or Energy Efficiency (or both), what kind of flows of Energy/Material are involved, the main objectives and outcomes, the website of the project, and the final report (if available). The summary description of each project has been also included in the dedicated sections of the Deliverable 2.1. During the SPIRE-SAIS project the project repository was continuously updated and due to the existing resources, it will be updated beyond the project timely.

6.2 Pact for Skills: Large Scale Partnership Energy Intensive Industries (LSP EII)

SPIRE-SAIS was already an approved partner of the European Pact for Skills, which is a flagship initiative of the European Skills Agenda. In the further course and within the launch of the Year of Skills in May 2023 SPIRE-SAIS and ESSA became the founder of the Large Scale Partnership on Energy Intensive Industries (LSP EII). This was done to ensure the sustainability of SPIRE-SAIS and the European Steel Skills Alliance (ESSA) under the common umbrella and with the support of the European Pact for Skills. With this LSP EII we established a **common all sectors comprising framework starting** with two specific foci:

- **Cross-sectoral activities**, based on the experience of SPIRE-SAIS for skills enabling and conducting **Industrial Symbiosis skills;**
- ESSA as an example of a **specific sector** related blueprint including an incremental upskilling of representative job profiles with a focus on t-shaped skills: technical and transversal skills (green, digital, social, individual, and methodological).

For the Blueprint's sustainable establishment, *its alliances and governance structures* have to be *aligned with existing European SPIRE coordination and sector structures* (A.SPIRE, sector associations, social partnership), assigning leadership for the specific elements of the Blueprint on the European (cross-sectoral and sectoral) and national/regional levels (sectoral, Hubs for Circularity). This will lead to improving the level of cooperation between associations and social partners, companies, training providers and other stakeholder groups for fostering the perspective of Human Resources as an enabler for technological development, implementation and exploitation.

For the implementation and rollout of the Blueprint are already in a close cooperation with the European Community of Practice for Industrial Symbiosis and Hubs for Circularity (ECoP H4C), by bringing in our Human Resources and Skills perspective in the H4C knowledge platform (https://www.h4c-community.eu/). With the ongoing collaboration we are looking for combining the European SPIRE-SAIS Blueprint and the LSP EII activities with the most important Hubs for Circularity on the regional level.

Additionally, we integrated and will further integrate the Blueprint in relevant activities on the European level (New Skills Agenda, Cedefop's Skills Intelligence Platform, and others). Beside the planned European-Regional cooperation within the ECoP H4C the further roll-out of the Blueprint is concentrating on specific sector activities, including VET system support of the member states, done in a common action with the Pact for Skills and other sectoral industry Blueprints (batteries, steel, automotive, construction, and others), as far as this is feasible and possible.

With these activities we hope to extend the Pact for Skills ecosystem and partnership by establishing alliances of EIIs to a green and digital transition, not only at European, but also at national, local and regional levels. In fact, SPIRE-SAIS, as a multi-sector Blueprint, contributes not only to the New Skills Agenda and the Pact for Skills, but also to the "Twin transformation: digital and green" of the European Commission.

6.3 SKILLS4Planet (Online Platform and Business Model)

SPIRE-SAIS has set up an IT infrastructure to host, administrate and disseminate online trainings for the whole ecosystem within an online platform SKILLS4Planet in line with and connected with other platforms. **SKILLS4Planet** is planned as an integrated part of an overarching **HUB5.0** connecting also with the **steelHub** of the European Steel Skill Agenda (ESSA) with the objective to provide an *omnichannel dissemination infrastructure* for the Skills, Learning Solutions and Qualification directories developed in the project. The platform offers a solution for sustainable and exponential impact of *Blueprint alliances*, in the case of ESSA the steelHub. Furthermore, SKILLS4Planet will be aligned with the Hubs for Circularity development in the Horizon Europe program Processes for Planet (P4Planet) and the online platform of the Hubs4Circularity projects H4C ECoP and H4C EUROPE (https://www.h4c-community.eu/).

With HUB5.0 we aim at developing and integrating training modules in a common online training and support platform, ensuring the accreditation of training (micro-credentials) and the integration of users and providers as well as the exchange of the different sectors.

6.3.1   SKILLS4Planet as part of a HUB5.0 Umbrella

HUB5.0 follows the vision of Industry 5.0 and places the wellbeing of the workers at the centre of the production process, empowering and helping them to take control of their upskilling and reskilling journey to support the transformation of the industry to provide prosperity beyond jobs and growth while respecting the production limits of the planet.

The HUB5.0 is divided in three different modules:

1. **Skill Directory module** with the skills requirements and foresight organized in Occupations, functions, and skills. This module allows to create an easy Data Base structure to modify it and use it online.
2. **Learning Solution Directory module, installed** to administrate a collection of e-learning courses, simulators, 3D models, videos and more. The administration includes monitoring the use of each learning solution, create different publishers, administrate access license to the content and more. The solutions are curated with the Skill Directory making it easy to search courses for occupation, function, or skill.
3. **Qualification Directory module, which allows the user** to upload qualification from different institutes and countries and connect them with the Skill Directory Module to filter qualifications per occupation, function or skill.

The **HUB5.0** is a platform developed with the approach of Continue Deployment, which allows to frequently deliver and to automate deployments of new functionalities and updates. Additionally, this infrastructure allows the deployment in several and independent instances, like steelHub. Every instance uses a dedicated Amazon Web Services in Europe, with their own Data Base, Dashboards and user access.

