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

Mapping of current VET provision for industrial symbiosis and energy efficiency skills of the EIIs sectors in selected EU Member States

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INTRODUCTION

D4.1. "Mapping of current VET provision for industrial symbiosis and energy efficiency skills of the EIIs sectors in selected member states" analyses the supply side of the skills related to industrial symbiosis (IS) and energy efficiency (EE). The aim of this report is to assess how the formal VET systems deliver skills relates to IS and EE in five selected EU Member States. It analyses how frameworks at national and EU level as well as concrete VET schools deliver skills related to IS and EE for the energy intensive industries (EII) sectors. The report also intends to establish the reference points and main mechanisms for, and barriers to, skills/training delivery in the European EIIs.

The countries covered in the report (Germany, Italy, Poland, Portugal and Spain) were selected for four reasons. Firstly, EII play important role in the economy of all selected countries. Secondly, partners representing these countries are involved in the SPIRE-SAIS project, providing an in-depth knowledge of the national context and, where needed, knowledge of the national languages. Thirdly, these countries cover different types of VET systems. Finally, the selection allows for a relatively wide geographic coverage of the EU Member States.

The report covers three steps to reaching the above-indicated main aim of this deliverable. Each step is reflected both in five country cases and their cross- case (or horizontal) analysis. These steps are:

a) An in-depth analysis of the national VET systems.
b) Delivery of IS and EE skills in the formal VET systems and at the school level (see Annex 1 for the list of VET schools and their programmes included in this deliverable).
c) An analysis of barriers and drivers of IS and EE-related skills provision in the formal VET systems and at the school level.

Below we provide a more detailed description of the three steps as well as an overview of the data collection approaches and the report's structure.

The first step, **analysis of the national VET systems** aims to understand how exactly IS and EE related skills are delivered in general. The report presents a comprehensive analysis of the VET systems in Germany, Italy, Poland, Portugal and Spain. It provides a general description of the VET systems in place and explains the role and involvement of EII representatives in the VET processes through the overall analysis of industries' involvement. It also maps potential providers of IS and EE skills through identifying types of institutions responsible for skills delivery in the country. Table (1) below summarises our operationalisation and data collection approaches for the analysis of national VET systems.

Table 0-1. Operationalisation and data collection for the analysis of the national VET systems.

General questions	Operationalisation sub-questions	Methods
National VET systems		
How do VET systems at a national level serve the needs of EII?	What are the main **characteristics** (relevant for EII) of the VET system in the country? What are the VET institutions that train professionals for EIIs (incl. organisations of VET institutions)?	Desk research Interviews Survey(s) Case studies
	What are the most important **policies** and VET **reforms** implemented in the country relevant for the delivery of EE and IS skills?	
	What are the key patterns of **relations** between national VET provision and a major EIIs companies in selected member states?	

Source: Visionary Analytics.

The second step focuses on the **delivery of IS and EE skills in the formal VET systems and at the school level,** specifically, the contents and methods of delivery. In other words, it

explains what skills are delivered to the students in the national VET systems and how. From the content side, this step maps out the coverage of the relevant EE and IS skills in the formal VET system. This is particularly important for understanding the skill gaps that exist in the formal VET education at the national level. From the process side, the focus has been set on the methods of delivery and cases of good practice with at least three cases per country. This step of the analysis has also sought synergies with WP3, which has provided the report with the list of the most relevant skills for cross-sectoral IS and EE.

VET schools were selected based on desk research, survey (see below), interviews conducted in 2021 and WP4 partners' suggestions. Selection criteria included:

- School offers specific programme or specific subject/ module within programme covering one or more of the four following job profiles selected for WP4: Energy Manager, Energy Technician, Waste Manager and Waste Technician. Ideally selected programmes should be cross-sectoral (i.e. programmes relevant for more than one EIIs sector).
- VET school provides formal initial VET for relevant job profiles.

Table 2 below summarises our operationalisation and data collection approaches for the analysis of skills delivery.

Table 0-2. Operationalisation and data collection for the analysis of the national VET systems.

General questions	Operationalisation sub-questions	Methods
Delivery of IS and EE skills in the formal VET systems		
What EE and IS skills are the most relevant across the process industries?	**What skills** are the most relevant for the cross-sectoral IS and EE of the EIIs?	The question will be answered by WP3
The content/ learning outcomes: What EE and IS skills are delivered and to what extent?	Which EE and IS skills are covered in formal VET? What are the **key EE and IS skills gaps** in formal VET (diff. between supply and demand of skills)?	Desk research Interviews Survey(s) Case studies
	For the EE and IS skills covered, to what **extent** these skills are covered (e.g. specific programme(s) or specific module(s), level of training, scope of knowledge covered)?	
The process/ training practices: How EE and IS skills are delivered?	**How** EE and IS skills are delivered (incl. good practice examples on training materials, training methods, training facilities and infrastructure, guidance and other available for school teachers and in-company trainers)	

Source: Visionary Analytics.

Finally, the third step involves an in-depth **analysis of barriers and drivers of skills delivery in the formal VET systems and at the school level.** It pinpoints the key challenges and provides insights into how VET systems and programmes could be improved to ensure a more effective provision of the EE and IS skills. On the other hand, it elaborates on good practice examples of VET programmes delivering EE and IS skills most successfully while bearing in mind their potential for upscaling or transfer. Table 3 below summarises our operationalisation and data collection approaches for the analysis of barriers and drivers.

Table 0-3. Operationalisation and data collection for the analysis of the drivers and barriers of IS and EE skills delivery.

General questions	Operationalisation sub-questions	Methods
Drivers and Barriers		
What are the factors determining successful provision	What are the main **drivers** (incl. national policy measures) that encourage formal VET schools to deliver skills concerning cross-sectoral IS and EE of the EIIs sectors?	Desk research Interviews Case studies

General questions	Operationalisation sub-questions	Methods
of the IS and EE skills in the formal VET systems?	What are the main **barriers** that prevent formal VET schools from delivering skills concerning cross-sectoral IS and EE of the EIIs sectors?	

Source: Visionary Analytics.

Methodologically, chapters of this report rely on a variety of data collection methods. First and foremost, desk research with the lists of sources presented at the end of each chapter constitutes the foundation of the analysis. We have also conducted a survey of A.SPIRE Members in respective countries to understand and map out their cooperation networks with formal VET providers and expectations for relevant skills delivery at the VET level. It was carried out between 12 April and 13 May 2022 and received 28 responses (12 full and 16 partial).

Apart from their main analytical purpose, the survey and desk research results have also been used for the purpose of identifying potential candidates for in-depth interviews at the VET school level. Besides, we have also used data collected from the previous interviews in other tasks in order to identify interviewees. The interviews have covered the following stakeholder groups: (a) national experts of the EE and IS; (b) representatives of institutions responsible for the administration of VET on the national or regional level; (c) representatives of selected VET institutions; (d) representatives of selected specific good practice examples.

Finally, particular attention has been paid to the analysis of good practice cases. The report has identified good practice cases implemented in partner countries that are directly related to: a) skills delivery processes, b) IS and EE, and c) EII. Horizontal analysis of these cases has been instrumental to identifying the overall trends concerning IS and EE-related skills provision, while lessons from specific case studies can be integrated directly in the SPIRE-SAIS Blueprint.

Good practice cases have been collected from three different levels: a) policy level (e.g. policy initiatives encouraging VET institutions to integrate green skills into their curricula; b) VET system level (e.g. projects implemented across VET schools on EE and IS skills); c) school level (e.g. IS courses or didactic materials developed by a concrete VET school). Good practices are integrated in respective chapters of country cases (see below) and presented in the form of light blue boxes.

Structure of the report contains a separate section with the horizontal analysis of the findings and then proceeds with country-based sections (for Germany, Italy, Poland, Portugal, and Spain respectively). Horizontal analysis refers to a cross-case analysis of all five country case studies, pointing out the key trends and patterns in EE and IS skills delivery with the implications relevant for the development of the SPIRE-SAIS Blueprint. Country-based sections provide in-depth answers to the operationalisation questions at the national level. Each country-based section begins with an introduction summarising the key VET characteristics of the country. It is then followed by chapters overviewing IS- and EE skills integration in national policies as well as the delivery of the IS and EE skills VET at both national and school levels. Case studies are concluded with a chapter identifying barriers and drivers to EE and IS skills delivery and subsequent conclusions.

CHAPTER 1. HORIZONTAL ANALYSIS OF COUNTRY CASES

1.1 Executive Summary

The following document contains the key findings of the horizontal analysis of five country-based case studies on Italy, Germany, Poland, Portugal, and Spain. This section provides a concise summary of the findings of each country across the key operationalisation dimensions in the format of a synthetic table. The following Sections 2, 3, and 4 go into further detail when outlining findings in the key dimensions. Section 4 provides a synthesis of overarching findings and provides some recommendations, while Sections 6 and 7 specifically focus on the results directly relevant for the SPIRE-SAIS Blueprint from the VET / WP4 perspective and on the idea of skills matrix.

Table 1-1. Summary of the cross-case analysis findings based on the operationalisation dimensions.

Country / Dimension	Italy	Germany	Poland	Portugal	Spain
General features of the VET system	A decentralised VET system with high levels of standardisation and permeability	A decentralised VET system with high levels of standardisation but medium level of permeability	A centralised VET system with high levels of standardisation and permeability	A centralised VET system with high levels of standardisation and permeability	A moderately decentralised VET system with high levels of standardisation but medium level of permeability
IS- and EE-related green skills in national policies	Absence of specific provisions regarding the IS and EE-related green skills in most national strategic policies.	National strategic policies have specific provisions regarding the IS and EE-related green skills, which are being implemented. However, monitoring and evaluation mechanisms are still pending.	Absence of either general or specific provisions regarding the IS and EE-related green skills in national strategic policies.	National strategic policies envision broad provisions regarding education for sustainable development. Monitoring and evaluation mechanisms are still pending.	Absence of either general or specific provisions regarding the IS and EE-related green skills in most national strategic policies (with the exception of one).
State of implementation of green skills at VET level	Despite the absence of strategic documents, most VET institutions (81%) and educators (91%) in Italy teach green skills. School-based delivery remains predominant despite an ongoing transition to a dual system.	Green skills are a structural part of the formal VET system. That is, they feature in every qualification's curriculum and training regulation through the existing standardised occupational profile (*Standardberufsbildposition*) on environmental protection	The educational practice reflects the lack of green skills coverage at the strategic national level. While green skills delivery is lagging across all education levels, the offer provided by VET schools is the least developed. School-based form of delivery remains predominant.	References to specific skills for EE and IS are scarce and difficult to contemplate in short-duration modules. There are yet no relevant reforms or national initiatives to promote EE and IS training. School-based delivery remains predominant despite an ongoing transition to a dual system.	School-based delivery remains predominant despite an ongoing transition to a dual system.

Country / Dimension	Italy	Germany	Poland	Portugal	Spain
Barriers of green skills delivery	-Low awareness of sustainability topics in secondary schools -Low popularity of technical education -Scarce evidence to assess and forecast skills	-Limited funding for policy initiatives that improve the uptake of green skills into the VET system -An overly complex system of stakeholder cooperation -Some trainees have unequal access to green skill training due to a highly decentralised delivery system	-Absence of top-down strategic action and lack of institutional support from the government -Prevalence of passive learning methods at the VET school level (as opposed to practical application) -Low level of teacher preparedness	-The National Qualifications Catalogue has only a few modular training units that cover green skills -Most of the non-formal job-related education and training is sponsored by employers, most of whom are SMEs that see it as a financial burden -Local business owners and company managers lack a perspective on how green skills can benefit the company	-Bureaucratic structure of the VET system (where Spain's autonomous communities have to translate the central directives into local law) slows down all implementation processes -At the VET school level, green skill delivery is confined to a select few professions -A lack of institutionalised relationships between some VET schools and companies working in the field
Drivers of green skills delivery	-Political agenda of the governments in 2018-2022 was favourable to public policies promoting green skills -Increasingly voiced industry needs for specialists with green skills -Well-developed green tertiary education and a positive track record of "green" VET courses	-A stable growth of the number of green jobs in Germany -Political agenda of the current government is favourable to public policies promoting green skills -Policy developments at the EU level (such as the European Green Deal)	-Improving eco-awareness and environmental sensitivity in society and growing demand for green skills among students -Both VET schools' staff and civic organisations are increasingly active in developing bottom-up education initiatives	-There are some financial incentives for innovation in the green economy field -Growing business sustainability can also help to accelerate the need for green skilled workers -As the VET system is becoming dual, VET schools increasingly resort to more practical and appealing training methods of skills delivery	-Current political agenda of the current government is favourable to public policies promoting green skills -The regulator continuously monitors the labour market for emerging skill needs, including green skills

Source: Visionary Analytics based on case studies.

1.2 Key features of VET systems

Table 1-2. Overview of selected VET systems

	Italy	Germany	Poland	Portugal	Spain
Key decision-making level	Regional	Balance between federal, regional, and local	Central	Central	Balance between federal and regional
Standardisation	High	High	High	High	High
Permeability	High	Low to medium	High	High	High
Accessibility for adult learners	Yes (separate pathways)	Yes (only some programmes)	Yes (mainly separate pathways)	Yes (separate pathways)	Yes (only some programmes)
EQF levels covered	EQF 3-5	EQF 2-4	EQF 2-5	EQF 2-5	EQF 3-4
Predominant delivery mode	School-based	Work-based	School-based	School-based	School-based
Recent key reform	Introduction of dual VET (2015)	Adjustment and development of CVET (2020)	Restructuring of VET, incl. expansion of incentive system and work-based VET (2016)	Development of National Credit System (2017)	Introduction of dual VET (2012)

Source: Visionary Analytics based on case studies.

Several commonalities and differences in the design and recent general reforms of the five analysed VET systems emerge:

- **Decision-making level:** Highly centralised VET systems (Poland, Portugal) do not allow for much adjustment of the curricula to address local labour market needs. On the other hand, there have been calls to create a national skills strategy in a highly decentralised Italian system to provide a unified framework and better streamline regional policies. Individual VET institutions have little autonomy to adjust courses in all countries analysed.
- **Curricula development:** Regardless of the distribution of responsibilities between central and regional governments, the adjustment of curricula is a long and complicated process that involves many stakeholders.[1] This does not allow for a swift adaptation of the teaching content to the quickly evolving market needs.
- **VET duality:** All countries have introduced reforms to include a predominantly work-based pathway in VET (based on the German dual VET model) and/or to include more of practical training in the school-based pathways. It is yet unclear how successful these reforms will prove in practice.
- **Inclusion of industry stakeholders:** Industry seems to be playing a much more active role in countries with work-based pathways deeper entrenched in their VET systems (mainly Germany, also Spain) than in historically school-based systems (Italy, Poland, Portugal).

[1] It might involve adjustment of occupational standards based on cooperation between ministries, bodies responsible for the national qualification repository and sectoral bodies; developing or changing of curricula following consultations with business and various advisory bodies; adapting the new standards and adjusting to local needs by regional authorities; and adopting the new curricula by VET schools. It can take years before graduates with new skills sets enter the market (e.g., estimated three years in Poland for curricula development and another three to five years for training of the first cohort).

- **Standardisation:** A high level of standardisation in the VET systems does not seem to impact the school-level skills delivery processes, which may be more (Italy, Poland, Portugal, Spain) or less fragmented (Germany) however standardised the system is.

1.3 Strategic planning: IS- and EE-related green skills in national policies

Except for Germany's 'National Action Plan for Sustainable Development in Education' (*Nationaler Aktionsplan Bildung für nachhaltige Entwicklung*), no specific strategies for green skills delivery have been identified in the target countries.

Broader national educational strategies rarely explicitly mention green skills.[2] They rather tend to acknowledge the broad need to re-adjust curricula to the changing labour market needs. National educational strategies also tend to highlight the teaching of transversal skills (e.g., entrepreneurship, adaptability, creativity, etc.) and practical technical skills (also evidenced in the shift towards dual VET systems).

Having said that, the industrial and environmental policies tend to recognise changing skills needs and often call for further reforms of the VET system, they rarely involve concrete action plans in the education sector. Even in Member States such as Germany, where action plans have been developed, there is a lack of monitoring and evaluation systems in place that are necessary for proper assessments. Another common ground of these policies is the inclusion of awareness raising activities targeted at the broader public. For example, the Italian 'Energy Efficiency Action Plan' (*Piano d'Azione Italiano per l'Efficienza Energetica*) includes an information campaign about energy efficiency directed at a broad audience of end-users. This showcases the often very narrow understanding of education for sustainable education, focused on giving information and shaping behaviour and detached from skills training.

Box 1-1. Good practices of IS- and EE-related skills provision: policy level

The German Federal Institute for VET's initiative ***'Sustainability in Vocational Education***' aims at developing new learning modules and didactic materials (e.g., guidelines on sustainability at work), creating new VET curricula and updating existing ones to include issues such as environmental awareness, green skills, sustainability, and circular economy. The initiative has also developed didactic materials such as guidelines on sustainability at work and in production processes. While the focus of this initiative was not exclusively on the EIIs, many of the new learning modules, curricula, and materials do concern EIIs-relevant occupations.
The Spanish government's initiative ***'Empleaverde'*** provides funding for projects supporting the creation of jobs in the green and blue economy. Organisations can apply for funding, for example, to upskill for the employed and the unemployed, conduct research about innovative ways to create new jobs and connect Spanish entrepreneurs with relevant actors and expertise EU-wide.
The project ***'Future skills trends in Emilia-Romagna'*** is an example of a regional policy-supporting initiative in Italy. It identifies key competencies needed to facilitate sustainable development in selected industries (including agri-food, mechatronics and automotive, construction) and digital and green skills that should be provided through the regional VET training offer. The document can be used by professionals in the education sector to (re-)design curricula and by policymakers to update skills standards.
In Portugal, the ***'Environmental Education Framework for Sustainability***' constitutes a guiding document for implementation of this theme in the scope of Citizenship and Development, a subject area that integrates the curriculum in the different cycles and levels of education and teaching. The framework, which is flexible in nature, can be used in very different contexts, as a whole or in part, through the development of projects and initiatives that aim to contribute to the personal and social development of students. Eight transversal themes are proposed to all cycles and levels of education and teaching, catalogued by sub-themes and objectives.

[2] For instance, in Poland, the term "skill of the future" is used.