The following diagram (Figure 17) shows the HUB5.0 replicated in different instance deployed as an example of this flexible infrastructure. steelHub is shown as one of the instances that have been used already for the last 3 years by several **publishers** (organizations and individual that upload learning solutions to the platform), and **users** (industry, universities, high schools, among others).
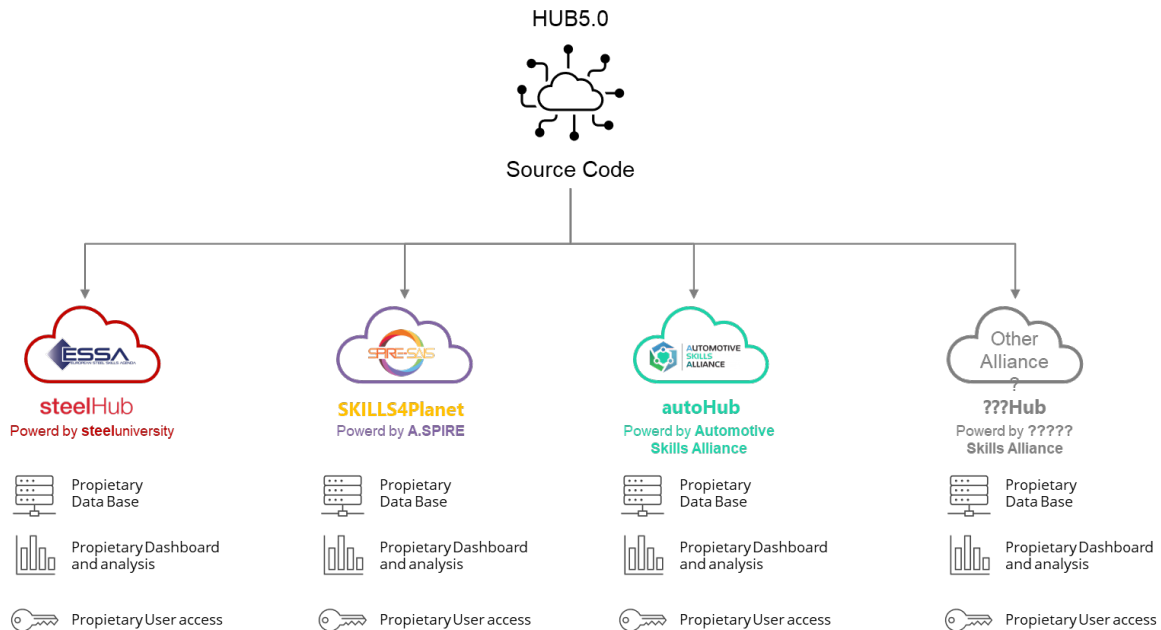
Figure 19: SKILLS4Planet Integration in an Overarching HUB5.0

This infrastructure allows to co-develop new functionalities in HUB5.0 infrastructure as well as innovative tools that can be connected to this solution, like API library to open the possibility for developers used the content in other solutions.

6.3.2   Alignment with Other (Online) Platforms

The further implementation and rollout of the Blueprint will be based on a close cooperation with the European Community of Practice for Industrial Symbiosis and Hubs for Circularity (ECoP H4C), by bringing in the Human Resources and Skills perspective. A further step will concern the integration of the Blueprint at European level, such as in New Skills Agenda, Pact for Skills, Cedefop's Skills Panorama and Skills Intelligence Platform, etc. The further rollout of the Blueprint will involve sector associations, including VET system support of the member states, with the Pact for Skills and other sectoral industry Blueprints.

SPIRE-SAIS is working on the structure and contents of a European Online Training Platform SKILLS4Planet to be connected with the common European Community of Practice of Hubs for Circularity platform (of the ECoPs H4C and EUROPE). We want to integrate trainings for Industrial Symbiosis and Energy Efficiency for the hubs for circularity (H4C). Beside a general online access, the Online Training Platform SKILLS4Planet will in particular collect and develop modules and tools related to the H4C regions in Europe.

The training platform is conceived as an open system space where existing training offers and new ones will be integrated in order to address specific sector needs. The challenge consists in providing the training offers and materials in different languages as well as in combining online learning with on the job training. In addition, it is important to update the platform after the project life through a supported business model. On this purpose, as the SPIRE-SAIS

Online Training Platform SKILLS4Planet was considered. To establish this kind of training platform, mechanisms were created for:

- identifying skills demands for IS and EE, considering skills gaps and needs for IS and EE implementation;
- identifying and organising (cross)sectoral upskilling and/or reskilling schemes, by promoting an efficient knowledge and skills provision;
- facilitating tools and resources to implement measures meeting the identified skills needs.

The online database will be connected to European tools, such as the European Skills Competence Occupation ESCO Databases, and to the formal national VET systems qualification offers. This aims at:

- informing and enabling national VET systems authorities to communicate new qualifications of EIIs and IS for a wider visibility to national VET systems' efforts to a more sustainable society.
- providing the possibility to individuate existing qualifications offer in formal VET systems that can help to improve skills for IS in the labour market.

6.3.3 Business Model

It is important to mention that publishers have to engage through an agreement with *the administrator of the instance* to sharing revenues between them to assure the sustainability of the solution. The platform described is an Omnichannel Marketplace for Learning Solutions, some are for free (as defined by the publisher, e.g. trainings developed in EU funded projects) and some are requesting a fee. The system offers to the publisher a platform to marketing their learning solution and take responsibility of all administrative process required, like payments and regular communication with clients. This "Market Place" charge to the publisher between 10% to 40% of the sells depending of the quality and reputation of the publisher. The process to sell the learning solution can be done using a **yearly license model** or a **pay-per-use model**.

For all the described components different scenarios for the implementation and running of the HUB5.0 and the related SKILLS4Planet of SPIRE-SAIS are under consideration, mainly concerning who is doing what and is responsible for (a) sales, marketing and administration, (b) IT and Backend administration of the SKILLS4Planet.

The infrastructure proposed can be done at different levels and requires the coordination of different teams to move forward the sustainability of the solution. Therefore, in the following section all the activities required to deploy this IT ecosystem are described (simplification of the infrastructure to highlight the main elements).

Publisher

Publishers are organizations like equipment and service providers, Learning Solution providers, Universities, Industries, etc, that want to distribute Learning Solution under a particular business model. To enrol publishers in the ecosystem, these main tasks need to be performed:

- **Sales, Marketing and administration:**
  - Meeting with Publisher to explain the business model and value proposition.

- Support the publisher with the integration and adaptation of the learning solution to the requirement of the system (the learning solution need to be in SCORM2004 4th edition)
- Legal agreement with between Publisher and Legal Organization in charge of SKILLS4Planet.
- Quarterly report of the use of the learning solutions.
- Pay to publisher for the use of their learning solutions.
- Request update of the learning solution based on quality feedback of the individuals.

Infrastructure

The infrastructure is used to administrate licenses access, learning solutions, competence map and more. The roles in this point can be divided in two categories:

- **Sales, marketing and administration**
    - Communication and marketing of the solutions, which include deliver presentation and demo session for clients and publishers.
    - Legal agreement between Clients and the Legal Organization in charge of SKILLS4Planet.
    - Report and analysis of the learning solution use.
    - Issue invoice to clients and collect payments.
    - Pay to publisher for the content used in the platform.
- **IT and backend administration**
    - Upload learning solutions from publishers.
    - Cybersecurity audit and implement corrections.
    - Continue development and deployment of new feature in the system.
    - Keep the system up to date with all corrections to avoid interruptions of service availability and protection.
    - Administration of the Amazon Web Service.
    - Monitoring service performance.

Open Learning Platform

The learning solution can be disseminated through this platform to those organizations and individuals with their own Learning Management System. Some examples of this type of platform are Moodle and LearnDahs+Wordpress.