The '***Environment, Energy and Climate Change Programme'*** in Poland addresses the challenge of global warming. It is funded by EEA Grants and operated by the Ministry of Climate, which is responsible for awarding funding and monitoring the projects. The Ministry of Climate fulfils its obligations with the support of the National Fund for Environmental Protection and Water Management. One of the expected results of the projects to be approved under this programme is the promotion of awareness-raising climate change mitigation and on circular economy. For example, educational projects such as "Climate at Metropolis Schools", "Act for the Climate", and "My TURQUISE PLANET" aim to broaden the knowledge of both the school communities and educators on the topic of climate change. The projects also help to disseminate contents, materials, and educational methodologies to tackle the current lack of support to teachers in the implementation of environmental education across school disciplines.

Source: Visionary Analytics based on case studies.

1.4 Implementation: the delivery of IS- and EE-related green skills in VET

1.4.1 National context

The delivery of green skills in VET can be analysed at two key levels. Firstly, national VET systems deliver some specific sustainability-focused programmes:

- The proliferation of sustainability-focused programmes varies across countries. Italy seems to be leading the way, with a well-developed offer of tertiary-level academic and non-academic (VET) pathways. VET providers in Spain, Germany, and Portugal also offer a good number of dedicated courses. Poland visibly lags behind with only one course focused on renewable energy delivered by a limited number of VET schools.
- These programmes tend to focus on advanced, technical, occupation-specific green skills.
- Sustainability-focused programmes increasingly get implemented in the context of dual VET systems due to the ongoing educational reforms in Italy, Poland, Portugal, and Spain since the early and mid-2010s. However, this does not necessarily mean that the taught programmes have a strong practical side, as illustrated by the case of Poland, where skills delivery remains largely theoretical.
- EE courses are much more prevalent than IS courses. For instance, in Italy, roughly one in ten of all VET courses at the post-secondary level fell into the category "energy efficiency". No courses explicitly focused on IS have been identified in any targeted country.

Secondly, green skills training can be included as a horizontal element in other VET courses:

- Only the German VET system incorporates green skills training in a structured manner in all VET courses. In other countries, green skills delivery in general VET courses tends to be fragmented, incomprehensive and often dependent on the initiative of individual schools. For example, within the Portuguese National Citizenship Education Strategy, it is up to schools to implement its citizenship education strategy (which involves the teaching of Sustainable Development and Environmental Education).
- Across virtually all countries, the importance of extracurricular activities, often provided by organisations outside the VET systems, has been stressed. Therefore, the delivery of green skills is more likely to be non- or informal and provided on an ad-hoc basis.

Box 1-2. Good practices of IS- and EE-related skills provision: Implementation level

'Green Jobs in the Metal Industry' (Germany) focused on developing green skills and jobs in the German state of Brandenburg. The project developed upskilling schemes for green skills, based on a thorough evaluation of which green skills and jobs were relevant for the industry. The training was offered to secondary VET students/ trainees, employees, and the unemployed. The project was based on a partnership of national and international stakeholders.
The Spanish Association for Standardisation and Certification's **training programmes about Circular Economy** are aimed both at companies and individuals. Training has been delivered through online and in-person sessions, experts' speeches, and in-company training. Topics are cross-sectoral and include circular economy, energy management, and environment management.
In Portugal, '***Network of Coordinator Teachers of Environmental Education Projects***' promotes environmental education. The Network has contributed to the promotion of various initiatives, recognition of projects, inclusion of content in school curricula and the creation of a network of teachers with technical-pedagogical skills for the coordination and promotion of projects in communities, developed with environmental NGOs.

Source: Visionary Analytics based on case studies.

1.4.2 International/EU context

In most countries, a significant share of green skills training is being delivered outside formal VET, as project-based, ad-hoc activities. The role of international stakeholders in this area is important – firstly, many successful initiatives are delivered internationally or with the support of international stakeholders.[3] Secondly, a share of nationally or regionally organised green skills training initiatives depends on international (EU) funding. In Italy, for example, the European Social Fund is a primary funding source for upper-secondary VET and CVET.

Box 1-3. Good practices of IS- and EE-related skills provision: International dimension

The blended learning course ***'Junior Expert in Circular Economy (JECE)'*** is a one-year post-secondary VET programme. It targets young Europeans living in the Emilia-Romagna region (Italy), with a focus on people who are neither in employment nor education nor training (NEET). This cross-sectoral course aims to equip the participants with the necessary skills for sustainable development and circular transition in the economy and society. The 2022 edition is financed by Emilia-Romagna Region and the European Social Fund (ESF) and organised by Centoform – a regional VET provider, with the support of a range of national and international partners. It follows a certification scheme based on EQF, ECTS and ECVET.
The Polish Future Industry Platform is currently developing ***'Guide 4.0 - how to educate the competencies of the future?***'. The initiative involves the development of a course for secondary school teachers to introduce methods for training the competencies of the future. Additionally, educators will have access to an online Guide 4.0 to facilitate mapping students' skills and prepare individual or group skills development programmes. They will also have access to educational tools, a manual, and tutorials developed during the project. The project is being delivered in partnership with International Development Norway (a Norwegian consulting and management company specialising in green energy, innovation, and education) and funded by the EEA and Norway Grants.

Source: Visionary Analytics based on case studies.

1.4.3 Delivery at the VET school level

Content of delivery at the VET school level usually is more focused on EE rather than on IS and remains school-based in most of the analysed countries (even though the situation is likely to change in the future as the dual VET becomes more and more prominent in the EU). While there is significant divergence among the analysed cases of green skills delivery approaches, some clear patterns can be established with regard to the key barriers and drivers at the VET school level. As the cross-case analysis demonstrates, delivery can be slowed down and/or hindered by the following factors:

[3] However, a significant downside of such international, project-based activities is their lack of sustainability – many promising initiatives simply discontinue after the funding dries up (based on the Italian case).

- A low supply of teachers with practical experience since most of these experts choose to remain in the industry. Some teachers responsible for green skills delivery might also lack in-depth knowledge about EE and IS because their older curricula do not cover these topics.
- In some Member States like Poland, the first factor can be further exacerbated by the prevalence of theory-based learning and exams combined with a very slow change in teaching practices.
- Some VET schools in Poland and Spain suffer from the lack of institutional support and/or insufficient funding, with many students and teachers having to invest in equipment on their own. Alternatively, students and teachers become overly reliant on additional investment from representatives of the industry or ad hoc donors (which implies that stable funding is not always guaranteed).
- In some Member States such as Poland and Italy, there is a lack of basic foundations in secondary education for the future development of green skills in their VET. This creates learning challenges for students in their future studies because IS and EE-related courses already presuppose some basic technical knowledge.
- Existing programmes in the field struggle with self-promotion and expansion for various reasons (e.g., low awareness of the "green skills" and IS and/ or EE concepts among secondary school students; red tape and bureaucratic barriers).

By contrast, the following factors play important role as drivers for an effective skills delivery:

- Local industry demand for specific green skills can contribute to the creation of new relevant VET courses and programmes. The demand could be further increased in the cases of industrial expansion (e.g., opening up of new factories and/or plants).

Box 1-4. Integration of the local industry demand into the skills delivery processes in Italy.

The industry's involvement is crucial in the delivery of VET courses in Italy. Many instructors come from local companies, while students can also take advantage of company-based study visits. Most importantly, local employers actively contribute to designing and adjusting the curricula. Specifically, curricula are up-to-date and address all the local industry's needs based on their recurring feedback. This way appropriate solutions are incorporated into courses for the (future) benefit of all industry actors. For example, the analysed school ITS TEC consults the industry front-runners for this purpose as well as the so-called GreenTech cluster, which comprises around 30-40 firms.

Source: Visionary Analytics based on case studies.

- Multi-stakeholder cooperation at all levels including local authorities, universities, research centres, training providers, and firms ensures effective and relevant training delivery. For example, it opens up additional feedback avenues between the industry and educational sector as well as allows for practical learning opportunities through internships and traineeships among students.
- Systemic approaches to the institutionalisation of outreach and promotion strategies. This refers to strategies such as creating specialised commissions or bodies, which should promote the local programmes and/or; seek for additional funding opportunities; or develop alumni networks. For example, in the case of Spain a specialised teacher-run energy commission at IES Federica Montseny is tasked with applying for relevant regional and national funding opportunities.

1.5 Overarching conclusions and recommendations

Conclusions

- Most of the five overviewed Member States still do not address the issues of EE and IS or even the broader notion of “green skills” in national policy documents and strategies (either educational or industrial) with some exceptions (e.g., Germany).
- Nevertheless, there is an emerging push from the policymakers and industry representatives at the national level to incorporate EE and IS topics in industrial strategies and reform the national education systems to allow for a more practice-based training and better integration of “green skills”.
- In many overviewed Member States, the adoption of legal instruments related to green skills is still recent and their impact on skills needs is not always clear.
- Courses and programmes related to EE and IS are usually present and more well developed at the academic tertiary level as opposed to post-secondary non-academic vocational courses and programmes.
- National approaches to the VET system design, which provides companies and VET schools with more flexibility in skills delivery, tend to perform better than their centralised counterparts.
- All overviewed national VET systems remain in need of clearer monitoring and evaluation indicators and, respectively, data on green skills to assess the potential effects of the existing skills delivery mechanisms.
- Practical learning about EE and IS beyond the school curriculum tends to be shaped by the additional efforts that the VET staff put into the educational process to as to go beyond the curriculum. However, these efforts are not even or coherent across all schools, which often produces varying outcomes in the level of green skills.
- At VET school level, the focus on passive learning methods and theory rather than practice in some overviewed Member States such as Poland inhibits the development of more effective teaching methods, while the application of dual VET, which involves both educational institutions and companies, has better effects. In dual VET systems, however, the teaching process heavily relies on cooperation between the VET schools and industry associations and the level of cohesiveness of acquired knowledge is not very high.
- “Green skills” delivery tends to be rather limited to only a few programmes in the analysed VET schools, although some technical programmes increasingly pick up “green skills”-related topics into the curriculum.
- Individual VET schools also generate various good practices that could be picked up at either regional or national levels, which tend to remain undocumented (e.g., blended learning programmes; student and teachers-developed didactic materials; multi-stakeholder networks).

Recommendations

- Further development of the dual VET systems and increased attention to the practical component in VET when it comes to green skills-related training (either through the establishment of dual systems or other means).
- Development of “green skills”-specific strategic documents through multistakeholder cooperation of at least education and environmental ministries/agencies in Member States, where such documents are still absent.

- Schools should be encouraged to cooperate with industry organisations not only to promote green skills but also to train their teachers, who would then be able to provide both theoretical and practical knowledge to the students, which is up to date with the current industry standards.
- Green skills in general should be more deeply entrenched into the national secondary education systems both through broad strategic documents (e.g., such as the Portuguese Students' Profile by the End of Compulsory Schooling) as well as narrower ones (e.g., subject curricula).
- Development of monitoring and evaluation tools (possibly, quantifiable) to better assess the existing green skills delivery instruments.
- More extensive documentation of the emerging good practices on skills delivery at the individual VET school level.
- Better integration of the EE and IS concepts into the skills delivery processes at the national and VET school levels through the development of EE- and IS-specific curricula as well as development of relevant modules and courses by the schools.

1.6 Important results/impact for the Blueprint from the VET / WP4 perspective

Several key gaps and barriers emerge across countries where the SPIRE-SAIS could contribute:

- **Educators' readiness:** Teachers often lack competencies and knowledge on how to teach green skills effectively.
- **Low levels of awareness:** On the one hand, some businesses still do not understand the practical importance of teaching IS and EE-related skills; they do not consider green skills in general to be a valuable part of an employee's skillset. On the other hand, there is a lack of systematised information on good practices that is available to VET institutions to better delivery IS and EE-related skills.
- **Poor evidence base:** Robust assessments of relevant educational programmes' effectiveness are necessary to replicate good practices.
- **Lack of monitoring and evaluation tools:** To produce robust assessments, national VET systems require a developed toolbox of monitoring and evaluation tools (incl., specific questions and indicators), which they still lack.
- **Course structure and tools:** Establishing a cross-sectoral IS/EE module that could be integrated in different occupational trainings could be helpful. Ideally, it would be accompanied by easily accessible didactic materials and guidance for education providers on how to deliver it best.
- **A uniform skills recognition system:** Green skills are not easily verified and certified, which discourages learners (as they rarely receive a formal certificate upon completion of training). It also hinders skills tracking and forecasting.

Other important barriers include:

- **Lack of coherent policies:** The responsibility for green skills delivery is usually split between many stakeholders (educational, industrial, and environmental ministries, regional governments, VET schools, civic organisations, etc.) and not guided by a single overarching strategy.
- **Insufficient funding:** Funding tends to be fragmented and short-term.

- **Lacking or absent infrastructure:** Schools have to work either without any or with only outdated industrial infrastructure (e.g., machines for industrial operations). They strongly rely on the support of industry associations.

1.7 Idea of the skills matrix

The matrix of cross-sectoral IS and EE skills has the following two key interrelated functions:

- **To "connect" different concepts used in the SPIRE-SAIS project including job profiles, occupations, and qualifications**
- **To identify how IS and EE related skills needs are addressed in relevant VET programmes:** Information about jobs and IS and EE skills' needs is identified in the WP3 based on the inputs from the industry (i.e., EII companies). At the same time, WP4 will analyse relevant VET programmes to find out if and how these specific skills are addressed.

This matrix is expected to be mostly useful to the representatives of the industry and VET providers. For example, a company searching for candidates for a particular job profile will know what qualifications are directly linked to this job profile. Moreover, the matrix will help to identify relevant national qualifications that exist in different overviewed Member States. Therefore, representatives of the industry will know whether qualification acquired by a candidate in another overviewed Member State is relevant for the position (job profile) they need to fill. This may contribute to international mobility of employees.

CHAPTER 2. BLUEPRINT CASE SUMMARY: GERMANY

2.1 Introduction

The German VET system features two types of VET provision: school-based and dual. There is no formal CVET in Germany. School-based VET is classroom-centred and combines elements of VET and general education. Dual VET which occurs at upper secondary level combines school-based learning with practical training provided in companies through apprenticeships (GO VET, 2019). There are, however, numerous other VET programmes at upper secondary (general education with vocational orientation, school-based VET programmes), post-secondary (specialised programmes), and at tertiary level (Master craftsperson, technician specialist, dual Bachelor and Master programmes). The focus of this case study will be dual VET since it is the most prevalent form of VET in Germany (CEDEFOP, 2018).

VET governance and provision occurs at three separate levels due to federalism in Germany:

- At **federal level**, legally binding training regulations and minimum standards for all occupations are published, and training plans are developed. The institutions responsible are the Federal Ministry of Education (BMBF), the Federal Institute for VET (BIBB) as well as other relevant ministries (e.g.: Ministry of Labour regulates youth protection at work; Ministry of Economic Affairs regulates trade and crafts codes) (**ESSA, forthcoming**).
- At **state level**, the Standing Conference of the Ministries of Education (KMK) which is composed of all 16 state education ministers coordinates the development of framework curricula (*Rahmenlehrplan*) for each recognised occupation (**ESSA, forthcoming**).
- At **local level**, so-called 'competent authorities' (i.e.: local VET institutions and relevant occupational associations) administer framework curricula, minimum standards, etc. based on local needs (GO VET, 2019).

As for general trends in green skills delivery in VET, there are several conclusions to be drawn from the analysis. Firstly, the German VET system incorporates green skills as part of the **broader concept of sustainability**. Recent policy documents and reforms have focussed on embedding green skills into considerations for economic, ecological as well as social sustainability. See the following section for relevant policies and how they relate to one another as well as Box 1 for relevant initiatives of Germany's Federal Institute for VET (BIBB). Secondly, **green skills delivery heavily depends on sectoral, vocational, and company needs**. All curricula only set out minimum standards. Beyond that, schools and companies are free to emphasise green skills as much or as little as they see fit. In fact, there currently is no nationwide monitoring system in place that could provide hard and fast data on the state of green skills delivery across the entire VET system.

As for the school level analysis of EE and IS related skills in VET, this inquiry focussed on Hans-Schwier-Berufskolleg which is located in the Rhein-Ruhr region of North Rhine-Westphalia (NRW) and the dual VET cycle '*Specialist in Wastewater Technology*' (Fachkraft für Abwassertechnik) offered at the school. That is because the programme in question matches the job profile Liquid Waste Management Technician explicitly. A solid amount of evidence regarding the contents and processes of delivery of EE and IS skills within the programme in question was triangulated with brief written answers to the interview

questionnaire. Most notably, Hans-Schwier-Berufskolleg is the only NRW-based VET school teaching this programme, meaning that all information NRW-level curricula, etc. apply to Hans-Schwier-Berufskolleg one-to-one. As for the contents of delivery, the teachings mandated by the national framework curriculum (*Rahmenlehrplan*) cover most skills and tasks required of liquid waste treatment technicians. Due to the principle of technology neutrality (see 'Delivery of IS and EE skills in VET at national level' section below), however, the framework curriculum does not mandate the use of any particular technology or teaching methodology. Unfortunately, Hans-Schwier-Berufskolleg gave no information regarding particular technologies and methodologies being taught. Teaching at the school is entirely classroom-based, as practical training occurs in-company. Teachers are neither being provided with any materials nor do they receive any noteworthy guidance. As such, oftentimes teaching materials are elaborated by the teaching staff drawing on the materials published by the relevant industry association, the German Association for Water Management, Wastewater, and Waste (DWA – *Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V.*). Teachers also participate in seminars and trainings provided by DWA.

2.2 Strategic planning: IS- and EE-related green skills in national policies

There is a scope for national policy to capture green skills in German VET because the system is regulated at the state level, while action is coordinated at the national level through KMK. Consequently, there is a plethora of educational policies focussing on emerging skill needs such as green skills as well as environmental and industrial policies relating to education.

All key educational policies capture green skills or environmental protection not as a standalone aspect but as part of the broader concept of sustainability. Sustainability stipulates that future development must not only be environmentally sound but should also take economic and social aspects into account. After all, an action that is beneficial for the environment might be economically unreasonable and might have socially undesirable consequences. The goal of the German sustainability-related education policy, therefore, is to enable students to take all three aspects into account, when making decisions, and to understand their interrelatedness (Anonymous, 2021). All educational policies do prescribe concrete steps on how sustainability is to be built into education and, more specifically, the VET system.