- **Sales, marketing and administration**
    - Marketing and communication to improve visibility to individuals through social media, mailing list, etc.
    - Report and analysis of the learning solution use.
    - Payment process of Individuals, for example integration with "Stripe".
    - Issue invoice to clients and collect payments for Organization (companies, Universities, etc)
    - Pay to publisher for the content used in the platform.
    - Create Learning Path with the learning solutions available for organizations and individuals.
    - Connect learning solutions from SKILLS4Planet.
- **IT and Backend administration**
    - Cybersecurity audit and implement corrections.

- Keep the system up to date with all correction to avoid service availability and protection.
- Administration of servers.
- Monitoring service performance.

Organizations with LMS

There are several organizations like universities and companies that already have a Learning Management System (LMS) in their system, and they normally require uploading a learning solution into their system to improve the accessibility of the content and to have more control over the students to make a follow-up. But, this is not a solution that publishers like because they are the ones delivering the content to these organizations and they will not be able to cut the service in case the organization did not want to continue the service. So, SKILLS4Planet will help in this process offering a "streaming" service of the content from the SKILLS4Planet. From this platform the access to the content can be managed and a follow-up can be conducted of the use of the content. Also, feedback about the quality can be collected . Therefore, the following actions are required.

- **Sales, Marketing and administration**
    - Marketing and communication to generate a commercial relationship with these organizations.
    - Support the integration of the learning solution into the company LMS.
    - Create custom learning path with the learning solutions available.
    - Issue invoice and collect payment in a quarter or yearly bases.
    - Technical Support for issues or problems.
    - Bi-weekly meeting with organization to support the integration of Learning Solution to solve the training needs.

6.4 Additional Important Topics

As lessons learnt from the development of the training courses and the rollout activities, two topics were identified as important during the course of the project and addressed accordingly: Train the Trainer and Image and Recruiting.

6.4.1   Train the Trainer

Concerning the Training Framework, train the trainer approaches, guidelines and related programs are and will be integrated in the SKILLS4Planet platform, reflecting the industry needs and the education systems. Train the Trainer is an important aspect of the SPIRE-SAIS training framework. After all, the quality of each training module is related to the skills of the trainers, tutors and the teachers, which in turn makes the training of trainers an indispensable part of the implementation of SPIRE-SAIS. Topics like industrial symbiosis and energy efficiency thereby increase the importance of appropriate training for the relevant skilled workers. From the beginning of the SPIRE-SAIS project, the aim was to develop train the trainer programmes as off-the-shelf solutions based on the demand-side (what training needs arise out of the use of new technologies) and supply-side analysis (what are companies/ providers offering).

An important realisation is that trainers often no longer act in the traditional role of teachers in classroom training, but rather as coaches, mentors or facilitators, especially in the context of online learning. During the duration of the project, the SKILLS4Planet online platform became

the main focus for a train-the-trainer approach. After all, the online platform contains the training programmes developed in the project, which are primarily intended for use by companies. In terms of training for trainers, SKILLS4Planet contains specific instructions for trainers on how to use the online platform. These are tutorials in video format, which are designed to enable trainers to support learners in using SKILLS4Planet in a particularly user-friendly and application-orientated way. As the SPIRE-SAIS online platform is primarily designed for self-learning, the trainers' main task is to support learners in their own learning experience and learning journey. To do this, the trainers need a deep understanding of how to use SKILLS4Planet. Facilitation is therefore an important part of the work of trainers in the context of SPIRE-SAIS. There is a difference here to classic "training", as facilitation does not relate to the design and development of training. Rather, facilitation is about selecting the appropriate material from existing training courses, conveying it or merely supporting the learner.

In addition to the specific handling of the SKILLS4Planet platform and the support of learners with regard to the training courses developed in SPIRE-SAIS, our project also aims to address general skills for trainers. This is less about specific content related to Industrial Symbiosis and Energy Efficiency and more about the ability of trainers to convey content in general. Accordingly, these are transversal trainer skills, so to speak, which are important across all energy-intensive sectors. These skills relate to modern learning environments and therefore also include green and digital skills. Such trainer skills are also implemented in the online platform SKILLS4Planet as follows: The job profile of the Corporate Trainer is used, in which relevant skills for trainers are combined. Even though the corporate trainer profile was developed in the ESSA project for ESSA's online platform, its focus is on trainer skills that are relevant not only for the steel industry, but for the process industry in general – so that the profile can now also be incorporated into SKILLS4Planet. Originally, the Train the Trainer skills were taken from ESCO's Corporate Trainer Profile and adapted to the needs of energy-intensive sectors with the help of expert assessments from the ESSA and SPIRE-SAIS projects. The individual, altogether 18 functional skills of the Corporate Trainer thereby reflect such skills that are important for trainer staff in modern learning environments in energy-intensive industries.

In the following there are some examples of trainer skills covered in the Corporate Trainer profile. The profile primarily focuses on skills that the Corporate Trainer needs in order to provide appropriate training. Among the necessary skills are, for example:

- Coaching and mentoring employees
- Providing learners with opportunities to develop individually
    - *Trainers thereby not only have the role of teachers, but often also act as coaches, mentors or facilitators. Especially against the background of the importance of lifelong learning, it is important that trainers also support learners and clients in acquiring knowledge themselves*
- Managing learning and development in groups
- Creating an inclusive learning environment
    - *These standards require and promote essential personal and social skills of trainers*
- Developing and preparing digital resources for learning and development
    - *This standard refers to the digital skills of trainers, including the provision of simulations and the use of online tools in general*
- Evaluating and improving learning and development provision
- Assess learner achievement

- *These standards refer to the ability of trainers to both reflect on their own training methods and evaluate the learning success of learners/clients. Personal skills of trainers are crucial, also in the context of self-reflection and self-criticism.*
  - All developments of training methods aim to be sustainable in several ways, not only environmentally but also e.g. socially sustainable

With the transversal skills of the Corporate Trainer Profile and the concrete instructions on the role of trainers as facilitators on the SKILLS4Planet platform, SPIRE-SAIS helps to equip trainers for the green transformation. SPIRE-SAIS thereby also contributes to imparting skills that also enable middle managers to take on the role of trainers. Because of the fast-changing technologies and the more incremental upskilling, new leadership (Kohlgrüber et al., 2022; Kopp et al., 2021) of managers in different production and functional company areas (see Figure 8) becomes increasingly necessary. Thereby middle managers take the role of "trainers" of their subordinated operators, foremen, and technicians. The challenge for trainers and managers is to combine the implementation of new technologies and strategies with the necessities and demands of the specific workplaces (workplace innovation). In this respect, SPIRE-SAIS provides useful and user-friendly tools to support this development of managers.

6.4.2   Image and Recruiting

For a successful implementation of Industrial Symbiosis and Energy Efficiency, as well as for the success of a green transformation in general, the right employees with the right skills are an essential prerequisite. Yet, the industry is struggling to recruit such skilled workers. These recruitment difficulties are directly linked to the negative public perception of the industry as an old economy with unattractive, inflexible, outdated and dangerous working conditions, as well as a polluting industry. The SPIRE-SAIS project included this topic of image and recruiting in the development of the blueprint strategy, supporting energy intensive industries in overcoming central human recourses challenges.

In the course of the project, in-depth insights were gained into current situations of individual energy-intensive sectors and regions. Not only were the challenges discussed, but also possible solutions that are already being implemented in the sectors. At the same time, details of how individual regions and sectors deal with recruitment challenges were gained in the rollout workshops. The tools developed in SPIRE-SAIS, e.g. by connecting stakeholders through the SPIRE-SAIS Rollout and by identifying skill gaps and fostering workers' training through SKILLS4Planet, thereby facilitate the development of recruitment measures in a sustainable manner, even after the project duration. In this way, SPIRE-SAIS can serve as a basis for follow-up activities in which concerted actions can be developed across different sectors of the process industry.

Within the rollout workshops, the General Assembly and dedicated workshops on image & recruiting with the involved companies, the main challenges and most in-demand jobs for Industrial Symbiosis and Energy Efficiency were discussed as well as the image and recruiting obstacles and success factors, definition and attraction of (new) target groups.

Main challenges and solution approaches

Firstly, the main challenges with regard to recruitment were discussed. An important common denominator here is that all representatives of various process industry sectors agree that recruitment is one of the current main issues in the process industry. In this context, it has long

been discussed that energy-intensive sectors have a *negative image* and are perceived negatively by the public. This leads to a lack of interest in working in the industry from potential applicants, including students and skilled labour. There are concerns about health and safety, combined with a critical public opinion of, for example, the steel sector, which is seen as an old and declining economy and a sector in crisis. Another example is the chemical industry, which is struggling with the image of an industry with safety problems due to accidents. In particular and across all industries of SPIRE-SAIS, there are difficulties in recruiting female graduates in the male-dominated energy-intensive sectors.

Other obstacles lie at the individual level, such as *salary levels* or *unpopular working hours and working models*, e.g. night shifts. In addition, the geographical location (as companies are often located in remote areas), the lack of political support for the process industry and an investment and innovation backlog pose major challenges for the energy-intensive sectors.

The lack of suitable applicants in general and especially in the field of industrial symbiosis also has a critical impact: There is a lack of specific knowledge on the part of applicants and a lack of an overview of various disciplines. This results in the *need for specific skills for industrial symbiosis*: on the one hand, practical experience is required, but on the other hand, an understanding of new competences (circular economy/environmental issues) is important. Companies in the individual sectors have difficulty finding graduates with such specific skills. There is also a lack of specific job profiles for industrial symbiosis.

To overcome these challenges, companies are doing their best, focussing mainly on *internal training and specific public campaigns.* The companies offer such specific training, as the knowledge gained at university is often insufficient and too general (especially with regard to industrial symbiosis) for the activities in the companies. Consequently, the job profiles for industrial symbiosis and energy efficiency are formulated holistically by the companies in order to attract people with a variety of general and specific skills. In addition, the companies promote cross-departmental work and discussions on various industrial symbiosis and energy efficiency topics.

Corporate campaigns that emphasise the importance of energy-intensive industries for public perception appear to be a promising strategy. However, these campaigns must go hand in hand with improving relations and co-operation between the energy-intensive sectors and universities/vocational training systems/secondary schools: More specific courses are needed, especially with regard to industrial symbiosis (see Deliverable D4.1, analysing the vocational training system). The image of energy-intensive industries must be improved at universities, in the vocational training system and in secondary schools. Public support is needed to improve public perception by emphasising the importance of solutions for energy-intensive industries with regard to climate change: Industry as a solution provider and as an opportunity for (new) applicants to drive climate change.

Some success factors are:

- Salary (salary in the steel sector, for example, is higher compared to other sectors)
- Early engagement with schools, direct communication with students
- Stability and the ability to deal with crises
- Field for research to achieve climate goals
- More flexibility in balancing work and family life (e.g. home office).

Approaches and Strategies in Favour

As the *image* of energy-intensive industries is a major hurdle and challenge in recruiting talents, a more realistic image needs to be conveyed: from an outdated, old, dirty, dangerous industry towards a digital and green industry. A *new narrative* for energy intensive sectors should emphasize the efforts with regard to the digital transformation and decarbonization and the strong willingness of energy intensive sectors to become more energy efficient. As *digital and green innovative and open sectors, they are part of the societal solution for climate change*. Challenge lies in demonstrating to the public the importance of these industries, while at the same time showing that talent is urgently needed to shape future transformations. Against this backdrop, creating motivation and possibilities for (new) applicants to engage in energy intensive sectors and to initiate change processes should be fostered. Potential applicants consequently have the opportunity in energy-intensive industries to design the *needed solutions for the future* and thereby make a positive contribution to the green transformation. Furthermore, the positive impact of energy intensive industries as important and sustainable components of social prosperity should be emphasised. In other words, *more visibility of the contribution of energy intensive sectors to a modern and green society is needed, as only with the transformation of these industries change can be brought about*. This requires a new European and national industry strategy (see German Steel Action Plan 2020 'For a strong steel industry in Germany and Europe'; Federal Ministry for Economic Affairs and Energy, 2020).

At the same time, working conditions should also be modernised, for example following the example of the technology and IT sector: improving work-life balance of employees, lower hierarchies, etc. (Echterhoff & Schröder, 2015). Rethinking of recruitment within the industries should, aside from higher educated people, also comprise vocational educated people, with an increase in efforts to integrate neglected target groups (e.g. female workers, migrants) with attractive training and upskilling possibilities (e.g. for migrant workers) for on-boarding and lifelong learning. Last but not least, young people's ideas and ways of thinking should also be included and considered to a greater extent. It thereby needs to be considered that ambitions, demands and mindsets of the young generation differ from the previous generations.

Against the background of IS improvement, *regional integration* is particularly important via the connections to regions by Corporate Social Responsibility (e.g.: urban IS, using cleaned water for communities, connect industrial sites and heat parts of a city with produced heat) but also by finding common solutions (e.g. pipelines for transport of heat and gas, better connections to urban infrastructure). Smart cities should integrate the value of industry's contribution to their ecosystems.

Internships and open-door events as means to convey a realistic image of industry, also for people at a young age, are already in place and should be fostered on the regional level, where people live, learn and work. But companies could not manage the transformative change alone. Therefore, all relevant stakeholders with their own responsibilities are in charge. Improving *relationships and cooperation* of companies with universities, the VET system and secondary schools is needed, as well as public support to increase positive impact on the image of energy intensive sectors. This should lead to improved knowledge among potential applicants about industry, while also fostering a better response to industry needs by educational institutions (creating closer relations to the surrounding communities).