The **National Action Plan for Sustainable Development in Education** (*Nationaler Aktionsplan Bildung für nachhaltige Entwicklung*) of 2017 outlines how Germany intends to meet the United Nation's Sustainable Development Goal (SDG) #4 on quality education for all. Hence, it features actions for all levels and types of education, including VET. For VET, the plan identifies five areas of activities relating to sustainability and green skills: (1) collecting best practices; (2) incorporating best practices and innovation from companies into training practices; (3) creating a network of training centres that excel at sustainability; (4) developing sustainability-specific competences; (5) re-designing curricula to place stronger emphasis on sustainability.

Perhaps the most significant step towards translating the actions proposed by the Action Plan into practice has been the introduction of standardised occupational profiles in August 2021. These will set thematic standards in four broad areas, including environmental protection and sustainability, for curriculum development. Integration of these profiles and related training requirements in future framework curricula will be mandatory. However, this reform does not affect current curricula (BIBB, 2021a).

In addition, the Federal Institute for VET (BIBB) is heavily involved in promoting sustainability in VET through creating best practices, another priority of the aforementioned Action Plan. This is being accomplished through BIBB's multiannual pilot programmes 'Sustainability in Vocational Education', as Box 1 below explains.

Box 2-1: BIBB Multiannual Pilot Programmes 'Sustainability in Vocational Education'

'Sustainability in Vocational Education' is a policy initiative implemented by BIBB at the federal level. The goal of the initiative has been to promote sustainability-related topics, environmental awareness, and green skills in German VET. To this end, BIBB has been partnering up with various stakeholders to develop learning modules, VET curricula, and didactic materials amongst others. All outputs have been aimed at various industries, including the EIIs.
Neither the **learning modules** nor **VET curricula** developed currently feature as mandatory parts of federal VET curricula. Instead, they are being made available for free to interested businesses and training centres. While learning modules only focus on specific aspects of a given topic (e.g.: energy efficiency), VET curricula constitute an entire course, thus, covering an entire topic comprehensively. VET curricula also include some profession-specific activities. **Didactic materials** usually focus on topics related to sustainability at work and in production processes. All three types of materials aim to stimulate the uptake of 'green' curricula in schools as well as companies.
Key lessons for SPIRE-SAIS are:

- Institutionalised cooperation between businesses and VET institutions is a good practice that helps to test the developed educational materials 'in the field' before upscaling them;
- The variety of skills delivery processes used is essential for the promotion of sustainability curriculum in vocational education both among trainers and trainees;
- Project deliverables should be sustainable – in other words, one should be able to use them in other projects and educational activities in the long-run. Ideally, they should also be available in open access for businesses and all training institutions.

Source: Visionary Analytics based on case study sources (see References)

German environmental and industrial policy also consider sustainability and green skills in VET but are less focussed on those. They view education and VET as one tool of many for achieving the respective policy's goal. The **German Sustainability Strategy** (*Deutsche Nachhaltigskeitsstrategie*) of 2021 and the **Climate Protection Programme 2030** (*Klimaschutzprogramm 2030*), for example, list education as a key factor and then proceed to refer to the National Action Plan for Sustainable Development in Education for implementation. In addition, the **Energy Efficiency Strategy 2050** (*Energieeffizienzstrategie 2050*) make vocation-specific suggestions for contents to be included into curricula. However, it does not focus on VET. The **German Resource Efficiency Programme III** (*Deutsches Ressourceneffizienzprogramm III*) remains rather vague and does not emphasise green skills acquisition. It only refers to its predecessor Resource Efficiency Programme II having strengthened the presence of resource efficiency as a topic in the education and pledges to continue this work.

2.3 Implementation: the delivery of IS- and EE-related green skills in VET

2.3.1 Delivery of IS and EE skills in VET at national level

Green skills are a structural part of Germany's formal VET system. They feature in every qualification's curriculum and training regulation through the existing standardised occupational profile (*Standardberufsbildposition*) on environmental protection (*Umweltschutz*). This focus is expected to be further enhanced with the progressive rollout of the new occupational profile on environmental protection and sustainability (*Umweltschutz und Nachhaltigkeit*) (Hemkes, 2021; Geissler, 2021).

Yet, there is no data on how well the system is delivering green skills or what share of institutions pay any attention to green skills. Currently, there is no monitoring system in place, although the legal framework stipulates one. (Hemkes, 2021). Some general observations are, however, available. Most importantly, green skills are taught both in schools and companies, as the minimum requirements set out in relevant framework curricula, training regulations, etc. require this (Hemkes, 2021; Geissler, 2021). Beyond these, green skills delivery heavily depends on:

1. Sectoral needs: If a company is active in an industry with high demand for EE or IS (e.g.: construction, chemistry, car industry), then it is more likely that said company imparts relevant green skills. Similarly, if a vocation belongs to an industry with green skill needs, then relevant curricula for school- as well as company-based learning are going to emphasise relevant skills. After all, curriculum development in both companies and schools is driven significantly by sectoral needs. Importantly, green skills might not always be labelled as such. They might just be part of a curriculum as part of the vocation's general requirements (Hemkes, 2021).
2. School and company attitude: All formal provisions regarding green skills and sustainability in training regulations, curricula, etc. are minimum standards only. The purpose of this is to allow for easy adjustment to local, industry, school, and company needs. This means that, apart from sectoral needs, the level of green skills provision also depends on a school's or company's willingness and ability to do so. After all, a company or a school can always choose to go beyond the minimum standards (Geissler, 2021).

As a result, dual VET providers can provide their graduates with varying levels of green skills upon entering the labour market, depending on the company they completed their apprenticeship with and the VET school they studied at.

The German VET system provides companies and schools with enough flexibility to allow VET delivery to adjust to emerging technologies and skill needs without adapting curricula. That is because curricula generally are technology- and product-neutral. Technology neutrality means that syllabi are not bound to one particular piece of machinery. Rather, trainees should master the processes necessary for a vocation, given the current state of the art. Similarly, product neutrality means that curricula should focus on particular products or outputs. Instead, trainees should be able to perform processes learnt with as many outputs as possible. This allows companies and schools to adjust training flexibly on a needs-basis (Geissler, 2021).

Green skills provision in German VET occurs both in transversal and subject-specific manner. All VET programmes will impart the transversal green skills mandated by the standardised occupational profile' environmental protection and sustainability.' They are designed to teach trainees how to attain the following learning outcomes:

- Avoidance of environmental pollution
- Environmentally, economically, and socially efficient use of energy and other resources
- Compliance with relevant environmental protection laws
- Avoidance of waste and recycling
- Capacity to develop own suggestions for improving company sustainability (BIBB, 2021a)

Since the profile 'environmental protection and sustainability' is transversal in nature, its contents will feature in all curricula for all trades once they are updated. However, there are not going to be any dedicated modules. They will not be subjects of their own right. Instead, contents will be incorporated into modules on occupation-specific skills, both in theoretical in-

school and practical in-company training. The specifics will, however, vary between vocations (BIBB, 2021b).

This shift towards environmental protection *and* sustainability represents a broader trend within German VET but also general education: There has been a shift towards a broader definition of green skills. That is because, previously, green skills and environmental protection were standalone issues. This is reflected by the former standardised occupational profile 'Umweltschutz' sole focus on environmental protection. However, over time, this exclusive focus on environmental protection has evolved into a broader emphasis on sustainability, thus, reflecting the fact that ecological, economic, and social issues are interrelated. Green skills provision is now being connected with economic and social considerations. The new learning outcome on environmentally, economically, and socially efficient use of energy and other resources is a case in point (Geissler, 2021; BIBB, 2021a).

Different framework curricula and training regulations also include occupation-specific green skills provisions. For example, all construction trade-related VET programmes feature energy-efficient building renovation and insulation training. Further, the 'Plant mechanic for sanitary, heating, and air conditioning' programme focuses on environmental technology and renewable energies such as solar heat generation, heat pumps, etc. (Geissler, 2021).

Box 2-2: Green Jobs in the Metal Industry

Green Jobs in the Metal Industry was a regional project with the immediate aim of developing green skills and jobs for Brandenburg's metal industry, implemented by a network of national and international stakeholders. The project ultimately sought to future proof the regional industry by establishing a social-organisational approach to innovation and by securing business locations and jobs.

The most important outputs were upskilling schemes for green skills. These were based on research conducted by the project consortium on available green technologies as well as relevant green skills and jobs for the metal industry. Some trainings were developed for work council members, while most aimed at potential and current employees. Trainings for employees were split into modules, each of which was geared towards a specific subgroup: One module focussed on green metal (aimed at secondary students), another on green awareness (aimed at trainees), a third on green tech (aimed at employees and managers), and a fourth on water supply systems (aimed at the unemployed). Trainings were linked to the official qualifications and trades relevant to the metal industry. This was based on relevant skills identified through the background research. All training materials are publicly available.

The project's main driver and a key takeaway has been its participatory approach. The implementing consortium featured stakeholders from various countries and sectors This allowed for cross-regional and -sectoral exchange and was intended as a starting point for upscaling. Another key takeaway has been the similarity of approach with SPIRE-SAIS (identifying skill needs and then developing upskilling schemes). As such, Green Jobs in the Metal Industry could serve as an example for risks and challenges these types of projects face.

Source: Visionary Analytics based on case study sources (see References)

2.3.2 Delivery of IS and EE skills in VET at the VET school level

Having outlined the general features of Germany's VET system, its treatment of EE and IS-related topics, and relevant policies, this chapter turns its attention to the delivery of relevant skills at VET school level. Gelsenkirchen, North Rhine-Westphalia (NRW)-based Hans-Schwier-Berufskolleg is the school chosen for analysis for its offering of the so-called 'environmental professions' (*umwelttechnische Berufe*) VET cycles. These include 'Specialist in Wastewater Technology' (*Fachkraft für Abwassertechnik*), 'Specialist in Circular Economy and Waste Management' (*Fachkraft für Kreislauf- und Abfallwirtschaft*), 'Specialist in Water Supply Technology' (*Fachkraft für Wasserversorgungstechnik*), and 'Specialist in Pipe, Canal, and Industrial Service' (*Fachkraft für Rohr-, Kanal- und Industrieservice*). This analysis will

focus on the delivery of one of these four cycles: 'Specialist in Wastewater Technology' (*Fachkraft in Abwassertechnik*), as it explicitly corresponds to the WP3 job profile 'Liquid Waste Treatment Technician'. This is a three-year-long dual cycle, meaning that students are being trained both in-school and in-company.

Knowledge levels regarding EE and also IS are comparatively high at Hans-Schwier-Berufskolleg. That is primarily because this school is the only VET school in the entire state of North Rhine-Westphalia teaching the 'environmental professions' (LANUV, 2022). After all, these professions are rather niche and, therefore, require high levels of equally specialised knowledge on part of the VET schools. Importantly, this is the kind of knowledge which other VET schools in NRW are unlikely to possess to the same extent or at least in the same specialisation by virtue of them not being acquainted with these programmes. Based on teacher statements, knowledge within the school is particularly high regarding the use of digestion tanks as well as aerator plates.

The priority EE and IS takes at the school, seems to be relatively high, too. That is because 26 out of the school's total of 75 teaching staff are involved in at least one of the 'environmental professions' (HSBK, 2020a). 12 of them are active in 'Specialist in Wastewater Technology' (HSBK, 2020b). In addition, EE and IS-related programmes occupy a prominent role in the school's educational offerings. Five out of 26 dual programmes offered at the school are related to either EE or IS (HSBK, 2020c). In addition, the school maintains a dedicated specialised school for environmental protection technology (*Fachschule für Umweltschutztechnik*), which is located one level above dual apprenticeships in the educational system.

Content of delivery

The key document for discerning the contents of delivery of the 'Specialist in Wastewater Technology' programme is the framework curriculum (*Rahmenlehrplan*). Contents are subdivided into 14 so-called learning areas (*Lernfelder*). The following gives an overview of these learning areas as well as the number of hours dedicated to them and the year of study. Note that learning areas one through six are common to all environmental professions, while learning areas seven through 14 are specific to the programme at hand (KMK, 2002):

1st year:

1. Planning an environmental concept (*Planen eines Umweltkonzepts*) (80 hours)
2. Dealing with microorganisms (*Umgehen mit Mikroorganismen*) (40 hours)
3. Use of environmental chemicals (*Umweltchemikalien einsetzen*) (80 hours)
4. Operating piping systems (*Rohrleitungssysteme betreiben*) (80 hours)

2nd year:

1. Analysing water and waste components (*Untersuchen von Wasser- und Abfallinhaltsstoffen*) (60 hours)
2. Operating and maintaining machinery and equipment (*Maschinen und Einrichtungen bedienen und instandhalten*) (80 hours)
3. Operating and maintaining electrical systems (*Elektrische Anlagen betreiben und instandhalten*) (40 hours)
4. Operating drainage systems (*Entwässerungssysteme betreiben*) (60 hours)
5. Mechanical cleaning of wastewater (*Abwasser mechanisch reinigen*) (40 hours)

3rd year:

6. Analysing wastewater and sludge (*Untersuchen von Abwasser und Schlämmen*) (60 hours)

7. Treating wastewater and sludge biologically and chemically (*Abwasser und Schlämme biologisch und chemisch behandeln*) (80 hours)
8. Connecting electrical devices (*Elektrische Geräte anschließen*) (40 hours)
9. Maintaining drainage systems and monitoring indirect dischargers (*Entwässerungssysteme instandhalten und Indirekteinleiter überwachen*) (60 hours)
10. Controlling and regulating wastewater treatment plants (*Abwasseranlagen steuern und regeln*) (40 hours)

The learning areas cover all skills necessary for performing the main tasks required of a liquid waste treatment technician quite comprehensively. Students learn how to analyse experimental laboratory data, to document analysis results, to perform laboratory tests, and to test chemical samples, as part of learning areas 5 and 10. Students are being acquainted with methods of extraction, conservation, and transport of water and wastewater samples as well as with methods of determining the contents of these samples quantitatively as part of learning arena 5. They also learn how to interpret and document their results and are being taught how to utilise them. Learning area 10 aims at imparting the use of similar tests for analysis of wastewater and sludge samples, but with greater focus on determining if samples comply with legal regulations and deriving necessary measures of process and quality management.

Meanwhile, trainees study how to drain hazardous liquids primarily as part of learning area 8. Here, students create concepts for wastewater drainage systems. They learn how to select an appropriate system by taking into account local wastewater characteristics, including, if and to what extent these include hazardous liquids, and geographic characteristics, amongst others. Selecting the appropriate system extends to choosing the correct pipework, equipment, and building structures, while also taking into account work safety. Finally, students learn how to recognise and respond to service disruptions.

Learning areas 3, 5, 10, and 11 add to students' ability of draining hazardous liquids, as they explore how to handle chemicals. As discussed previously, learning areas 5 and 10 focus on analysing the chemical contents of water, wastewater, and sludge. Meanwhile, learning area 3, quite literally concerns itself with handling chemicals. As such, students are being acquainted with using environmental chemicals for water treatment, industrial cleaning, as well as wastewater and waste disposal. Part of learning about these processes is knowing the structure and properties of the chemicals in use, including how dangerous they can be and how they react with other chemicals. Furthermore, students discover how to package, store, and transport hazardous materials in accordance with current legal requirements and with the reduction of environmental and health hazards in mind. Learning area 3 is not restricted to hazardous liquids only as students of all 'environmental professions,' including those which are not primarily concerned with wastewater and liquids, receive this aspect of training. Finally, learning area 11, which is specific to 'Specialist in Wastewater Technology,' draws on the foundations from learning area 3 to focus specifically on handling chemicals and draining hazardous liquids as part of wastewater treatment. As such, it extends the skills taught in area 3 by teachings about how to operate and maintain wastewater treatment plants based on the findings, as well as coordinating and optimising processes using state-of-the-art software.

The key skill for both liquid waste management technicians and 'Specialists in Wastewater Technology' is the performance of water treatments. It is explicitly covered in learning areas 8, 9, 11, 13, and 14. Learning areas 8 and 11, as previously mentioned, deal with (hazardous) wastewater drainage system and with the treatment of (hazardous) wastewater in wastewater treatment plants, respectively. Meanwhile, learning area 9 is concerned with the mechanical cleaning of wastewater. That is, students learn how to remove suspended wastewater components using techniques of mechanical separation, using appropriate software for process management, interpreting results, and assessing competing solutions based on

economic, environmental, and work safety-related considerations. Learning areas 13 and 14 are relevant because students practise how to manage and maintain all relevant systems.

Finally, most skills relevant to the liquid waste management technician job profile, both transversal and technical ones, are being covered by the programme, mostly in several learning areas at a time. For example, in terms of transversal skills students acquire general regulatory awareness and knowledge about legislation on waste and energy management in all learning arenas, except areas 2, 3, 5, 6, 7, and 14. Similarly, environmental awareness explicitly features in six of the 14 learning areas (1, 2, 3, 5, 8, 9). Despite not being mentioned unequivocally, collaboration, creativity, and critical thinking as well as business knowledge, fostering cooperation, identification of potential opportunities, and project planning and management all play critical roles in topics related to running and maintaining the various functions of wastewater treatment plants (i.e.: in improving the efficiency of processes, in troubleshooting, identifying opportunities for collaboration, renovations, etc.) (KMK, 2002).

Finally, students gain basic understandings of how EE and IS function. Any learning area that appeals to processes of handling wastewater or chemicals or disposing of hazardous chemicals conveys system optimisation and process analysis skills, primarily in terms of EE. After all students are being taught to detect inefficiencies and elaborate optimisations. These processes require an understanding of the energy use and costs involved and, further, encompass the collection and analysis of energy data. Examples of such learning areas are areas 8, 9, 11, 13, and 14. IS-related skills, by contrast, do not feature explicitly in any learning area. However, it does feature in the mission statement of 'Specialists in Wastewater Technology,' which includes the treatment of water for reuse by private individuals as well as industrial businesses (BIBB, 2022).

Process of delivery

The process of delivery of the above contents, however, is less intuitive than it would at first appear, since the 14 learning areas do not correspond to separate modules. Instead, different thematically related learning areas are being joined into a total of five programme specific subjects, with the contents of different learning areas being taught at different stages of the programme. Table 1 below gives an overview of all subject-learning areas combinations.