Against this backdrop the *lack of suitable applicants* in the field of Industrial Symbiosis should be solved by balancing (new) people with fresh ideas with experienced company staff, working in teams. However, imparting skills and knowledge internally (with a focus on in-house talents)

is the most suitable and realistic way recently in order to avoid a war for talents and to retain talents in the company. This needs more specific courses, especially in the field of industrial symbiosis, on the job and online. In this respect, SPIRE-SAIS contributes with its training courses to raise awareness and introduce the topics of Industrial Symbiosis and Energy Efficiency for employees in various industries.

As company structures oftentimes pose challenges, these changes need to come step by step, for the adaption of new structures and learning arrangements to succeed.

Further insights and examples from the sectoral and regional rollout workshops

The SPIRE-SAIS rollout relates heavily to the topics of image and recruitment. In the rollout, the topic of image and recruitment was discussed many times during the sectoral and regional workshops in connection with industrial symbiosis and energy efficiency. Connections were fostered during the rollout workshops between different stakeholder groups, which were able to contribute their respective perspectives and topics. Further rollout workshops could address the topic of image and recruitment even more actively in the future and develop further solution strategies, even after the project duration. Discussion in the rollout workshops also made clear that, through the SKILLS4Planet platform, which offers training programmes focusing on industrial symbiosis (IS) and energy efficiency (EE), recruiting can also be facilitated. SKILLS4Planet thereby helps to identify skills gaps and promotes workforce development and strategic planning. By providing detailed insights into the needs of industry, especially companies, SKILLS4Planet enables a better understanding of the specific requirements of each sector, which in turn supports the recruitment of suitable candidates.

Industrial symbiosis can have a significant impact on talent recruitment from both an employee and industry perspective. For workers, industrial symbiosis creates a new job pool that allows for smoother movement between roles in the circular economy. This mobility can be beneficial for workers as it provides them with multiple opportunities in a sustainable and evolving sector. However, sector representatives from SPIRE-SAIS are concerned that the high turnover of staff from an industry perspective may raise concerns about investment in extensive training programmes. However, it is expected that a balance will be achieved in the long term that reconciles labour mobility with retention.

The integration of industrial symbiosis not only improves sustainability and competitiveness, but also emphasises the importance of regional skills development. Accordingly, sector representatives expect many important steps in talent acquisition and training to take place at the regional level. The involvement of different stakeholders is crucial, as skills are often tied to specific regions. The regional focus on industrial symbiosis, often associated with industrial clusters, can also help to attract talent by emphasising the benefits of a circular economy approach. The sectoral workshops show that the challenges with regard to skill needs differ regionally. For example, the Finnish chemicals sector (more specifically the battery sector) shows that there are strong skill needs and thousands of skilled workers are required, which are currently missing from the Finnish labour market. Meanwhile, the situation in the Italian Emilia-Romagna region is different - there are enough qualified workers and good training opportunities, but the chemical sector here is in a process of change, from classic chemical production to more sustainability, which currently leads to challenges in the sector; as a result, many people in the region are losing their jobs. The current regional situation in Emilia-Romagna and missing job offers tends to cause qualified workers to migrate to other regions and countries.

A crucial aspect of labour force development is the focus on education and training. While attracting talent is the first step, continuously improving skills ensures that the workforce remains competent and can adapt to changes in the industry. However, despite its potential benefits, industrial symbiosis is often perceived as complex and difficult to explain. The concept has various definitions, which makes it less attractive. To counteract this, emphasising positive terms such as sustainability, greening and modernisation can help to better communicate the benefits.

It is fundamentally important to emphasise the clear benefits of industrial symbiosis. It pushes the boundaries of collaboration between industrial neighbours, offers site-level solutions and connects different sectors. This collaborative potential can be a compelling aspect for industry to work towards common goals, making Industrial Symbiosis an attractive proposition despite its inherent complexity.

When asked whether it is more difficult to attract workers to traditional or green jobs, sector representatives give a nuanced answer. Greener jobs tend to be more attractive as the focus is increasingly on sustainability. However, it is crucial to communicate that the green transition will bring changes in job roles. Clear explanations and a focus on upskilling and reskilling are crucial to prepare the workforce for these changes. Rather than just differentiating between green and traditional jobs, it makes more sense to discuss the overall transformation of the industry and the opportunities it presents.

To summarise: While recruiting skilled workers for energy-intensive industries is a challenge, tools such as the SKILLS4Planet platform and the SPIRE-SAIS rollout offer valuable solutions. By addressing skills gaps, fostering regional collaboration and focusing on continuous workforce development, these efforts can improve talent attraction and retention and ultimately contribute to a more sustainable and competitive industry. The rollout workshops have further underlined the efforts to improve the image of energy-intensive sectors and at the same time show that real change processes are underway in the various sectors and regions. Efforts must continue to improve the perception of energy-intensive industries among young, qualified applicants. In particular, the green and digital efforts of the sectors should be highlighted in order to break away from the status of the old economy. Transformation processes are also taking place with regard to working conditions - away from hard, dirty work towards a more modern way of working and better integration of disadvantaged labour market groups.

The rollout and the sectoral workshops have also shown that the individual sectors are pursuing specific, sector-coordinated measures on image and recruitment. Although most of this is primarily happening at company level, sector-specific dialogue is taking place in various working groups. In the steel sector, ESTEP's Focus Group People should be emphasised in particular, where measures relating to image and recruitment are also discussed with the members. The water rollout has shown that there is also a working group in the water sector that deals with human capital and therefore also with recruitment issues. The sector associations, which create important connections, are particularly valuable partners. The SPIRE-SAIS project and the rollout have created further connections and networks between stakeholders within the sectors and regions and strengthened structures that can facilitate communication and cooperation even after the project has ended. However, a major challenge of SPIRE-SAIS was to achieve concerted action across all sectors represented in the project. This long-term and demanding task remains open for follow-up projects.

6.5 Sectoral-National-Regional Training Ecosystem Framework and Rollout

In close cooperation and within workshops with the SPIRE-SAIS Sector Representative Steering Committee we decided to have specific sector rollouts integrating their national members (national associations, companies, training providers, public authorities, and others). Due to its cross-sectoral relevance the rollout to the Water and Engineering sectors were more dedicated to an integration of stakeholders from the different industry sectors - very much in line with the Industrial Symbiosis concept. The second priority was to start rollout in selected pilot regions related to Industrial Symbiosis.