Table 2-1. Programme specific subject-learning areas combinations in 'Specialist in Wastewater Technology'

	Subject-Learning Area (LA) combinations by year of study		
	Year 1	**Year 2**	**Year 3**
Wastewater and environmental technology (*Abwasser- und Umwelttechnik*)	LA 1	LA 8, 9	LA 11, 13
Analytical technology (*Analysentechnik*)	LA 2, 3	LA 5	LA 10
Machine and equipment technology (*Maschinen- und Gerätetechnik*)	LA 4	LA 6	LA 14
Electrotechnical works (*Elektrotechnische Arbeiten*)	-	LA 7	LA 12

Source: Visionary Analytics based MSB NRW, 2003.

The remaining subjects 'economics and business administration' (*Wirtschafts- und Betriebslehre*), 'German/communication studies' (*Deutsch/Kommunikation*), 'religious education' (*Religionslehre*) 'physical education' (*Sport/Gesundheitsförderung*), 'politics/social studies' (*Politik/Gesellschaftslehre*) convey interprofessional skills (MSB NRW, 2003).

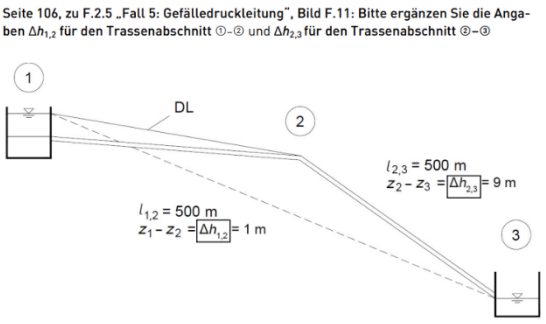
By design of Germany's dual, apprenticeship-style VET system, teaching for 'Specialist in Wastewater Technology' at Hans-Schwier-Berufskolleg is classroom-based. Practical learning occurs primarily at students' training enterprises. Meanwhile, skills delivery at the school

occurs in blocks. That is, students spend several weeks at a time at the school. In-company and in-school teaching, therefore, alternate. For example, for the 2021/22 school year, which began on 16th August 2021 and ended on 24th June 2022, students in their first year completed two blocks of three weeks and one of four weeks at school, the first one taking place in December, the second between February and March, and the third in June. Second year students undertook five blocks, four of which were three weeks long and another of two weeks. Finally, third (i.e.: final) year finished four blocks, two of three weeks, one of four weeks, and another of five weeks (HSBK, 2020d). Hence, students are being called to school at varying intervals and for various durations, depending on the contents foreseen in the framework curriculum for any given year of study.

Neither teachers nor students use any special materials such as dedicated software at the school. Instead, teachers create modules themselves, based on the learning outcomes outlined in the relevant framework curriculum. However, as the programme's head teacher points out, many of the teachings are based on materials published by the German Association for Water Management, Wastewater, and Waste (DWA – *Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V.*) – the peak industry association promoting sustainable water and wastewater management. Its members hail from all kinds of industries with links to water and wastewater management (DWA, 2022b). A key aspect of DWA's activities is the publication of educational materials such as specialist articles and books, worksheets, and information sheets. Unfortunately, these materials are neither publicly available, nor were teachers at Hans-Schwier Berufskolleg ready to share any due to copyright restrictions.

Nevertheless, the following gives an overview of the available materials that seem relevant to EE and IS-related skills in the course. Available worksheets cover various water and wastewater-related topics. These include materials on vacuum wastewater drainage (*Unterdruckentwässerung*), pressure drainage (*Druckentwässerung*), wastewater management in rural areas (*Abwasser ländliche Gebiete*), wastewater pipes (*Abwasserleitungen*), sewage plants for industrial operations (*Abwasseranlage Industriebetrieb*), or measuring suspended matter (*Schwebstoffmessung*). The cost for accessing worksheets through DWA's online shop approximately ranges between 20€ and 50€, depending on how comprehensive and up to date the contents are. DWA's rulebook for the creation of worksheets (*DWA-Regelwerk Arbeitsblatt*) gives some insight into the purpose of the worksheet tasks. As such, they are meant to aid in the implementation of legal requirements surrounding matters of environmental but also operational relevance as well as improve the understanding of technical processes, facilities, and measures (DWA, 2018). One concrete example that is in part publicly available is that of a worksheet on hydraulic dimensioning and proof of performance of sewage pressure systems (*Hydraulische Dimensionierung und Leistungsnachweis von Abwasserdrucksystemen*). Here students are given a scenario that includes various technical specifications, including technical schematics (see Figure 1 below). Students are then asked to fill in missing information by performing relevant calculations correctly. This particular task is about the routing of wastewater pressure pipe at a gradient (DWA, 2020).

Figure 1: Example of task from DWA worksheet with relevance for 'Specialist for Wastewater Management'



Source: Visionary Analytics based DWA, 2020.

While it does not seem to be the case that teachers at Hans-Schwier-Berufskolleg or affiliated in-company trainers receive dedicated guidance related to EE and IS topics within the 'Specialist in Wastewater Treatment' programme, teachers do have access to at times relevant further training provided by DWA. As is the case with DWA-derived teaching materials, contents of these trainings are not publicly available due to copyright restrictions.

2.4 Barriers and drivers of green skills delivery

2.4.1 Drivers

There are three broad political and socio-economic factors that have driven the uptake of green skills into German VET curricula:

- The number of green jobs in Germany has been growing steadily over the past few years. This is, in turn, likely to generate heightened demand for specialists with 'green' skillsets (Statistisches Bundesamt, 2019). The German federal government is, for example, heavily involved in the development of eco-innovation parks which are key sources of demand for IS- and EE-related green skills (BMU, 2014).
- There has been significant socio-political pressure (e.g.: from Fridays for Future[4] as well as in the context of the 2021-2022 European energy crisis) to accelerate the 'green transition.' These pressures are also felt by the public sector institutions responsible for VET and respective industries. Consequently, uptake of 'green' elements has been fast-tracked significantly. As a result, curricula for all VET occupations are to include strict teaching standards for environmental protection and sustainability (Hemkes, 2021).
- Recent policy developments at the EU level are expected to be another driver at the German national level. The European Green Deal as well as the Next Generation EU recovery package likely means that sectors relying on EE or the application of IS in their production will gain the financial means to innovate further. This is likely going to lead to a further increase in demand for green skills.

In addition to these broader factors, BIBB's pilot projects on sustainability for education (see also Box 1) have contributed to establishing EE- and IS-related practices in different industries. For example, a project on introducing dedicated sustainability training in the chemistry industry has recently become part of the industry's main strategy. However, there is currently no systematic approach to upscaling successful pilot projects (Hemkes, 2021; Geissler, 2021). Based on the responses from the teachers at Hans-Schwier-Berufskolleg, there are no known school level factors that drive green or IS/EE skills delivery.

[4] Large scale demonstrations urging for more and faster action to limit climate change and to protect the environment, often involving the younger generations. See also: https://fridaysforfuture.org/.

2.4.2 Barriers

There are three key barriers to the delivery of green skills:

- Limited funding has hindered the implementation of policy initiatives that improve the uptake of green skills into the VET system. An example of this are BIBB's Multiannual Training Programmes. While the programme itself is rather broad, specific initiatives to be funded are narrower. However, as is the case with any funding programme, BIBB faces budget constraints, which means that the institution has priorities when financing projects for certain industries and topics. This means that IS and EE as well as some EIIs are not always featured in VET-related projects.
- Stakeholder cooperation in curriculum development can be another barrier. Developing new curricula requires research on how green skills related topics can be integrated, but it also requires cooperation with partner companies with the right kind of competencies. The latter is particularly challenging because SMEs – which constitute most businesses in the EIIs – often lack time, resources, and motivation to assist, even if they themselves implement green skills training. That is why the process of preparing materials on the necessary skills can sometimes be rather slow.
- Trainees have unequal access to green skill training. While there is a uniform legal framework at the federal level, local administrations, and businesses can significantly influence what contents are taught at schools and trained in-company. This also relates to the use of supplementary learning modules, courses, etc. provided by BIBB. Hence, some schools and businesses might be quite receptive to 'green' content, whereas others might not be. This means that a school's or a company's attitude might significantly impact a trainee's 'green' learning experience. This leads to fragmentation of the VET system regarding the 'greening' of curricula (Hemkes, 2021; Geissler, 2021).

At school level at Hans-Schwier-Berufskolleg the key barriers for the delivery of green, EE, and IS skills in the 'Specialist in Wastewater Technology' programme are a lack of cooperation with producers of simulation technology which leads to such programmes not being available to students for training purposes and of didactically processed teaching materials.

2.5 Conclusions

- The national policy space that captures green skills in German VET is coordinated through KMK, while the VET system itself is regulated at the state level. Germany has also adopted detailed educational as well as environmental and industrial policies, which all to various degrees capture green skills as part of the broader concept of sustainability.
- Green skills feature in every qualification's curriculum and training regulation horizontally through the existing standardised occupational profile on environmental protection. Different framework curricula and training regulations also include occupation-specific green skills provisions.
- There are also ongoing changes in the VET system targeting green skills specifically. Currently, Germany is working on the rollout of a new standardised occupational profile on environmental protection and sustainability.
- The German VET system provides companies and schools with flexibility to allow VET delivery to adjust to emerging technologies and skill needs without regularly adapting curricula.
- So far, Germany is in the early stages of developing a blueprint of a monitoring system for assessing the green skills delivery. Thus, it is hard to assess levels of

green skills of the German graduates upon entering the labour market (with the level seemingly fluctuating significantly from school to school).

- At the school level, the teaching processes heavily rely on cooperation between the schools and industry associations. Meanwhile, the level of cohesiveness is not very high. Teachers remain responsible for creating modules by themselves, based on the learning outcomes outlined in the relevant framework curriculum, although relevant industry associations tend to offer educational materials for use in class.

CHAPTER 3. BLUEPRINT CASE SUMMARY: ITALY

3.1 Introduction

Initial vocational education and training (IVET) in Italy covers four educational programmes. At the **secondary level**, students can enrol in a 5-year technical and vocational school programme, which combines general education and VET, or a 3- to 4-year vocational training programme (IeFP). At the **post-secondary level**, students can gain specialised knowledge in their chosen field through a 1-year Higher Technical Education and Training (IFTS) or a 2-, and sometimes 3-year, Higher Technical Education (ITS) programme. **Continuous VET (CVET)** targets mainly the employed, is organised by employers or social partners, and offers no official qualification. Finally, **adult learners** can acquire the standardised lower- and upper-secondary diplomas through Provincial Adult Education Centres (CPIAs; CEDEFOP, 2018).

National and regional governments share the responsibility for VET planning, implementation, and funding. The **national government** (through coordinated efforts of the Ministry of Education and the Ministry of Labour) establishes the broad VET framework. It monitors and anticipates skills needs, defines strategic goals, and designs and maintains VET pathways. The **regions and autonomous provinces** draft VET curricula, plan for post-secondary programmes (ITS and IFTS) accommodating regional skills needs and recognise non- and informal learning. **VET funding** comes from the national and regional governments (mainly directed towards lower-secondary education programmes), the European Social Fund (ESF; a primary funding source for upper-secondary VET, also CVET), and employers (who contribute to CVET) (CEDEFOP, 2019).

Increasing incorporation of work-based learning into the historically mainly school-based education is the key reform theme. Italy has trialled a **dual VET system** since 2015, which has increased the share of work-based activities in the existing VET programmes. It has also introduced apprenticeship schemes that can lead to formal qualifications at lower- and upper-secondary, and even higher education levels. Effectively, students face the same entry requirements to enrol in the apprenticeship programme as the traditional predominantly school-based course, follow the same education pathway, and receive the same certification upon graduation (CEDEFOP, 2019).

The initial analysis of green skills delivery in the Italian VET provides different conclusions depending on the education level. On the one hand, **explicit green skills delivery in secondary-level formal VET is largely lacking**. If taught at all, green skills tend to be “hidden” in other broader subjects or delivered through work-based or extracurricular activities (interview results, 2021).

On the other hand, **the post-secondary green educational offer (both academic and non-academic) is relatively rich, with a range of dedicated EE- and IS-related courses that teach advanced and technical green skills** (Confindustria Lombardia, 2021; interview results, 2021; Tripoli et al., 2020; Zuccaro et al., 2021). It seems to adequately address the skills demand, as evidenced in high student retention and school-to-work transition rates. A good practice example of such post-secondary technical education is *ITS Territorio-Energia-Costruire*. ITS TEC is a VET school in Emilia-Romagna, which delivers **a range of EE- and IS-focused courses** with contributions from a range of local stakeholders, emphasis on the practical learning aspects, and good practices to combine pedagogical and technical expertise of instructors.

3.2 Strategic planning: IS- and EE-related green skills in national policies

Since the regions have almost an exclusive responsibility for designing and implementing VET curricula, **Italy has neither a national VET strategic plan nor a nationwide educational policy framework concerning green skills delivery** (Interview results, 2021b).[5] Nonetheless, **green skills are well-covered in national environmental and industrial strategies** related to EE, IS, and broader environmental sustainability topics (Interview results, 2021a and 2021b). Even though they do not directly influence the education system, these strategies signal the importance of green skills development and flag their currently insufficient delivery by VET. For example:

- **National Strategy for the Circular Economy (*Strategia nazionale per l'economia circolare*)** identifies the need to support the development of technical (STEM) skills, green, and transversal skills such as critical thinking, creativity, problem-solving, and adaptation to change.
- **Integrated National Plan for Energy and Climate (*Piano Nazionale Integrato per l'energia e il Clima* - PNIEC)** lists the essential skills and professions necessary for a green transition but notes that "the VET offer does not yet seem to adequately include these new skill sets in education and training programmes".[6]

Several national environmental and industrial strategies also provide concrete action plans for green skills delivery and awareness-raising on sustainability issues. For instance:

- **National Recovery and Resilience Plan (*Piano Nazionale di Ripresa e Resilienza* – PNRR)** provides a comprehensive roadmap for Italy's development and covers several measures relevant for IS- and EE-related skills delivery. For instance, the Plan introduces a set of reforms aimed to strengthen and update the VET system in general, a dedicated communication programme to raise awareness on environmental issues and challenges; a new funding scheme to encourage pursuing doctoral programmes focused on digital and environmental transitions; and new regulatory frameworks for an improved connection between the industry and education.
- **Italian Energy Efficiency Action Plan (*Piano d'Azione Italiano per l'Efficienza Energetica* – PAEE)** includes a three-year training and information campaign about

[5] Some stakeholders recognise the need to create such a national plan – see, for example https://www.cislbasilicata.it/gambardella-serve-un-piano-strategico-per-la-formazione/.
[6] The PNIEC is still under consultation and has not been approved yet.

energy efficiency directed at a broad audience of end-users (EE awareness-raising) and businesses, banks, public administration, and other entities (EE training).
- **PNIEC** introduces a three-year information and training programme aimed at promoting the efficient use of energy.

Finally, some activities, plans, or institutions (e.g., inter-professional training funds) have been emerging at the regional level that somewhat address green skills as part of a broader initiative (e.g., green skills in overall skills forecasting). Box 1 below presents an example of such a policy supporting initiative in Emilia-Romagna. Nonetheless, **coherent educational strategies focused on green skills are generally lacking at the regional level as well** (Interview results, 2021b).

Box 3-1. Good practice example: Supportive action to drive curriculum design and policy change

The project **Future skills trends in Emilia-Romagna (*Le traiettorie evolutive delle competenze in Emilia-Romagna*)** focuses on industries towards which the Emilia-Romagna Region has directed its Smart Specialization Strategy (S3) policies: agri-food, mechatronics and automotive, construction, health and wellness, cultural and creative, green economy, and digital.

For these industries, the document outlines the following:
- the key competencies needed to facilitate sustainable development
- digital and green skills needed for three regional VET professional qualifications (technical expert in business management, technical expert in project management, and technical expert in service management)
- digital and green skills, which should be provided through the regional ITS training offer.

The document can be used by professionals in the education sector to (re-)design curricula and policy-makers to update skills standards (e.g., the Regional Repertory of Qualifications).

Source: Visionary Analytics based on case study sources (see References)

3.3 Implementation: the delivery of IS- and EE-related green skills in VET

3.3.1 Delivery of IS and EE skills in VET at national level

Despite the relatively low coverage of green skills delivery in educational policies (or lack thereof), there is some evidence suggesting that Italy is relatively ahead of other EU Member States in terms of green skills coverage in the IS and EE context. One survey has shown that, in 2018 81% of VET institutions and 91% of VET educators in Italy taught green skills – higher shares than in any other country covered by the survey (Lewis et al., 2018b).[7] More broadly, Italy's above-average performance in the areas of energy efficiency, waste management and circular economy are well documented (Camera dei Deputati, 2020; Tripoli et al., 2020). However, green skills delivery in Italy varies significantly depending on the educational level. Table 1 summarises the key patterns in green skills delivery at the secondary and post-secondary levels.

[7] Italy, Romania, Spain, Turkey, and the UK were covered in the survey. The study does not differentiate between formal and non-formal VET providers or education levels.

Table 3-1. Green skills delivery in Italian VET by education level

	Secondary	Post-secondary
Green skills coverage	Not formally covered	Relatively well covered in dedicated courses
Green skills taught	Transversal skills, awareness-raising	Advanced technical skills
Delivery modes	Delivered within the civic education module and other broader subjects, through practical experience, or by non-formal providers as extracurricular activities	Delivered within dedicated, specialised programmes, both academic (graduate, post-graduate, doctoral) and non-academic (ITS, IFTS), focused on EE, IS, and other greening topics.

Source: Visionary Analytics based on the case study analysis and sources (see References)

Secondary-level formal VET does not explicitly incorporate green skills in educational pathways, although green skills are often delivered non-formally (Interview results, 2021a and 2021b). Overall, **transversal skills and awareness issues tend to be covered much better than technical skills** (Interview results, 2021b). Two curriculum modules[8] particularly relate to green skills, although they do not mention them explicitly:

- **Civic education (*educazione civica*)** includes "environmental education, sustainable development, and protection of environmental heritage" as one of the competencies' sets and covers broader sustainability aspects (environmental, social, and economic).[9]
- **Pathways for Transversal Skills and Orientation (*Percorsi per le Competenze Trasversali e per l'Orientamento* – PCTO)** follow the EU framework for the key transversal competencies for lifelong learning.[10]

Furthermore, green skills topics can be "hidden" in other subjects, such as biology, sciences, or energy efficiency (in energy-focused VET courses). Digital skills, which are somewhat linked to green skills,[11] are also relatively well covered in formal schooling (Interview results, 2021b).[12] Students also tend to acquire certain job-specific (incl. green) skills through internships and apprenticeships, whose importance has risen with the shift to the dual system (Interview results, 2021a and 2021b).

Finally, secondary **VET students can acquire green skills through ad-hoc or extracurricular activities**. There is a relative abundance of educational activities delivered on a project basis, often implemented in cooperation with regional stakeholders (social partners, industry, universities, etc.) and financed by the ESF (Interview results, 2021a). Although they often provide good opportunities to develop green skills, they are rarely sustained after the project funding has ended.

Looking at post-secondary education, **Italy has been credited for relatively well-developed green skills pathways in tertiary education**, both academic and non-academic (Interview

[8] These modules are set by the federal government and apply to all education programmes administered by the Ministry of Education. This means they are covered in the 5-year professional and technical VET programmes but not in the 3-year IeFP programmes, which are run by the regions.
[9] Schools are required to dedicate at least 33 hours annually for teaching this module. See also: https://eacea.ec.europa.eu/national-policies/eurydice/content/national-reforms-school-education-33_en.
[10] PCTO is taught for a minimum of 150 hours for technical institutes and 210 hours for professional institutes in the final three years of the programme. Green transversal skills taught within this module include "interpersonal skills" and "entrepreneurship". See: https://ec.europa.eu/education/education-in-the-eu/council-recommendation-on-key-competences-for-lifelong-learning_en.
[11] Overlapping competence areas include "communication and collaboration" and "problem solving". See: https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework
[12] See, for example: https://www.miur.gov.it/scuola-digitale.

results, 2021a and 2021b). At the academic level, dedicated graduate, post-graduate[13] and doctoral programmes[14] have been successfully introduced (Interview results, 2021b; Tripoli et al., 2020). At the non-academic (VET) level, ITS and IFTS programmes that focus on green skills and address broader green transition issues have been developed. For example, VET providers offered 21 ITS routes[15] and awarded 316 diplomas[16] in the "energy efficiency" area in 2019 (Confindustria Lombardia, 2021; Zuccaro et al., 2021).

The post-secondary VET offer aims to equip graduates with advanced and technical green skills. The good coverage of these skills has been evidenced in the aforementioned survey research – teaching of technical and practical skills in VET was found to be significantly more widespread in Italy than elsewhere (Lewis et al., 2018b).[17] In general, **post-secondary "green" education programmes have been praised for their results, particularly in terms of completion rates and employment outcomes** (Interview results, 2021b; Confindustria Lombardia, 2021; Zuccaro et al., 2021).[18] Box 2 below briefly introduces one such IFTS programme, while section 1.3.2 below delves deeper into a selected ITS provider's educational offer.

Box 3-2. Good practice example: Post-secondary VET programme *Junior Expert in Circular Economy*

The blended learning course **Junior Expert in Circular Economy (JECE)** is a one-year IFTS programme. It targets young Europeans domiciliated in the Emilia-Romagna region qualified with at least a school diploma, preferably aged 18-25 and neither in employment nor education nor training (NEET). The 2022 edition is financed by the Emilia-Romagna Region and the European Social Fund (ESF) and organised by Centoform – a regional VET provider, with the support of a range of national and international partners.

The course aims to equip the participants with the **necessary tools and skills for sustainable development and circular transition in the economy and society**. These include the analysis, evaluation and improvement of manufacturing processes, impact assessment methods, total quality management for environmental sustainability, entrepreneurship, and digital literacy. The course is taught in English and is composed of interactive online and in-presence classes (446 hours), project work (34 hours), and an internship (320 hours). The course follows a certification scheme based on EQF, ECTS and ECVET. Students can enrol tuition-free.

Source: Visionary Analytics based on case study sources (see References)

[13] For example, Master in Bioeconomy and the Circular Economy is an interdisciplinary programme jointly offered by four Italian universities, four non-academic partners, and two technology clusters. See: https://masterbiocirce.com/.
[14] Especially industrial PhDs (*dottorato industriale*), which exemplify strong connections with business
[15] Out of a total of 201 ITS routes available (10.4%)
[16] Out of a total of 3,761 ITS diplomas awarded (8.4%)
[17] 64% of VET educators in Italy taught "expert procedural knowledge on energy, waste, resource efficiency, sustainable development, etc." and "practical involvement in saving energy, protecting ecosystems, etc.", compared to 43% and 54% respectively in all countries surveyed.
[18] The relative success of these programmes can be linked to the good demand-supply match. It has been well-documented that Italian employers tend to seek green skills (esp. managerial and technical) among executives, intellectual, scientific, and highly specialised professions to a much higher degree than among lower-skilled professions (ADAPT & Confindustria Lombardia, 2021; Frey et al., 2021; Unioncamere & ANPAL, 2020 and 2021).

3.3.2 Delivery of IS and EE skills in VET at the VET school level

Content of delivery

Higher Technical Institute Land-Energy-Construction (*Instituto Tecnico Superiore Territorio-Energia-Costruire* – ITS TEC) is one of seven Higher Technical Institutes in the Emilia-Romagna region. ITS TEC is a non-profit foundation comprised of multiple stakeholders, including VET providers, universities, other training institutions, municipalities, research centres, other local bodies, and over 500 companies – both SMEs and large corporations.[19]

At the time of research, ITS TEC offered three courses – all related to EE and IS topics:[20]

- Blue Course **"Build Liveable Urban Environment"** with graduate profile "higher technician for energy saving and sustainability of the building-land system"[21]
- Green Course **"Waste Management, Energy & Environment"** with graduate profile "higher technician for the circular economy, through the correct and sustainable management of waste, by-products and waste, for the recovery of matter and energy"[22]
- Red Course **"Renewable Energy Development"** with graduate profile "higher technician for the development of renewable energy"[23]

Process of delivery

All courses are delivered at the **tertiary non-academic level (EQF 5),** with twenty-one places offered every year for each course. They are funded by the Ministry of Education and the regional authorities as well as a (symbolic) student fee of €200. Additionally, other ITS TEC stakeholders contribute according to the needs and capabilities. For example, in-class instruction is delivered at the premises of schools and universities in Ravenna and Ferrara (Interview results, 2022a).

The industry's involvement is crucial in the delivery of the courses. For the most part, instructors come from local companies and, to a lesser degree, from universities and other education providers.[24] Students can also take advantage of study visits (in companies in Emilia Romagna, other Italian regions, and abroad, e.g., via Erasmus+ partnerships). Finally, local employers actively contribute to designing and adjusting the curricula (Interview results, 2022a).[25]

Thanks to the latter, curricula are up-to-date and address all the local industry's needs (Interview results, 2022a). In particular, the industry front-runners are consulted. For example, companies for which circular economy solutions are particularly important are associated in the GreenTech cluster (currently around 30-40 firms). Their needs are addressed, and appropriate solutions are incorporated into courses for the (future) benefit of all industry actors. On top of the private sector feedback, **ITS TEC also tries to foresight the industry demands**. For example, when the Green Course was launched, the awareness and pressure from the industry regarding circular economy solutions were still weak. ITS TEC is also more flexible

[19] See: https://www.itstec.it/chi-siamo/soci-e-partner.html.
[20] Additional two courses have been introduced starting in October 2022: Lime Course "Learning Information Modelling Environment" (higher technician for the digitisation and virtualisation of built heritage) and Yellow Course "Young People for Low-Cost Energy" (higher technician 4.0 for the management of energy and renewable energy plants).
[21] For a more detailed course content, see: https://www.itstec.it/corsi/blue.html.
[22] For a more detailed course content, see: https://www.itstec.it/corsi/green.html.
[23] For a more detailed course content, see: https://www.itstec.it/corsi/red.html.
[24] The Ministry requires at least 50% of teachers of ITS courses to come from the industry.
[25] Part of the curricula is set at the national level, but part is adjustable to local needs.

and can adjust curricula quicker than schools or universities (Interview results, 2022a). The process of designing and approving a new course or adjusting the curriculum of an existing course can last one year (plus two years to educate the first cohort).

Regarding the course delivery, **there is a strong focus on the practical aspect**. Each course lasts for two years and involves 2,000 hours of training, delivered in two main modalities (Interview results, 2022a and 2022b):

- **In-class teaching** (1,200 hours or 60% of the course load): Firstly, lectures focus on passing the theoretical knowledge. However, they involve a lot of active learning methods, such as working on real-life case studies from the partnering companies. In general, teamwork tasks and design-thinking methodologies (where students analyse problems and come up with solutions) are mostly used as they engage students with a challenge. Secondly, many hours are spent in computer labs, where students learn the dedicated software (e.g., for plant design or energy consumption verification) and practice labs, where they can use simulators (e.g., of photovoltaic systems). Finally, transversal skills, especially English and communication, are also taught.
- **Internships** (800 hours or 40% of the course load): Students apply the acquired knowledge and skills at company premises. Every student participates in two internships per year with a partnering company, which means about 120 placements are organised every year. Students often find jobs in companies where they have interned.

Such a practice-focused curriculum requires expert knowledge from the instructors – Box 3 below presents ITS TEC's approach to managing teachers.

Box 3-3. Good practice example: ITS TEC's approach to ensuring quality teaching

Approx. 80% of teaching hours are delivered by practitioners from the industry. However, "sometimes good technicians are not good teachers" (Interview results, 2022a). Therefore, there are always two instructors delivering the training with complementary roles:

- Instructors from the industry are responsible for passing the practical knowledge in class and supervising students during their internships.
- VET tutors with pedagogical training monitor the training, assess instructors and provide them with teaching tips. They also lead the dialogue with students and instructors to identify and resolve problems.

Finally, there are periodical meetings of teachers with a teacher coordinator, who ensure the delivery of the curricula (e.g., so that instructors do not duplicate the content).

Source: Visionary Analytics based on case study sources (see References)

ITS TEC's teachers do not generally receive any external support or guidance. However, it delivered some "train the trainers" activities for teachers in secondary schools (to incorporate the EE and IS content in a transversal manner). Approx. 240 teachers participated.

3.4 Barriers and drivers of green skills delivery

As the triangulation of the evidence from secondary sources and interview results show, the main barriers to green skills delivery at the policy level are as follows:

- **Lack of a universal green skills definition:** The lack of common understanding of what "green skills" encompass hampers assessment, validation, tracking, and forecasting of green skills (Interview results, 2021a and 2021b; Lewis et al., 2018a).[26]
- **Lack of awareness:** Stakeholders (incl. companies, VET providers, general public) are unlikely to realise the importance of green skills (Interview results, 2021b; Lewis et al., 2018a). Knowledge about available green transition support mechanisms is also limited (esp. EU-level initiatives and funding such as the Green Deal, the Just Transition Mechanism, etc.).
- **No formal pathways and certifications:** Since green skills tend to be "hidden" in curricula or acquired during informal (work practice) or non-formal activities (extracurricular courses), it is difficult to track and assess their levels, forecast needs, etc (Interview results, 2021a and 2021b).
- **Lack of a long-term vision and sustainable funding:** Green skills delivery on a project basis is often inefficient and fragmented. The discontinuation of often effective programmes results in a significant waste of opportunity (Interview results, 2021a).
- **Lack of evidence:** Robust assessments of educational programmes' effectiveness are necessary to document and replicate the best practices (Interview results, 2021a).

Further barriers have been acknowledged at the school level:

- **Low preparedness of education providers:** Training for the trainers in transversal and green skills education is under-provided, and relevant educational facilities (labs, didactic tools) and methodologies required to teach green skills are scarce in general education (Interview results, 2021b and 2022a).[27]
- **Poor foundations of post-secondary students**: Since secondary-level education focusing on EE and IS is lacking, students face a big knowledge gap when they enter specialised technical courses at the post-secondary level (Interview results, 2022a).
- **Scarcity of experts**: There are skills shortages in the relevant sectors, and it is difficult to ensure technicians also have time to teach (Interview results, 2022a).
- **Low awareness about ITS education**: ITS schools were founded in 2010, and even schoolteachers are sometimes unaware of their offers. Technical education is also considered inferior to university education (i.e., a second-choice carrier path) (Interview results, 2022a).
- **Infrastructural problems**: ITS TEC does not have a dedicated building, and training is delivered in other high schools and universities (Interview results, 2022a).

On the other hand, key drivers of improving green skills delivery in Italy include:

- **Robust policy framework:** In Italy, the National Recovery and Resilience Plan covers broad sustainability issues well and can facilitate the development of further policy actions relevant to the delivery of green skills. Additionally, specific regulations encourage higher involvement of businesses (e.g., training tax reliefs). Finally, education reforms opened the door for specialised courses adapted to local needs (such as ITS TEC) (Interview results, 2021a, 2021b and 2022a).

[26] This issue has also been recognised at the EU policy level in the Osnabrück Declaration – see: https://www.cedefop.europa.eu/files/osnabrueck_declaration_eu2020.pdf.

[27] "Lack of adequate and specific learning facilities" was the most commonly identified problem among Italian VET educators, followed by "too few staff have knowledge of green skills" (Lewis et al., 2018b). Both these issues have been also addressed in the PNRR, which emphasises "the enhancement of laboratories with 4.0 technologies" and "training teachers to be able to adapt training programmes to the needs of local firms" as key goals in ITS system development – see: https://www.governo.it/sites/governo.it/files/PNRR.pdf.

- **Industry demand**: Local demand for specific green skills (combined with the flexibility of educational offers) facilitates the creation of new relevant courses. For example, Ferrara, where ITS TEC's Blue Course is taught, has always had a tradition in architecture and sustainable buildings. In Ravenna (Green and Red Courses), there has been a push towards energy efficiency from the municipality and the industry (Interview results, 2022a).
- **Stakeholders buy-in**: High involvement of different stakeholders (including local authorities, universities, research centres, training providers, and firms) ensures effective and relevant training delivery (Interview results, 2022a).
- **Well-developed green tertiary education:** Relatively widespread and high-quality green skills delivery at the tertiary level (such as at ITS TEC) can have spill-over effects to other education levels and the economy at large (Interview results, 2021b).
- **Positive track record of "green" VET courses:** Good outcomes of VET graduates in EE- and IS-related courses can spur a vicious cycle where more (talented) students enrol in similar courses in the future, and providers respond by further improving the curricula and increasing the number of seats and/ or programmes (Interview results, 2021a and 2022a).

Additionally, several actions have been identified, which could contribute to a better green skills delivery if improved. These include scaling up **awareness-raising** activities, more efforts towards **stakeholder buy-in** both at the strategic planning and the delivery stage,[28] and establishing a commonly recognised **skills certification system**[29] (interview results, 2021b).

3.5 Conclusions

- There has been a push from the policymakers at the national level to incorporate EE and IS topics in industrial strategies and reform the education system to allow for more practice-based training aligned with local industry demands.
- This policy push, as well as increasingly voiced industry needs, have led to the development of a relatively rich offer of post-secondary technical courses, including in EE and IS topics.
- IFTS and ITS courses are designed specifically around the local industry demands, delivered with significant buy-in from a range of stakeholders, and focused on teaching practical skills and competencies.
- However, green skills are still poorly covered in general (secondary) education, although a new sustainability-focused module has been recently introduced. This results in low preparedness and awareness of secondary school graduates regarding green skills.
- Generally, (post-secondary) EE and IS education in Italy is relatively advanced, and the specific ITS TEC courses analysed above can constitute a good practice example.
- Nevertheless, barriers to (more) effective green skill delivery persist – mostly low awareness of sustainability topics, the perception of technical education as a second choice, and scarce evidence to assess and forecast skills.

[28] See also Lewis et al. (2018a).
[29] For example, micro-credentials at the EU level would help to improve transparency in skills assessment, tracking, and forecasting.

CHAPTER 4. BLUEPRINT CASE SUMMARY: POLAND

4.1 Introduction

Formal **initial vocational education and training** (IVET) in Poland **covers three main programmes**. At the secondary level, besides general education, students can choose between a five-year programme at a professional technical school (*technikum*) or a sectoral school course (*szkoła branżowa*), divided into two stages (three- and two-year). At the post-secondary level, post-secondary schools (*szkoła policealna*) deliver VET for most professions in one- to two-and-a-half-year programmes.[30] Continuous VET (CVET) and adult learning fall outside the formal education system and can be accessed at continuing education centres, practical training centres, further training and professional development centres, and VET schools. There are also programmes for the unemployed, special educational needs (SEN) learners, and other vulnerable groups, as well as training in crafts and specialised programmes for employees (CEDEFOP, 2019).

The Polish VET system is **centralised**. At the national level, the Ministry of Education and Science (supported by other ministries responsible for particular occupations) coordinates and implements secondary-level VET policy, establishes core curricula, and distributes governmental funding. At the regional level (voivodship), public authorities play a coordinating role mainly by supervising the implementation of national policy and providing pedagogical supervision. At the local level (county), authorities are responsible for running schools, including VET schools. Voivodships can also take over responsibility for schools of regional and trans-regional significance (e.g., groups of schools important for the regional economy) (CEDEFOP, 2019).

The critical reform efforts have been directed at incorporating more work-based and practical components (historically predominantly school-based) and involving businesses representatives in the vocational training process. Other recent policy actions have included a new classification of occupations in VET, a re-orientation of the VET core curriculum towards learning outcomes, and campaigns to change the perception of VET as "second-choice" education.

Two main takeaways emerge upon the initial analysis of green skills delivery in the Polish VET. First, green skills are absent from policy discourse, and their delivery is lagging at all educational levels, particularly in VET. Second, there is a disconnect between skills training and environmental awareness-raising. The need to improve transversal skills training and shift to more active learning methods is realised (at least at the rhetorical level), but it does not link to the challenges of the transition to a resource-efficient, low-emission, innovative economy. At the same time, notions of "environmental education", "education for sustainable development", or "climate education" are limited to simple fact-based teaching on the human-nature relationship.[31]

A case study conducted at the school-level, which is summarised in subsection 1.3.2, reaffirms the macro trends identified at the national level (i.e., uniform national curricula not adapted to

[30] Separate colleges of social work (*kolegium pracowników służb społecznych*) provide three-year programmes exclusively for social worker occupation.
[31] Acknowledging the differences between these notions, for the sake of simplicity and clarity, the term environmental education is used in this document.

local needs, low priority given to practical training, and high dependency on the school's or teachers' initiative to engage students in extracurricular activities).