The further rollout of the Blueprint will be done with the LSP EII focusing the establishment of sectoral-national rollout workshops and regional ecosystem. While the steel industry has already several national-regional ecosystems running (which have to be kept alive), the other sectors just started this process (see chapter 5.4). Beside cross-sectoral topics relevant for almost all sectors, explicitly the sector needs and related trainings, directed to their specific workforces are addressed. Connecting the results with other activities on the European but especially on the national and regional-local level by establishing a European Community of Practice for Skills Adjustment and Training is the other priority. This is not only a rollout but a connection to and an exchange with existing initiatives and networks, together with the development of a marketing strategy and business models.

Such as SPIRE-SAIS this is conceptualised as an ongoing **Social Innovation and Interaction Process** integrating and engaging relevant stakeholders of the Energy Intensive and Process Industries in the development, testing and improvement, leading to an accepted implementation and institutionalisation of the inventions and interventions within the project. Therefore, a central focus is on the participative development process and installation of strategies, measures and tools, supported by a common acceptance, advancement and promotion of the results to the broader interested public.

The related activities have to concern a complex framework of actions that should include the understanding of economic, social and political dynamics and the relationship with the territory interested by a relevant and, in some cases, heterogeneous industrial presence as well as the needs to foresee and promote the improvement of existing and creation of a new networks able to integrate the project results in the direction of human-centricity, resilience and sustainability in energy intensive industries. Aim is to share all the information and data to speed-up a real flow of "resources" among the different industries but also to appoint a "cockpit", a direction entity to assure a governance in the perspective of an Industry 5.0 implementation.

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Annex

A1. Skills Description

Category 1: Technological Skills

1.1 Skills related to Industrial Symbiosis

IS basic understanding:
to have acquaintance/familiarity with IS approach, and its core concepts & methodologies, resource reuse and recycling* as well as resource valorisation strategies. It includes to

- Understand IS as one of the main means to achieve/implement the different circular economy strategies (in circular product design and development and circular business models).
- Be able to discuss how IS is a part of a transformation of systems towards CE and sustainability
- Understand the differences among IS, CE and sustainability and how these concepts are related.

**Resource reuse/recycling* is the ability to reprocess of discarded waste materials for reuse, which involves collection, sorting, processing, and conversion into raw materials which can be used in the production of new products. [1]

System optimisation and process analysis:

(1) Optimization is the discipline of finding the best alternative among a set regarding a specific criterion and given constraints**. [2] System optimisation, as a skill, is the ability to enhance system capabilities about IS and integrate of subsystem elements to the extent that all IS components operate at or above user expectations. [3]
(2) Process analysis as a skill refers to the ability to carry out a systematic review of all IS steps and procedures followed to perform a given IS activity. [1] A process analysis can be used to improve understanding of how the IS process operates, and to determine potential targets for IS process improvement and increase efficiency. [1]

Field experience (in IS):

- It refers to the level of experience achieved through applying IS knowledge gained during the classroom with supervised practice in the production field. [4]

Product life cycle thinking assessment:

- Every part of a product's life cycle – extraction of materials from the environment, the production of the product, the use phase and what happens to the product after it is no longer used – can have an impact on the environment, society and economy in many ways.
- Product life cycle (thinking) assessment, as a skill, is the ability to evaluate the environmental, social and economic impacts of a product, process or service from the very first life cycle (development) stage to the very last (market entry and market removal) or to any life cycle stage in between. [5][6] It includes to identify and to reduce negative or improve positive impacts and consider the most relevant aspects. [22] It implies to be familiar with the implications of material and design decisions for other stages of the products life cycle; to be acquainted with different methods and tools to picture the life

cycle of a product; and to understand, interpret and work with results of e.g. LCA (life cycle assessment), LCC (life cycle costs) and SLCA (social life cycle analysis).

- This skill includes having a knowledge about *eco-design** of product, technology and processes. *_Eco-design_ is the integration of environmental aspects into the product development process, by balancing ecological and economic requirements. Eco-design considers environmental aspects at all stages of the product development process, striving for products which make the lowest possible environmental impact throughout the product life cycle. [7]

Sustainable resource management:
Sustainable resource management, as a skill, can be defined as

- the ability to perform sustainable practices by managing resources in a way that will benefit current and future generations. [8] This skill implies to understand the role of processes and materials from a IS perspective and to know the relation of resources with sustainability. [22]

This skill includes *waste reduction and prevention*, waste management***, as well as *water conservation*****, *environmental monitoring***** and *****resource cascading.

*_Waste reduction and prevention_ is the ability to use less material and energy to minimize waste generation and preserve natural resources. It is broader in scope than recycling and incorporates ways to prevent materials from ending up as waste before they reach the recycling stage. [1]

 **_Waste management_ herein refers to the skills required to collect, transport, dispose or recycle and monitor waste. [1]

***_Water conservation_ refers to the ability to perform a more efficient, conservative use of water in the production plant which includes the ability to monitor sites, to negotiate with regulatory authorities, or professionals such as engineers, planners and surveyors, to advise about possible water conservation solutions and to keep up to date with changes in legislation/EU directives. [1]

****_Environmental monitoring_ is the ability to assess environmental conditions and trends, support policy development and its implementation, and develop information for reporting to national policymakers, international forums and the public. [9]

*****Resource cascading: Resource cascading allows for significantly extending a resource's useful life through repeated utilization, exploiting sequentially its full potential to improve its efficiency. This approach to production and consumption states that energy recovery should be the last option, and only after all higher-value products and services have been exhausted. [22]

1.2 Skills related to EE

Understanding energy use and costs:
It refers to have

(1) an understanding of the principles needed to perform a more efficient, conservative use of energy in the production plant [1],
(2) the ability to collect, arrange and analyse energy and financial data for the purpose of identifying energy use and savings, [10]

(3) the ability to arrange and retrieve data, knowledge and ideas, research and investigation of specific technical and financial knowledge. [11]

It also includes to have an acquaintance with the manufacturing principles to reduce energy consumption.

Energy management of equipment and parts:

- to be able to target, implement, and track progress to ensure energy savings of machinery, equipment, processes, and technologies. [12] This skill includes efficiently monitoring energy and metering energy data, finding opportunities to save energy, targeting energy opportunities, and tracking the progress.