4.2 Strategic planning: IS- and EE-related green skills in national policies

Generally, recognition of the seriousness of the climate crisis and the necessity to react to it (including education and skills development) is lacking in strategic planning at the national level (Interview results, 2021a and 2021c).

The term "green skills" is absent in Polish strategic documents. Instead, in the policy narrative, skills development and environmental awareness are treated as two separate issues. First, there is a recognition that Polish students lag in soft and transversal skills development,[32] despite their above-average basic skills levels.[33] Therefore, most educational and industrial policies emphasise the necessity to improve the provision of transversal and soft skills, both in terms of kinds of skills taught (what?) and delivery methods (how?). For example:

- The **Integrated Skills Strategy 2030** (*Zintegrowana Strategia Umiejętności* – ZSU) (2020) focuses on the "skills of the future", including entrepreneurial, social, teamworking, adaptability, leadership, critical thinking, and problem-solving skills.
- The **Human Capital Development Strategy 2030** (*Strategia Rozwoju Kapitału Ludzkiego 2030* – SRKL) (2020) recognises the need to teach "pro-innovative skills" within the core curriculum, including problem-solving, idea generation, independent thinking, decision making, change management, leadership, perseverance, and cooperation.
- The **Lifelong Learning Perspective** (*Perspektywa uczenia się przez całe życie*) (2013) acknowledges the need to reform curricula and encourage more student-centred teaching methods (active learning) to foster the development of creativity and innovativeness.
- The **Strategy for Sustainable Growth** (*Strategia na rzecz Odpowiedzialnego Rozwoju* – SOR) (2020) stresses the importance of transversal, digital, and vocational skills and the need to reform teaching methods to incorporate more active learning approaches and practical training.[34]
- **Poland's Industrial Policy** (*Polityka Przemysłowa Polski*) (2021) includes competence development as a key strategic axis and emphasises digital skills, adaptability, and lifelong learning. It also highlights the importance of dual training in VET.

At the same time, environmental policies either do not include educational aspects at all or focus on awareness about sustainable development and ecology, most often referred to as "environmental education". Most notably, in 2001, Poland adopted a dedicated **National Environmental Education Strategy** (*Narodowa Strategia Edukacji Ekologicznej* – NSEE), which provided funding instruments for environmental education initiatives and initiated

[32] For example, the *Human Capital Development Strategy* (SRKL) states that "[t]he unquestionable quantitative success of Polish education (…) must be turned into a qualitative success, by focusing on the delivery of universal key competences at all education levels".
[33] Among the EU countries, Poland had the third lowest share of underachievers in mathematics and science, and the fourth lowest share in reading, according to the OECD PISA study (see EC, 2019).
[34] The Strategy does not include education within its key priority areas though, but merely mentions human capital as a horizontal enabler for achieving the Strategy goals.

consultations to identify innovative and effective teaching approaches in environmental education. However, as one source emphasises, the Strategy was never ratified – thus constituted merely "a collection of wishes addressed to various institutions which were not obliged to implement them" (Tuszyńska, 2017, p. 48).[35] It was discontinued after the **NSEE 2013-2016** edition.

Other environmental policies, such as the **Circular Economy Roadmap (*Mapa drogowa transformacji w kierunku gospodarki o obiegu zamkniętym*) (2019)** and the **National Environmental Policy 2030 (*Polityka ekologiczna państwa 2030*) (2020)**, also stress the importance of providing information and raising awareness on ecological issues. However, like the NSEE, the strategies tend to be vague and fail to provide concrete action plans. Environmental education understood therein is also very shallow and touches upon only basic knowledge (Interview results, 2021c).

Box 4-1. Good practice example: The Environment, Energy and Climate Change Programme

The ***Environment, Energy and Climate Change Programme*** addresses the challenge of global warming. It is funded by EEA Grants and operated by the Ministry of Climate which is responsible for awarding funding and monitoring the projects. The Ministry of Climate fulfils its obligations with the support of the National Fund for Environmental Protection and Water Management. One of the expected results of the projects to be approved under this programme is the promotion of awareness-raising climate change mitigation and on circular economy.

Currently, some of the educational projects being implemented are:

- **Climate at metropolis schools** (PL-CLIMATE-0032): The implementation of the projects will contribute to increasing the awareness of students and teachers in the field of climate change, as well as reducing local greenhouse gas emissions.
- **Act for the climate** (PL-CLIMATE-0033): The project aims to broaden the knowledge of the school community and residents of Brwinów and Michałowice communes about climate change (including problems related to it, its effects and ways of mitigating and adapting to them) by implementing adaptation and mitigation measures at schools, as well as related educational and information activities.
- **My TURQUISE PLANET** (PL-CLIMATE-0045): Four schools from Piaseczyński County participate in this project, creating blue-green infrastructure to manage rainwater and increase biodiversity. The new infrastructure will improve the microclimate and mitigate the effects of drought periods, as well as create a visually attractive educational space, supporting various forms of activity, learning and development.

These projects can help to disseminate contents, materials, and educational methodologies to tackle the current lack of support to teachers in the implementation of environmental education across school disciplines.

Source: Visionary Analytics based on case study sources (see References)

4.3 Implementation: the delivery of IS- and EE-related green skills in VET

4.3.1 Delivery of IS and EE skills in VET at national level

The educational practice seems to reflect the lack of green skills coverage at the strategic planning level. Furthermore, **although green skills delivery is lagging across all education levels,[36] VET schools' offer is the least developed**. Higher education (HE) seems to be reforming relatively quicker than the formal schooling system,[37] with some dedicated "green"

[35] There is a broader implementation gap. Institutions (or their local branches or representatives) that are responsible for implementing a given strategy are often unaware that it exists, let alone take steps to implement it (Interview results, 2021b).
[36] Several studies have also recognised an undersupply of green skills training in the market offer (Kacak, 2015; Kozar, 2019).
[37] This is likely due to higher independence and flexibility of Higher Education Institutions (HEI) – most actions are bottom-up, driven by dedicated individuals.

courses emerging[38] and educational initiatives being launched for the broader public.[39] Students also receive some basic environmental education targeted at shaping green behaviours and attitudes in the early education stages (pre-school and primary). However, green skills coverage decreases as students progress up the education ladder and decreases even further if they choose a vocational rather than a general education pathway (Interview results, 2021a and 2021c).

Regarding the teaching content, **the disconnect between skills training and environmental awareness, visible at the strategic planning stage, can be also observed in VET implementation**. Environmental education is limited and treated very narrowly. At the secondary level, it entirely excludes elements of developing skills and shaping green attitudes and focuses solely on basic fact-giving on key environmental and climate change topics (Interview results, 2021c).[40] Transversal skills training seems to be similarly disconnected from the transition challenges to a resource-efficient, low-emission, innovative economy.

The delivery of environmental education and transversal skills training is generally not embedded in the curricula in a structured and comprehensive manner, even though skills training is emphasised at the policy level. They are primarily delivered within broader subjects, but specific guidelines on implementing them are lacking (Siekiera and Luck, 2016; UN, 2021). Therefore, the actual implementation largely depends on school management and individual teachers – their attitudes, competencies, ability, and willingness to go beyond the curricula and organise extracurricular activities (Kozar, 2019; UN, 2021). This results in an uneven delivery, meaning that **VET students from different classes and schools do not have equal opportunities to acquire green skills** (Siekiera and Luck, 2016; UN, 2021).

Furthermore, both transversal skills and environmental education are largely taught within general rather than vocational subjects. Therefore, most of the curriculum content related to environmental education is only taught in high schools and professional technical schools (which combine general and vocational education). By contrast, **environmental education coverage in sectoral schools, which are strictly vocational, is much more limited** (UN, 2021). The fact that high schools are more likely to make an effort to organise extracurricular activities (often in cooperation with HEIs) than VET schools exacerbates this gap (Interview results, 2021b; Kozar, 2019).

At the same time, specific vocational programmes dedicated to energy efficiency (EE) have emerged (for instance, a specialisation "renewable energy systems and equipment technician"), which include training on specific greening topics within dedicated subjects (such as "rational energy management") (UN, 2021). However, a still low prevalence of such courses is unsurprising – the greening of the economy and transition to renewable energy sources are not priorities of the Polish government, and the demand for skilled workers in these fields is limited (Interview results, 2021c).[41] Furthermore, VET graduates' skills do not reflect the labour

[38] For example, University of Silesia offers a master's course on "environmental administration". See: https://katalog.us.edu.pl/catalog/program/view?id=11955.
[39] For instance, an interdisciplinary group of academics from University of Warsaw has developed a free course book for educators on climate change. See: https://klimatyczneabc.uw.edu.pl/.
[40] The content includes, for example: notions of ecological tolerance and sustainable development, various forms of nature protection, the need for international cooperation for the protection of biodiversity (biology); environmental problems of the modern world, including climate change, other threats to geodiversity and biodiversity (geography); types of air, water and soil pollution, their sources and impact on the environment, types of smog and mechanisms of its formation; solutions for environment protection from pollution and degradation (chemistry). See: https://www.gov.pl/web/edukacja-i-nauka/tresci-dotyczace-edukacji-ekologicznej-obecne-w-polskich-szkolach.
[41] For instance, in 2016, the construction of new wind turbines was practically banned. See: https://www.reuters.com/article/us-energy-poland-windfarm-idUSKCN0YE17V.

market demand and they are generally not prepared for those few available green jobs (Interview results, 2021a).

Finally, **environmental education is taught exclusively within natural sciences subjects,** in line with the fact-giving rather than value-shaping approach (Interview results, 2021b and 2021c; Ocetkiewicz, 2020). Although environmental education is also, in theory, included in the core curriculum of subjects such as ethics, foreign language, basics of entrepreneurship[42] and, since recently, form period,[43] the exact teaching content is not specified, and teachers are not offered any support in implementing it (UN, 2021).[44] See Box 2 for an example of an initiative that can potentially contribute to overcoming this challenge.

Looking at how training is delivered, most sources are critical about methods applied in the teaching of environmental education. According to survey data from 2011, 70% of educators taught environmental education through lectures (Babiarz and Garbuzik, 2017). More recent assessments suggest that not much has changed since (Batorczak and Klimska, 2020).

Box 4-2. Good practice example: The Future Industry Platform

The ***Future Industry Platform*** was created to strengthen the competitiveness of enterprises operating in Poland by supporting their transformation towards industry 4.0 One of the main goals of the initiative is to strengthen the competences of human resources for the industry of the future. The Future Industry e-learning Platform offers courses on digitalisation and industry 4.0 and is currently offering two e-learning courses on environmental management:

- Transformation in the field of resource management: Renewable energy sources
- Transformation in the field of resource management: circular economy and sustainable production

The courses are organised in modules that correspond to the stages of awareness, targeting, planning, and testing.

Source: Visionary Analytics based on case study sources (see References)

4.3.2 Delivery of IS and EE skills in VET at the VET school level

Content of delivery

The selected school-level example largely reaffirms the macro trends and institutional solutions. **Professional Technical School No. 4 in Katowice (*Technikum Nr 4 w Katowicach*)** is a public school, forming a part of a larger Technical and General School Complex No. 2 in Katowice (the Silesia region).[45] Among other courses, the school delivers a professional technical course **"Energy Technician"** (EQF 4). As with all curricula in Poland, the course programme is developed at the national level and uniform for all schools that deliver it.[46] Furthermore, no specific courses in the national vocational curricula address EE or IS topics more directly.[47] Nor are there any references to EE or IS in the generic "Energy Technician" curriculum. Some aspects of energy productivity are included in terms of ensuring the efficiency of power plant machinery (e.g., boiler plants).

Process of delivery

[42] See https://www.gov.pl/web/edukacja-i-nauka/tresci-dotyczace-edukacji-ekologicznej-obecne-w-polskich-szkolach.
[43] See https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20200001008.
[44] For example, in a recent survey of Polish language teachers, only 38% of respondents said that the core curriculum for Polish language and its reading list enable topics related to the climate crisis to be introduced in class (Guzy and Ochwat, 2021).
[45] The complex also includes a general education high school and a post-secondary school.
[46] Although from the 2023/24 school year, specialisations will be introduced for 5th year students. They can be designed and developed by the school to introduce some flexibility and address local skill demands.
[47] See https://www.ore.edu.pl/2019/08/programy-nauczania-zawodu-2019/.

The main way students can engage in EE, IS, and broader sustainability topics is via **extracurricular activities**. The teacher of energy subjects at *Technikum No. 4* does try to encourage and motivate students to participate in local events such as (Interview results, 2022):

- **Energy Days** *(Dni Energii)*, which involved computer workshops and lectures on the assessment of EE, environmental impact and financial aspects of selected renewable and conventional electricity and heat supply technologies, led by experts from the University of Silesia[48].
- **Silesian Science Festival** *(Śląski Festiwal Nauki)*, which, among other things, touched upon the energy topics such as solar power[49].
- **A family picnic "Eco-responsible"** (*Ekoodpowiedzialnie)*, which included contests, workshops, and presentations related to environmental protection[50].
- **Earth Day** *(Dzień Ziemi)*, focused on the environmental challenges and promoting "green" behaviours[51].
- **Regional and national competitions**, e.g., Water and Wind Turbine Tournament *(Turniej Maszyn Wodnych i Wiatrowych)* for the design of power source models (wind turbines), evaluated based on their power and energy efficiency[52].

Nevertheless, **organising or involving the school in such activities highly depends on teachers' will and students' motivation** (as participation is voluntary). Meanwhile, the core curriculum is focused on more generic topics and delivered at a lower technical qualification level (rather than higher, e.g., preparing for managerial or design roles). Graduates obtain the main qualification of "assembly, commissioning and operation of power system transmission installations and units", including:[53]

- assembling and starting up electricity and heat transmission and distribution equipment;
- carrying out maintenance and inspections of electricity and heat transmission and distribution installations and equipment;
- performing measurements of the parameters of installations and equipment for the transmission and distribution of electrical and thermal energy.

The course is largely delivered in class and focused on the theoretical rather than practical aspects. This could be attributed to the nature of the final exams that lead to the formal qualifications – these test only theoretical knowledge ("pen and paper" exams; Interview results, 2022). The authorities, which fund the school, only feel obliged to prepare students for the exam and not for the world of work (Interview results, 2022). Therefore, funding for labs, equipment, tools, machines, and other solutions that could foster students' practical skills is extremely scarce. Teachers often rely on personal connections at local energy companies that donate (often old, decommissioned) equipment to the school. However, students sometimes complain they only get to practice on outdated equipment (Interview results, 2022). Likewise, company visits or guest lectures at the school from industry practitioners can only be organised based on teachers' personal connections in the sector.

[48] See https://zstio2.katowice.pl/index.php/elektryczni-w-szkole/34-misja-czyste-powietrze.
[49] See https://www.zstio2.katowice.pl/index.php/wydarzenia/177-slaski-festiwal-nauki-dzien-pierwszy.
[50] See https://www.zstio2.katowice.pl/index.php/wydarzenia/616-ekoodpowiedzialnie.
[51] See https://www.zstio2.katowice.pl/index.php/wydarzenia/609-dzien-ziemi.
[52] See https://www.gkpge.pl/grupa-pge/zrownowazony-rozwoj/edukacja/pge-turniej-maszyn-wodnych-i-wiatrowych.
[53] See https://www.ore.edu.pl/2019/08/programy-nauczania-zawodu-2019/.

Students are required to complete two internships as part of the course in the third and fourth years. However, **schools typically do not have formal agreements with local firms**, and students must look for internship opportunities themselves. Teachers and other school staff might help some students in finding placements, but this is done informally and ad-hoc (Interview results, 2022). Furthermore, internships should last for eight weeks (280 hours) – only about 5% of the course load (a total of approx. 150 weeks of schooling). Finally, internships are not overseen by the school. Although each student has an assigned supervisor from the company, the amount of support offered to interns often depends on the person's or firm's attitude (Interview results, 2022).

Regarding external support, relatively good pedagogical guidance from the Centre for Education Development *(Ośrodek Rozwoju Edukacji)* is available for general education teachers (especially high schools), but coverage of vocational topics is poor. **Local universities provide some support (e.g., via guest lectures and events)**, aiming to attract students to continue education in energy-related tertiary education courses.

4.4 Barriers and drivers of green skills delivery

The main barriers to green skills delivery in Polish VET have been identified as follows:

- **Absence of top-down strategic action:** Green skills are not mentioned in the policy discourse, and the lack of a strategic plan makes structural changes in formal schooling impossible, especially given the low independence of schools (Interview results, 2021a and 2021c). More broadly, there is apparent negligence of the importance of greening the economy and even climate change hesitancy among government officials. Thus, there is little hope that the current approach will significantly shift (Interview results, 2021c).
- **Prevailing passive learning methods:** The need to shift from fact-giving approaches to more active and skill-shaping methods have been recognised at the strategic planning level. A dual VET system has been introduced to incorporate more practical and work-based learning[54], but whether and how school-based teaching is being reformed is unclear (Interview results, 2021c). The prevalence of theory-based exams also hinders the change in teaching practices (Interview results, 2022).
- **Low teacher preparedness:** Teachers, particularly those teaching vocational subjects, are often not competent or equipped to deliver effective green skills training (Interview results, 2021a and 2021b).[55] At the same time, instructors with practical experience are scarce (since wages in the industry for experts are much higher than for VET teachers; Interview results, 2022).
- **Lack of institutional support**: Schools and teachers receive insufficient funding to invest in equipment. Pedagogical support is also scarce, and information about projects and funding sources is hard to find. Finally, there are no institutional solutions to include a broader range of stakeholders in the design and delivery of the courses (Interview results, 2022).

[54] See Siekiera and Luck (2016).
[55] For instance, survey data has shown that 82% of educators need support in teaching environmental education – among them, 87% expect financial support (e.g., funding of extracurricular activities or purchase of didactic tools) and 55% – content-related support (e.g., guidance or teaching materials) (Babiarz and Garbuzik, 2017; see also Mróz and Ocetkiewicz, 2019).

Improving eco-awareness and environmental sensitivity among society has been identified as the critical enabler for future green skills training improvements (Interview results, 2021a and 2021c). This can spill over into the education sector in at least three ways:

- Despite the education they received, students are increasingly demanding the expansion of environmental education coverage in curricula.[56]
- HEI staff and civic organisations are increasingly active in developing bottom-up educational initiatives for school students.
- A shift to more sustainable consumption creates a positive market pressure that forces businesses to become greener, creating more demand for green skills and green skills training.[57]

Furthermore, the industry demand for energy technicians could drive further curricula adjustments. As of now, companies mostly select graduates/employees based on their soft skills and basic knowledge of broad energy issues and practices. They need to train them, however, equipping them with specific skills required at a particular job (Interview results, 2022).

4.5 Conclusions

- EE and IS are generally not addressed in national policy documents and strategies either educational or industrial.
- Although some courses related to EE and IS emerge at the academic tertiary level, generally, the coverage at all levels is relatively weak. The lack of post-secondary non-academic vocational courses on EE and IS is particularly striking.
- The VET system is highly centralised and rather rigid, leaving little leeway for regions and schools to adapt curricula to local demands, let alone to design and deliver customised courses.
- At the secondary VET level, the closest course to EE topics is “Energy Technician”, although the official curriculum does not address EE issues directly.
- The practical training and learning about topics beyond the curriculum are highly shaped by the school’s and individual teachers’ efforts as well as by students’ motivation, potentially leading to varying outcomes depending on school, class, and individual students.
- The lack of top-down strategic, financial, and communication support (e.g., awareness raising or guidance) surfaces as the crucial barrier to effective green skill delivery. At the school level, the focus on passive learning methods and theory rather than practice (reinforced by the theory-only formal exams) further inhibits the development of more effective teaching methods.

[56] For example, in August 2021, Minister of Education and Science and Minister of Climate and Environment signed a letter of intent concerning cooperation on environmental and climate education and announced the development and inclusion in the curricula of dedicated “green” lessons. This happened in response to the demands expressed by students during the consultation on the government's strategy for the younger generation. See: https://www.gov.pl/web/edukacja-i-nauka/podpisano-list-intencyjny-dotyczacy-wspolpracy-na-rzecz-edukacji-ekologicznej-i-klimatycznej and https://monitorrynkowy.pl/edukacja-ekologiczna-wkracza-do-szkol-ruszaja-prace-nad-przygotowaniem-zielonych-lekcji/.

[57] See also Kozar (2019).

CHAPTER 5. BLUEPRINT CASE SUMMARY: PORTUGAL

5.1 Introduction

The Portuguese education system is very centralised in terms of organisation and funding. Education in Portugal is established according to the democratic principles of the Constitution of the Republic, approved in 1976, namely the freedom to teach and learn (Art. 43) and citizens' rights and duties of the state in the educational plan (Articles 73-77). These principles were fundamental for elaborating the Basic Law of the Educational System, approved in 1986, where the objectives, structures, and ways of organising education are defined.

The Portuguese VET legislation does not mention any policy regarding EII, as it is focused on the scope of coordination, execution, and evaluation of the national policy regarding VET in a broader range. However, many initiatives can be found in the general education systems. The commitments assumed by Portugal in the European Union (EU) and various international forums in the field of environmental education for sustainability have strengthened the intervention capacities of public entities in terms of transversal action and inter-ministerial cooperation. Particularly relevant in this area is the partnership established between the ministries of Environment and Education. However, the delivery of EE- and IS-related skills is not addressed enough by initial and continuous VET programmes, including those specified in the National Qualifications Catalogue and funded by the European Social Fund.

In Portugal, there are several paths of dual certification (school and professional) aimed at young people, in which the vocational skills necessary for professional activities are developed. At the same time, the secondary level of education is obtained.

Initial VET programmes available at the secondary levels that lead to EQF level 4 are:

- Professional programmes (*CP - Cursos Profissionais*);
- Apprenticeship programmes (*CA - Cursos de Aprendizagem*);
- Specialized Artistic Programmes (*CAE - Cursos Artísticos Especializados*).

There are other regulated programmes leading to dual certification (OECD, 2011), namely at the sectoral level:

- Training programmes for young people (*CEF – Cursos de Educação e Formação*) are also available in **basic and secondary education**, leading to EQF level 2 and EQF level 4 (Cedefop, 2021);
- In **post-secondary education,** Technological specialisation programmes (*CET - Cursos de Especialização Tecnológica*) lead to EQF level 5 and a technological specialisation diploma (DET – Diploma de Especialização Tecnológica);
- Higher professional technical programmes (*CTeSP - Cursos Técnicos Superiores Profissionais*) that lead to EQF level 5. In addition, VET learners can apply for higher education through special access[58].

[58] These students will take exams at the Higher Education institutions to assess whether they have the knowledge and skills considered essential for entry and progression in the study cycle for which they apply. The evaluation and ranking of candidates are carried out based on cumulative criteria: the final classification of the course held by the candidate; the classification of the final exam of the respective course; and the classification of the knowledge and skills assessment test required by the Higher Education Institution to which they apply. In 2022, three thirds of the vacancies were promoted by polytechnic and only one third by universities (Público, 2022).

CVET for adults focuses on lifelong learning and increases adults' employability by upgrading their knowledge and skills. Adult trainees are guided towards the most suitable training offer to obtain a qualification through the CVET system. This can be (i) the Validation of Prior Learning (RVCC - and subsequent guidance for further training); (ii) Adult Education and Training Courses (EFA - with a duration of two years and equivalent to the EQF Level 2 or EQF Level 4, aiming to contribute to the development of adult personal, social, cultural and scientific competences); and (iii) Certified Modular Training (UFCD - with the duration of 25h or 50h; aimed at the development of technical skills necessary for professional practice). The institutions that offer CVET programmes are the Training Centres of the *Instituto de Emprego e Formação Profissional (IEFP)*, public schools, private and sectoral education establishments and approved private training centres.

In addition, in-company continuous professional training is also available (Cedefop, 2021), as well as training actions officially designated as “other vocational training” (*OFP - Outra Formação Profissional*). These actions are usually not funded. This includes "catalogue training programmes" or tailored training offered by companies specialised in specific sectors to corporate or individual customers. The customer pays for these courses, and if the promoting training company is not certified by DGERT, there are no tax benefits for the buyers. These usually job-unrelated trainings lack a coherent and consistent policy and a comprehensive adult education policy that could foster the participation of those that are low-skilled and do not usually participate in adult education (Guimarães, 2019).

5.2 Strategic planning: IS- and EE-related green skills in national policies

Over the past years, partnerships between the Ministry of Education and the Ministry of Environment have resulted in environmental education projects aimed at all levels of education. In 2009, the **Environmental Education for Sustainability Working Group** (GTEAS) was set up to monitor and implement the projects provided for in the cooperation protocol established between the Education and Environment departments. Currently, the **National Environmental Education Strategy 2020 (ENEA – Estratégia Nacional de Educação Ambiental 2020)** encourages and finances educational actions aimed at schools, municipalities, public administration, and the corporate sector to serve the three central pillars of environmental policy: decarbonising society, making the economy circular, and valuing the territory.

The **Citizenship and Development** subject is part of the components of the national curriculum. It is developed in schools according to three complementary approaches: transdisciplinary nature in the 1st cycle of basic education, autonomous subject in the 2nd and 3rd cycles of basic education and component of the curriculum developed transversally with the contribution of all subjects and training components in secondary education. In this sense, the programmes of all subjects of the curriculum integrate the development of transversal competences in the domain of the various aspects of education for citizenship, namely environmental education for sustainability.

The **National Education Strategy for Citizenship (ENEC – Estratégia Nacional para a Cidadania)** includes a set of skills that must be provided by the citizenship education of Portuguese children and young people, such as those linked to sustainable development and

environmental education. In addition, the Strategy states that each school must implement and coordinate an Education Strategy for Citizenship at School (EECE).

Students' Profile by the End of Compulsory Schooling (Perfil dos Alunos à Saída da Escolaridade Obrigatória) (2017) is a guiding document that describes the principles, vision, values, and competences that Portuguese students need to develop by the time they finish compulsory schooling. The document states that basic and secondary education must promote skills for adopting behaviours that respond to the global challenges of the environment and build a sustainable future. Students should be able to:

- (i) adopt behaviours that promote health and well-being, namely in daily habits, food, consumption, physical exercise, sexuality and their relationships with the environment and society.
- (ii) understand the balances and weaknesses of the natural world in the adoption of behaviours that respond to the great global challenges of the environment.
- (iii) manifest environmental and social awareness and responsibility, working collaboratively for the common good, intending to build a sustainable future.

Box 5-1. Good practice example: The Environmental Education Framework for Sustainability

The **Environmental Education Framework for Sustainability (Referencial de Educação Ambiental para a Sustentabilidade) (2018)** is a guiding document for the development of projects and initiatives within the scope of the discipline of **Citizenship and Development** that integrates the curriculum in the different cycles and levels of education (pre-schooling, basic and secondary education). It is organised in learning outcomes and is intended to change behaviours and attitudes towards the environment on the part of young people and children as well as their families and communities.

The Referential is organised into eight transversal themes, constituted by sub-themes, objectives, and learning outcomes. These themes are (i) Sustainability, Ethics and Citizenship; (ii) Sustainable Production and Consumption; (iii) Territories and Landscape; (iv) Climate Change; (v) Biodiversity; (vi) Energy; (vii) Water; and (viii) Soil.

Source: Visionary Analytics and ISQ based on Pedroso (Coord., 2018).

Considering strategies for promoting green skills in national environmental and industrial policies, Portugal has developed roadmaps and action plans for a Circular Economy in line with the ambitions of the European Commission. Two relevant documents that regulate this area and prescribe goals for education and training are the following:

- **Leading the Transition: Action Plan for the Circular Economy in Portugal (PAEC)** establishes a commitment to the construction of environmental literacy and the education of citizens for environmentally conscious choices.
- The **National Energy and Climate Plan 2030 (PNEC 2030)** establishes objectives of promoting new aspects of training specialised technicians for the energy efficiency and renewable energies sector and promoting training for technicians and specialists in the construction and NZEB (nearly zero-energy buildings) buildings area. It also intends to include and anticipate training and professional requalification to guarantee a fair transition and to foster capacity building (education and training) in climate change mitigation.

5.3 Implementation: the delivery of IS- and EE-related green skills in VET

Vocational Education and Training and Adult Education are under dual authority: the **Ministry of Education and the Ministry of Labour, Solidarity and Social Security**. The National Qualifications System (NQS) includes institutions directly and indirectly linked to the State administration and other consultative bodies[59]. At the local level, Municipalities have responsibilities for investing, equipping, and maintaining school buildings, providing meals, and managing schools' staff, including in VET schools. School clusters have some autonomy in curriculum management.

The design and adaptation of VET qualifications is the responsibility of ANQEP in collaboration with the 18 Sectorial Qualification Councils. This system of anticipation of qualification needs (SANQ) has been reinforced through a greater diversity of input data and the involvement of a significant and representative number of stakeholders at the regional and local levels. This system, however, still makes it challenging to adapt learning content to rapidly changing market needs.

IVET and CVET courses within the National Qualifications Catalogue (CNQ) lead to a **dual certification** that covers general education and professional training organised in short-term training units (UFCD - Unidades de Formação de Curta Duração) and Work-based learning. The CNQ also provides a reference framework for the prior learning validation process. This **modular organisation** of the VET system allows the permeability (horizontal and vertical) between different programmes and between general education and VET programmes, as well as flexibility in the type and duration of courses for adults (Cedefop, 2021).

5.3.1 Delivery of IS and EE skills in VET at the national level

Besides the **Citizenship and Development** curricular component, VET students can access technical and professional modular training units that cover IS- and EE-related themes such as environment, sustainability, and circular economy, depending on the qualification path. The National Qualifications Catalogue includes 392 qualifications and 8537 training units of short duration (25 to 50 hours). Some qualifications are related to green jobs, such as Environmental Management Technician or Solid Waste Management Systems Operator. A search on the catalogue retrieved **29 training units** related to the themes of EE and IS (see Annex 2 for a full list of training units). For example, the unit "Environment, Safety, Hygiene and Health at Work" introduces concepts on the main environmental problems today, such as "Waste, its definition and waste production"; "Waste Management, Entities managing specific waste streams"; and "Operating strategies and Good practices for the environment". This UFCD makes part of 110 different qualifications in the NQC.

The UFCD "Environmental Management" (50 hours) aims to train learners to identify and systematise the concepts of environmental management, the relevant legislation in the scope of environmental management, the requirements of the NP EN ISO 14001 standard, the most significant environmental aspects and impacts, and to know how to recognise and classify urban and industrial waste and the methodologies for its management. This UFCD is present in 15 qualifications.

[59] These are the National Agency for Qualification and Vocational Education (ANQEP), the Directorate-General for Education (DGE), the Directorate-General for Employment and Relations (DGERT), the Institute for Employment and Vocational Training (IEFP), the Sectors of Qualification Council (CSQ), the Qualification Centres (Centros Qualifica) and other VET operators.

Training units more aimed explicitly at sustainability are a part of a smaller number of qualification paths. This is the case for the UFCD "Environmental management and sustainability – concepts and principles" that provides learning content such as concepts, principles, and definitions relevant for the development of green skills. This unit is part of three professional qualifications: Solid Waste Management Systems Operator, Water Treatment Systems Operator, and Water Treatment Systems Technician. Overall, these units are focused on basic knowledge-related objectives.

However, references to specific skills for EE and IS are scarce and difficult to contemplate in short-duration modules. Besides this, there are yet no relevant reforms or national initiatives to promote EE and IS training. For this reason, different projects and training centres are now offering "Other professional training" in more specific EE[60] and IS skills or, more often, circular economy (see Box 2 below). Recently, ANQEP started the efforts to update the National Qualifications Catalogue. To this end, it opened an international public tender in April 2021 to acquire services to carry out diagnostic studies of the required qualifications and competencies.

Box 5-2. Good practice example: EduZWACE – Education for zero waste and circular economy[61]

EduZWACE – Education for Zero Waste and Circular Economy is an Erasmus+ project (2018-1-EL01-KA202-047749) that aims to fill a gap in vocational education and training (VET) related to "zero waste" and circular economy by developing the interdisciplinary skills needed for future work in this field. The international consortium consists of organisations from nine European countries. The Portuguese participant organisation is LNEG (Laboratório Nacional de Energia e Geologia). Four intellectual outputs were developed as part of the project: a knowledge platform that includes a resource centre, an online course, and a diagnostic tool. EduZWaCE supports the exchange of good practices, enabling stakeholders to deepen and spread-out knowledge, develop and reinforce networks, increase their capacity to operate at a transnational level, and share and confront ideas, practices, and methods. In addition, the partnership delivered online courses targeting two job profiles (the Manager and the Technician/Worker), including EduZWaCE Skill Card Sets designed to enable further ECVET certification of the courses; and The Knowledge Hub, an interactive resource centre, which gathers useful information for VET teachers and professionals from companies who seek for knowledge and inspiration on zero waste and circular economy.

Source: Visionary Analytics and ISQ based on https://www.eduzwace.eu

The partnerships between VET centres and companies are fundamental for effectively training VET students. These partnerships usually consist of internship agreements for work-based learning but can take other forms:

- For instance, the programme for Energy Management technicians includes an internship at the end of the course. This practice in a work context (PCT – Prática em Contexto de Trabalho) is required to complete the course (it also counts on 35% for the final assessment)[62]. Internships can happen in other companies, but at CICCOPN, the AICCOPN members are prioritised. Here, students have an internship tutor who assesses attendance and performance. The Final course work is elaborated along the PCT with the accompaniment of a CICCOPN tutor/trainer (CICCOPN Interviewee).
- ATEC also collaborates regularly with tenths of companies through curricular internships within the courses and by providing tailor-made training for businesses. In addition, after students complete their training programmes, the centre recommends them to companies open for hire (ATEC Interviewee).

[60] For example, ADENE (Energy Agency) offers training courses in different areas that demand energy efficiency, such as industry and construction (https://academia.adene.pt/academia-adene/portefolio-formacao/)
[61] https://khub.eduzwace.eu
[62] https://catalogo.anqep.gov.pt

- The team of teachers from Externato Santa Clara, responsible for the programme for liquid waste management operators, often organises study visits to water treatment plants. Besides this, the course includes a 210-hour internship. Here students face some limitations since they are minors and cannot work on shifts as is usual in these facilities. Thus, the internships usually happen in pet stores or florists. At the workplace, they have a mentor and are also accompanied at school. Usually, every year about 15 students go on an internship. The school has partnerships with some companies that are maintained yearly, and the partners are usually the same (about 10 to 12 companies). Internships are held from May to July when employees go on vacation, and students can substitute them (Externato Santa Clara Interviewee).

As for the funding of VET courses, these are usually funded by the European Social through Operational Program Social Inclusion and Employment[63] (POISE – Programa Operacional de Inclusão Social e Emprego). This allows students to receive a meal allowance and transport allowance.

- ATEC is a non-profit association whose promoters are Volkswagen, Siemens and the German Chamber of Industry. It receives funding from European Social Fund through the Operational Programme of Human Capital[64] (*POCH – Programa Operacional do Capital Humano*) to implement training programmes. Students enrolled in the programme for Energy Management Technicians receive a meal and transport allowance and can also receive accommodation grants if the trainee lives more than 50km from the training centre. They can also receive financial support for expenses with the care of minor children and dependent adults, under the responsibility of the trainee, when the trainee proves the need to entrust them to third parties for reasons of attending the training[65].
- The management of CICCOPN is shared between IEFP and the Association of Civil Construction and Public Works Industrialists. It also receives funding from the European Social Fund through POISE and POCH. Trainees enrolled in the Energy Management Technicians programme also have the right to financial support for meals and transport[66].

5.3.2 Delivery of IS and EE skills in VET at the school level

Content of delivery

CICCOPN and ATEC provide an EQF level 5 programme for Energy Management technicians[67]. This qualification profile is relatively new — it was first approved and legislated in 2015, and the first edition was held in 2017. This qualification includes the following EE-related technological modules and learning goals[68]:

- Electric power quality (25 hours):
  - *To identify potential energy savings in an electrical installation and reduce consumption.*
- Automated systems (50 hours)
  - *To monitor, rectify and improve the system's functional performance.*

[63] https://poise.portugal2020.pt
[64] https://www.poch.portugal2020.pt/
[65] http://www.atec.pt
[66] http://www.ciccopn.pt
[67] The training course has the duration of 1560 hours, over 12 months; it includes 560 of work-based learning.
[68] Based on WP3 IS & EE related skills identification.