System optimisation and process analysis:

(1) Optimization is the discipline of finding the best alternative among a set regarding a specific criterion and given constraints. [2] System optimisation, as a skill, is the ability to enhance system capabilities about EE and integrate of subsystem elements to the extent that all components operate at or above user expectations about EE. [3]
(2) Process analysis as a skill refers to the ability to carry out a systematic review of all steps and procedures followed to fulfil EE objectives. [1] **A** process analysis can be used to improve understanding of how the process operates, how to monitor energy use and to determine potential targets for EE. [1]

Energy data collection and analysis:

- This skill consists of the ability to collect data to measure the energy performance, ability to undertake the detailed analysis required for energy audit savings calculations, ability to assess, select, install and use appropriate monitoring equipment and develop analysis systems. [10]

It includes *complex information processing and interpretation**

*Complex information processing and interpretation can be referred as the ability to get complex raw data transformed into a meaningful form (information) in the CPU (central processing unit) and evaluate the output. [1]

Field experience in (EE):

- It refers to the level of experience achieved through applying EE knowledge gained during the classroom with supervised practice in the production field. [4]

Category 2: Individual/Personal Skills

Environmental awareness:

- Being environmentally aware means understanding how our behaviour of energy and materials use impacts the environment and committing to making changes to our related activities to protect the environment. [1] This skill includes the capacity to include environmental concerns about the consequences of resources use alongside others (such performance and safety) in taking decisions, including in the choice of processes and technologies. [1]

Collaboration:

- Collaboration skills can be defined as the interpersonal and intrapersonal qualities and competencies we leverage to collectively solve a problem or make progress toward a common goal. [13] They can be effectively use in value chain, network chain and generation of alliances.

Skills in this category include *team-based approach*, effective communication*** and *multidisciplinary thinking and acting****.

To understand the **team-based approach*, first, we need to define "teamwork". Teamwork is the cooperation between people characterised by a unified commitment to achieving a given goal, participating equally, maintaining open communication, facilitating effective usage of ideas [6]. The team-based approach is a style of project management in which everyone on the project team is held equally responsible for the quality and success of the project. [14]

**Effective communication: refers to the ability to exchange ideas, thoughts, opinions, knowledge, and data so that the message is received and understood with clarity and purpose. When we communicate effectively, both the sender and receiver feel satisfied. [15]

***Multidisciplinary thinking and acting: refers to have perspective defined by the ability to draw insights from multiple disciplines and to apply them to your own area of focus in a way that challenges traditional notions and enriches the process. [16]

Initiative taking & entrepreneurship:

- Sense of initiative and entrepreneurship refers to an individual's ability to turn ideas into action. It includes creativity, innovation and risk-taking, as well as the ability to plan and manage projects in order to achieve objectives. [1] This supports individuals in the workplace in being aware of the context of their work and being able to seize opportunities, and is a foundation for more specific skills and knowledge needed by those establishing or contributing to social or commercial activity. This should include awareness of ethical values and promote good governance.

This skill includes *working autonomously*, strategic thinking** and decision making****.

*Work autonomously: The more expertise you have, the greater responsibility you have in making these decisions independently. With greater autonomy comes less support or supervision but increased accountability. [1] Working autonomously requires ability to achieve results with no supervision or with limited supervision, ability to work both independently and as a member of a team, to make independent decisions and solve problems on your own. It also demands self-motivation, confidence and time management. [1] It can be defined as the ability to develop one's own ways of doing things, motivating oneself with little or no supervision, and depending on oneself to get things done. [6]

**Strategic thinking: It is the ability to acquire business insights and possible opportunities, in order to achieve competitive business advantage on a long-term basis. [6] It involves seeing the big picture, planning ahead, and putting thought into action, typically to gain a competitive advantage in business. It is an organizational and pragmatic type of critical thinking. [17]

***Decision making is defined as making a choice from several alternative possibilities. [6] It is a valuable leadership ability which demonstrates the capacity to think objectively and weigh different options. [18] In this case, it refers to the ability to develop and assess business cases for implementation of EE and IS opportunities. [10]

Complementary, systematic, critical thinking

- <u>Critical thinking</u> refers to the ability to analyze information objectively and make and defend judgements based on internal evidence and external criteria and to critically evaluate the credibility and reliability of information before using or passing it on to others. [1][6]
- It involves the evaluation of sources, such as data, facts, observable phenomena, and research findings before making a reasoned judgement/logical decision. [1]
- Good critical thinkers can draw reasonable conclusions from a set of information, and discriminate between useful and less useful details to solve problems or make decisions. [1] An employee with critical thinking skills can be trusted to make decisions independently, and will not need constant handholding.

<u>Complementary thinking</u> refers to be able to adopt multidisciplinary approaches which complement each other.

<u>Systematic thinking</u> is a holistic approach to problem-solving considering every part of the issue. It's an approach of analysing and understanding problems in detail before making conclusions and understanding the underlying structures that cause the issue and thinking of a wide range of different solutions before deciding which one is the most appropriate. [19]

Creativity: Creativity is the ability to think about a task or a problem in a new or different way, or the ability to use the imagination to generate new ideas. Creativity enables you to solve complex problems or find interesting ways to approach tasks. If you are creative, you look at things from a unique perspective. [1]

This skill implies to know and select techniques to stimulate creative thinking.

Category 3: Regulatory

General regulatory awareness:

- to be able to understand and keep up with the latest general legislation that directly or indirectly support and promote IS and EE and to commit to act in compliance with them.

Legislation on waste management and CO_2 emissions:

- to be able to understand and keep up with the latest legislation on waste management and CO_2 emissions and to commit to act in compliance with them.

Category 4: Business related

Business knowledge:

- It refers to the basic knowledge that is needed to start, run, and/or grow a business. It covers the knowledge in Business life cycle, Business model, Marketing, Production, Human resource, Financial (analysis, planning and management), Accounting and audit, Business management areas. [20] It is a sum of skills, experiences, capabilities, and insight which you collectively create and rely on in your business. [21]

Identification of potential opportunities:

- The ability to identify potential opportunities about IS and EE requires the capability to think logically and creatively, to have knowledge about business cases, to have an entrepreneurial mindset, to keep up with emerging trends, to integrate EE and IS findings into cross-business plans. It includes to

- Be able to broaden the perspective of what kind of value is captured within a business through IS
- Understand the financial differences, chances and risks associated with IS

Fostering cooperation:

- It refers to the ability to achieve and sustain the networking and cooperation between stakeholders and also between facilitators, as well as the skills related to the use of collective intelligence facilitation tools, encouraging collective decisions and negotiation. It is not only based on the IS facilitator's technical knowledge, but also based on every stakeholder's input. [11] It includes to
  - Understand what a value chain, a supply chain and a value network mean in IS context
  - Be able to identify and to map the interactions and the stakeholders involved in a symbiotic value network
  - To be acquainted with the main value network collaboration strategies
  - Understand how reverse logistics works and how it can be developed
  - Be able to define the steps to establish a symbiotic value network context
  - Know which tools can be useful for the management of symbiotic value network towards sustainability

Business model transformation:

- It refers to the skills needed to transform the current businesses into a sustainable and energy efficient ones. These skills include broad and deep industry knowledge on sector specific best practices and processes, globally relevant emerging trends about IS and EE and business challenges. [11] It includes to
- Understand the need of integrating IS and sustainability within the Business model
- Be able to draft a business model with a focus on IS, circularity and sustainability

Project planning and management:

- ability to direct and guide a group in completing tasks and attaining goals of EE assessment and IS. [10]

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A2 Selected Main Training References

KATCH-e — Training for Circular Economy in the Construction and Furniture Sectors

Brief description:

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

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

Language: English

Modality: Online

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

Cost: Free

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

1. **Basics:** Basic knowledge on **circular economy** that supports the understanding of the other materials;

2. **Business:** The **business approach**, required for the success of new, more circular and sustainable products or product-service;

3. **Design:** Product and product-service system design according to circularity and sustainability criteria; and

4. **Assessment and communication:** A support area with contents regarding assessment and communication in circular economy **with a life cycle perspective.**

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

8 Modules

7 Tools

CircularStart into Business

Brief description:

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

Target group: Incubators, trainers, consultants, entrepreneurs, start-ups, training centers, universities...

Language: English

Modality: Online

Duration: 55 h

Cost: Free

Training platform: 4 specific courses for each stage of business model development:

1. **Ideation:** Define the **value proposition of your business** through exploring and producing as many ideas as possible regarding circularity strategies.

2. **Integration:** Learn to analyse the circularity of the value chain of your business, in order to identify opportunities for circularity performance and therefore, to **specify a business model based on a circular value chain.**

3. **Validation:** To validate and improve your business models' sustainability and circularity performance which can be **measured by specific indicators.**

4. **Implementation:** To structure and take advantage of an entire communication strategy (based on ethical, transparency and sustainability values) and to define how to **execute, monitor and innovate** the business model.

Other resources: Manual for trainers, guidance tool, Circular Business Model Canvas

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

4 COURSES — Ideation, Integration, Validation, Implementation

29 units | 650 slides | 39 excercises | 60 supporting resources

Circ Lean | THE SELF-ASSESSMENT MODULE

Brief description:

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

Target group: Industry managers	Language: English	Modality: Online	Duration: 10 - 20 hrs	Cost: Free

The module consists of the following:

➢ **Knowledge and illustrative examples**: An introduction to the concept of industrial symbiosis, the methodologies for its implementation within your company, and how industrial symbiosis can benefit your organisation. Your organisation may already be doing industrial symbiosis but not calling it as such.

➢ **Training exercises**: Guided exercises to help you gain practical experience of the concepts.

➢ **Activities** to be carried out in your own organisation with supporting documents: Documents that you can download to help you log your organisation's information and identify potential industrial symbiosis opportunities.

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

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

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

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In☯ight Fostering Industrial Symbiosis through the development of a novel and innovative training approach

Brief description:

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

Target group: VET students, Business Managers & Public Bodies	Language: English & partly in French, Italian, Romanian, Slovenian and Spanish	Modality: Online	Duration: 150 h (6 ECVET points)	Cost: Free

The Curriculum's five learning modules are:

1 — IS THEORY, CONCEPTS AND CONTEXT
- 1.1 Introduction to **Circular Economy**
- 1.2 Introduction to **Industrial Symbiosis**
- 1.3 Circular Economy and **IS at EU level**

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

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

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

5 — IS CASE STUDIES
- 5.1 **Territorial** approach
- 5.2 **Industrial park** approach
- 5.3 **Company** approach

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

IEOOC — Industrial Ecology Open Online Course
Online since 2018

Brief description:

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

Target group: University students	Language: English	Modality: Online	Duration: Not estimated	Cost: Free

The course is divided into three broad sections:

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

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

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

Junior Expert in Circular Economy

Brief description:

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

Target group: European young people with at least a school diploma and university students	Language: English	Modality: Hybrid	Duration: Annual course: 800h (4 ECVET)	Cost: Free (20 places available)	EQF level: IV

Link: https://studycirculareconomy.com/#:~:text=A%20Junior%20Expert%20in%20Circular,control%20of%20product%20and%20process & https://centoform.it/portfolio/junior-expert-in-circular-economy-2022-2023/

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

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THE EUROPEAN JUNIOR WATER PROGRAMME (EJWP)

Brief description:

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

Target group: Junior employee from a water-related organization	**Language:** English	**Modality:** Hybrid	**Duration:** 2-year Programme, 8 weeks (1 day per week)	**Cost:** Please contact EJWP for a cost estimate

EJWP's specialists provide training on competences including:

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

Link: https://juniorwaterprogramme.eu/

EJWP's 3 pillars:

➤ Knowledge creation and transfer: Masterclasses on European policies, water technology and innovations, and primary water challenges – including local water projects of participating organisations

➤ European network opportunities through EJWP community building: Integration in Water Europe, EJWP Ambassadors, and event participation

➤ Personal and professional skills development in international teams: Emphasis on cultural awareness and diversity in project exercises

Certified Water Steward Programme

Brief description:

Irish Water is running a water stewardship training programme in partnership with Water Stewardship Ireland and the Lean & Green Skillnet. The programme supports business customers with **training on how to lower water consumption and reduce operating costs while also protecting the environment.**

Target group: Employees responsible for water management in their company	**Language:** English	**Modality:** Online	**Duration:** 8 weeks	**Cost:** Funded By Irish Water and the Lean & Green Skillnet

Learning Experience

Online Learning

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

Workshop Webinars

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

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

Reduce Water Use
Training on water conservation and quick wins at your site to drive behavioural change

Monetary Cost Savings
Understand and visualise your site's water lifecycle to reduce operating costs

Reputational Benefits
Accepted under Bord Bia's Origin Green Scheme and accredited by EWS

Protect the Environment
Add the latest cutting edge green credential to hit your sustainability targets

EUROSTEELMASTER2022 RINA

European Advanced Training Course for the Worldwide Steel Sector

SPIRE-SAIS

Brief description:

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. As for the Steelmaster, the course is addressed to Steel sector, but Energy Efficiency and Industrial Symbiosis are transversal to all the planned modules. Within the Master two seminars took place: ECOSLAG and ControlInSteel.

| **Target group:** Professionals related to the steel sector | **Language:** English | **Modality:** Online | **Duration:** Annual course programme – 5 days – 30h | **Cost:** Full fee: 650,00 Euro (+VAT) Student fee: 250,00 Euro (+VAT) |

Seminar ECOSLAG (2h)

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

Seminar ControlInSteel (1h 40min)

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

Link: https://www.rina.org/en/media/event s/2022/05/16/eurosteelmaster-2022

European Advanced Training Course for the Worldwide Steel Sector

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