- Smart grid development project – optimisation (50 hours)
    - *To test, adjust, detect errors in projects or their implementation and make the necessary corrections.*
- Work-based learning (560 hours)
    - *The on-the-job training component aims to apply acquired knowledge and knowledge to the practical activities of the respective professional profile and carry out activities under guidance, using the techniques, equipment and materials that are part of the processes of production of goods or provision of services. This training is carried out in partnerships established between the training institution and companies, other employers, and business or socio-professional associations, among others, and can adopt different modalities, namely internships.*

Although few modules directly approach EE, the representatives of both training centres consider that their training contents are up-to-date, mainly because the learning outcomes of the modules (UFCD) are updated, and the trainers are very experienced and have a thorough knowledge of the industries and workplaces requirements. This way, they can introduce IS and EE topics transversally in the existing modules. For example, at CICCOPN, the trainers address such topics as wind energy, photovoltaic energy, and energy management from the point of view of energy saving. They do not identify relevant gaps between the delivered skills and skills requested by the industry.

The representative from ATEC considers that IS skills are provided primarily in training courses directed to leadership, management, consultants, and industrial optimisation in tailored training programmes. On the other hand, EE skills are more present at lower levels of VET training.

The Externato de Santa Clara offers an EQF level 2 programme (CEF) for water treatment operators[69] aimed at students 16 years or older with a history of school failure. Here, students and teachers notice a gap between what skills are delivered and the skills requested by the industry since school is much more demanding than companies. This way, students often introduce new practices such as recycling that are appreciated. This qualification includes the following IS-related technological modules and learning goals[70]:

- Environmental management and sustainability – concepts and principles (25 hours)
    - *To identify the fundamental concepts and principles of environmental management and sustainability.*
- Metrology and calibration (50 hours)
    - *To organise a control system for monitoring and measuring devices.*
- Work-based learning (210 hours)
    - *The internship in a work context aims at the acquisition and development of technical, relational and organisational skills relevant to the professional qualification to be acquired.*

Process of delivery

At CICCOPN, the programme for Energy Management Technician follows a hybrid structure with face-to-face sessions and online training. At CICCOPN and ATEC, priority is given to the practical part of the course. The representatives of both organisations consider that their group

[69] The training course has the duration of 2 years; it includes 210 of work-based learning.
[70] Based on WP3 IS & EE related skills identification.

of trainers has much experience working in these areas. In theoretical sessions, the trainers resort to presentations, manuals, and the industry's specific software. At ATEC, there are two types of trainers: internal and external. The internal ones are trained in the areas in which ATEC already has certification, or they propose that the trainers receive other training; for example, in international protocols (DOMOTICA, KNX) or work in tension. According to ATEC's representative, trainers try to be up to date with the industry practices and requirements. The trainers experiment with new methods to keep younger students motivated, such as gamification and learning management platforms; they also use theoretical contextualisation and demonstration.

CICCOPN's team considers that the centre has good facilities that allow many trainees and quality training. These include electrical laboratories, building materials laboratories and photovoltaic systems (accredited by IPAC). The lab is funded by CICCOPN and does essays for companies in the construction sector. In addition, they receive visits from university students and other interested groups. As for ATEC, the centre had to seek partnerships in the former EDP (energy company) training centres to work in medium voltage and high voltage. ATEC's pedagogical team also stresses in the interview the importance of behavioural skills training, promoting a positive attitude and practical exercises to identify how concrete problems can be solved. The purpose is to improve trainers' employability in the industry.

Besides the training courses, CICCOPN promotes after-work webinars on sustainability issues in the construction sector (connects EE and SI), sustainable cities and construction waste for professionals. This is a way of informal learning and a strategy for disseminating the training programmes. Both CICCOPN's and ATEC's representatives mention often participating in European projects on energy efficiency and sustainability issues such as sustainable construction and materials.

At Externato Santa Clara, the programme for liquid waste operators required the adaptation of a school laboratory. The representative explained in the interview that the school had to acquire water analysis kits, thermometers, and materials to collect water. Specific software was also necessary to build models and present visits to wastewater treatment plant simulations. As for the pedagogical methods, preference is given to project-based learning and a final internship. Teachers try to find opportunities for students to learn outside the classroom and establish partnership opportunities. These are often part of corporate social responsibility projects. Recently, a class created a short film about sea pollution, and the students won the third prize, awarded by BPI (Portuguese Investment Bank).

5.4 Barriers and drivers of green skills delivery

On the other hand, the following drivers have been identified:

- The current **political agenda** is favourable to public policies promoting green skills and the upskilling of workers in circular economy and energy efficiency. This concern materialises in the recent adoption of legal instruments that regulate the availability of funding for green transition and VET training. School representatives agree that the political context is favourable to the implementation of green skills and that funding is available for schools to develop their programmes (CICCOPN and ATEC Interviewees).
- The **environmental education strategy** throughout schooling promotes environmental awareness and the search for sustainable solutions. It can increase the

interest and demand for training in the areas of EE and IS. The need to motivate students for these training areas should be addressed by general education and not only by VET schools (CICCOPN Interviewee).

- The dual VET system favours **work-based learning (WBL)** and facilitates the identification of training needs and communication between the educational and professional systems; also, integrating students into the work market is easy since there is a lack of workers with IS and EE skills (ATEC Interviewee).
- VET schools usually resort to more appealing training methods and strategies of skills delivery. For example, trainees enrolled in these programmes frequently have access to Erasmus + exchanges; visit different companies where they can work and learn for a day or two; participate in companies' workshops and have short stays in foreign units of multinational companies. Overall, the pedagogical model of VET schools can be more effective and motivating than regular school education (ATEC Interviewee) (CNE, 2021).

On the other hand, the main barriers to the delivery of green skills in Portugal's VET system are as follows:

- The National Qualifications Catalogue has only a small number of modular training units that partially cover sustainability or circular economy (29 in a total of 8537 UFCDs, see Annex 2).
- Creating new qualifications is a complex process and takes a long time between approval and implementation (ATEC Interviewee). Since the 18 sectoral councils are jointly responsible for more than 300 qualifications listed in the National Catalogue of Qualifications, it is challenging for members of sectoral councils to update qualification requirements regularly (OECD, 2020).
- There is a lack of perspective, among business managers, on how green skills can boost the business model and company profits or corporate social responsibility. When companies do not value skilled workers, the personal investment in training is not attractive since it will not guarantee professional recognition or career progression (ATEC Interviewee). This is especially true in lower levels of training: environment training is usually offered in EE at a post-graduation level, and there is little demand from companies for less-educated workers with training in these areas, such as waste management operators. Thus, it is necessary to promote companies' awareness of the importance of IS and EE skills (Externato de Santa Clara and CICCOPN Interviewees).
- Some sectors of VET training (e.g., civil construction and industry (CICCOPN and ATEC Interviewees) are not appealing to the younger population — they associate it with hard and unpopular work. Therefore, there is a shortage of workers, especially skilled workers. It is up to the training centres to motivate prospective students, make these job profiles more appealing, and adapt traditional training to the new technologies of the sectors[71].
- The lack of local planning creates an excessive offer of training programmes, making it difficult to have enough inscriptions to start the courses (ATEC Interviewee). This also

[71] ATEC tried to open a CEF course for young people in energy management, but there were no enrolments.

prevents students from entering the desired programme, undermining the principle of VET.

5.5 Conclusions

- Overall, currently, there is a positive context for the delivery of EE and IS skills in Portugal in terms of available funding, political will, social awareness and technical know-how. However, the materialisation of these concerns seems to cover mostly broad environmental education rather than EE and IS-specific concerns.
- The adoption of legal instruments such as the National Energy and Climate Plan 2030 (PNEC 2030) is recent and still has not impacted skills needs. In the same way, financial instruments such as PRR are still far from execution, delaying investments in EE and IS innovations.
- The offers of training in specific IS and EE skills come from outside the National Qualifications Catalogue and are provided as "Other training courses". While these provide ways to re-skilling and upskilling but are still scarce in initial VET programmes. In addition, training programmes available for adults' education are not organised and depend on the financial availability of trainees.
- The demand for EE and IS skilled workers from industries is still not extensive.
- Although funding and availability of resources do not seem to be barriers, EQF levels of training face different challenges: at the top level, a demanding and intensive training for people already integrated into the work market, that invest their free time and receive lower recognition; at the bottom level, a certain lack of coordination, with training paths that do not correspond to the interests of young people and have limitations on the professional side.

CHAPTER 6. BLUEPRINT CASE SUMMARY: SPAIN

6.1 Introduction

Formal VET in Spain covers both initial and continuous VET. **IVET** falls under the sole authority of Spain's Ministry of Education and is divided into three cycles: Basic (lower secondary, ISCED 3), Intermediate (higher secondary, ISCED 3) and Higher VET (tertiary, ISCED 5). Curricula are established by the central government, but Spain's regional governments do retain the autonomy to adjust up to 45% of any curriculum's content to local needs. Each cycle features 2,000 hours of training across two years. Up to 50% of these 2,000 hours are dedicated to work-based learning in Basic, and up to 65% in Intermediate and Higher VET. **Formal CVET**, on the other hand, is governed by the Ministry of Labour and is delivered in the form of Professional Certificates. In fact, the central government has sole authority over curricula. As of 2020, there were 583 different certificates available at three different skill levels with varying training hours and shares of work-based learning (Ministerio de Educación, 2020a; CEDEFOP, 2018).

The so-called National Catalogue of Professional Qualifications (CNCP) is the backbone of both IVET and CVET. The CNCP defines the professional standards, units of competencies, and formative modules upon which all formal VET programmes are based. IVET programmes usually consist of several related professional standards, while Professional Certificates only pertain to one specific standard. As of July 2020, there were 665 qualifications and 2,236 corresponding competency units (CEDEFOP, 2018; Ministerio de Educación, 2020a).

Apart from this, the Spanish VET system has several other notable features (CEDEFOP, 2018):

- Dual VET has been available for all IVET cycles since 2012.
- Intermediate and Higher VET cycles are available for adult learners.
- Both IVET and CVET programmes offer flexible modes of delivery (e.g.: part-time studies, remote or blended delivery)
- Prior learning can be validated and counted towards the completion of IVET cycles or Professional Certificates.

There are several key findings that have emerged from analysing the Spanish VET system and its delivery of EIIs-relevant green skills. Firstly, the policy environment does not emphasise green skills. While there are numerous policies on education and VET as well as energy efficiency, neither focus on green skills. Only the recently revised law governing VET, promises to focus green skills in VET. Similarly, the Ministry of Environment's 'Programa Empleaverde' (see Box 1) funds projects that enhance green employability. Secondly, current green skills delivery is confined to a select few professions. Thirdly, more widespread roll out of green skills delivery is hindered by the Spanish VET system's division of responsibility between national and regional governments. That is because national policy must be implemented into regional curricula before they can unfold any effect.

As a result, EE and IS-related skills delivery at school level seems rather piecemeal. Few programmes focus explicitly on relevant skills. One example is the Higher VET cycle *Técnico Superior en Eficiencia Energética y Energía Solar Térmica* (TS en Eficiencia Energética) of the *Energía y Agua* professional family[72], which features an explicit EE focus. Meanwhile, relevant skills delivery in other cycles, such as the Higher VET cycle *Técnico Superior en*

[72] One of the two professional families that focus specifically on green skills.

Química y Salud Ambiental (TS en Química), is limited to certain modules only. As for the process of delivery, teaching staff at the schools analysed (Escuelas San José for TS en Eficiencia Energétca and IES Federica Montseny for TS en Química – both situated in Valencia) elaborate all relevant teaching materials themselves. Owing to the more all-encompassing approach to EE-skills of TS en Eficiencia Energética, Escuelas San José provide a dedicated section of the school's laboratory to the programme as well as a 'teaching house' for practical implementation, specialised software solutions, and connections to approximately 40 companies with EE focus for mandatory work placements. IES Federica Montseny, by contrast, do not dedicate any such resources to EE-skills within TS en Química due to the rather limited nature of relevant teachings. As for guidance, teachers at neither school receive any meaningful support. The same is the case for in-company trainers at companies affiliated with IES Federica Montseny for the lack of EE focus in TS en Química. Meanwhile, in-company trainers at businesses affiliated with Escuelas San José work together with a school-based mentor who monitors students' process and can intervene in case of difficulties during company placements.

6.2 Strategic planning: IS- and EE-related green skills in national policies

Educational policy in Spain, which includes VET, is legislated at the national level. The key theme of current VET policies is the recognition of a need to modernise the system because the last major reform occurred in 2002 (Ministry of Education Interviewees). First steps were taken in 2012 with the introduction of dual VET. The **Modernisation Plan for VET** (*Plan de Modernización de la Formación Profesional*), the **Strategic Plan to Promote VET** (*Plan estratégico de impulso de la Formación Profesional*), and a **proposed national VET reform** (*Anteproyecto Ley Orgánica de Ordenación e Integración de la Formación Profesional*), which has since been signed into law as of March 2022, continue in this spirit of modernisation. Despite exhibiting increasing attention to green skills from one plan to the next, none outline concrete steps for the implementation of green skills into the system. Only Programa Empleaverde (see Box 1) constitutes a good practice example of a policy initiative with concrete green skills focus.

Box 6-1: Empleaverde as a policy good practice focussed on green skills

Programa Empleaverde of the Spanish Ministry of Environment's 'Fundación Biodiversidad' is a policy-level initiative that provides funding for projects that support the creation of jobs in the green and 'blue' economies. The programme focuses on funding projects that train unemployed people, research about innovative ways to create new jobs, connect Spanish entrepreneurs with relevant actors and expertise EU-wide, and upskill employed people. The ultimate goal is to boost environmental sustainability of economic activities. The programme's annual budget was €10,47M in 2019.

Three projects funded by Programa Empleaverde are particularly noteworthy:

- Red Emprendeverde is Spain's biggest network for supporting green entrepreneurship. The community is composed of entrepreneurs, impact investors, academics and actors from the civil society and public sector. The goal is to create and consolidate existing environmentally sustainable businesses by supporting entrepreneurs and linking them with other relevant actors.
- Laps Emprendeverde are free trainings for green businesses which require further development. Trainings are thematic and past topics included circular economy, climate change, and ecological production methods.
- Destino Emplea Verde is a training programme that supports green employability. Trainings improve participants' job searching skills. This includes generic skills such as CV or job interview skills, but also specialised ones such as knowledge about the state of the green labour market

Source: Visionary Analytics based on case study sources (see References)

The 2020 **Modernisation Plan for VET**'s goal is to effect economic revival through committing to fostering the nation's human capital and talent by making curricula more focussed on digitalisation, innovation, and entrepreneurship. Hence, all current VET programmes are to be revised to reflect this shift in focus. However, there is no specific mention of EIIs or green skills, although the plan does recognise the need to adapt VET to changing skill needs which likely also entails green skills. Further, sectors of strategic importance are being recognised, some of which seem relevant to EIIs (e.g.: automation, new materials) (Ministerio de Educación, 2020a).

The 2021 **Strategic Plan to Promote VET** is part of Spain's plan for distributing the funds available through Next Generation EU. It includes more provisions related to green skills than the Modernisation Plan by virtue of the EU requiring that a share of the funding be contributed towards the green transition. The Strategic Plan's primary goals are to match skills demand with supply and to establish a system of lifelong learning. The plan also includes provisions on reskilling and upskilling the workforce. At least 40% of the budget allocated to this provision is to be dedicated to improving green skills delivery in formal CVET. However, the plan does not go into detail as to how green skills delivery is to be improved (Gobierno de España, 2021).

The **National VET Reform** is the first piece of VET legislation to specifically refer to green skills, since the last reform in 2002. The purpose of this new law is to upgrade VET delivery and to introduce some structural changes. One such change is that all VET cycles are to include at least 25% in-company training. One of the guiding principles of the VET system is to be the adaptation to emerging (skill) needs from the ecological transition and environmental sustainability. The law will require that these topics feature in the curricula of all VET cycles for both classroom and in-company training. However, the law does not include instructions on how exactly implementation should occur and what contents it should feature. This is left to curriculum drafters and the autonomous communities (Ministerio de Educación, 2021). Given that the VET reform has only been signed into law recently as of July 2022, VET cycles are yet to be revised according to the new law's requirements. In fact, none of the school

representatives interviewed were aware of this project or the effects it might have on the contents or processes of delivery (Adell Sales, 2022; Camacho & Gil, 2022).

Spain does have national policies on both energy efficiency and circular economy. However, education and more specifically VET is only a topic in circular economy related policies. The **Plan for Energy Saving and Efficiency 2011-2020** (*Plan de Ahorro y Eficiencia Energética 2011-2020*) and the **National Action Plan for Energy Efficiency 2017-2020** (*Plan Nacional de Acción de Eficiencia Energética 2017-2020*) are Spain's key energy efficiency policies and they are tied to legally binding EU energy efficiency targets. However, neither consider education or green skills as relevant enough to be included in the strategy.

España Circular 2030 is the key strategy for achieving a circular economy. National goals set out in the strategy include reducing waste by 15% and improving water use efficiency by 10%. Unlike the energy efficiency plans, España Circular posits a "generation of quality employment" as one of its guiding principles. This is driven by the realisation that moving towards a circular economy entails new skill needs. Hence, the strategy proposes to improve both IVET and CVET such that they can meet those emerging skill needs. The **Action Plan for a Circular Economy 2021-2023** (*Plan de acción de economía circular 2021-2023*) concretises measures to be taken between 2021 and 2023 in order to reach the goals set out in España Circular 2030, thereby outlining how IVET and CVET are to be improved to meet emerging skill needs: (1) updating all occupational standards of the CNCP to reflect the principles of circular economy; (2) updating curricula of all formal VET to include elements of sustainability and circular economy; (3) educating the teachers.

6.3 State of Implementation of Green Skills at VET Level

6.3.1 Delivery of IS and EE skills in VET at the national level

Green skills delivery in Spain's VET system is rather narrow. That is because only six of the 26 professional families along which the various VET programmes are organised contain green skill-related contents. The 'Energy and Water' (*Energía y Agua*) as well as the 'Safety and Environment' (*Seguridad y Medio Ambiente*) stand out because both were created specifically with green skills in mind. Consequently, the share of VET programmes that link to green skills is highest within these two families, compared to the 24 others. Other professional families that relate to green skills include 'Mechanical Manufacturing' (*Fabricación Mecánica*), 'Chemistry' (*Química*), and 'Glass and Ceramics' (*Vidrio y Cerámica*). However, these families include only singular programmes that convey some green skills. The reason why green skills delivery in the VET system currently is so narrow is that the Spanish education conveys such skills in higher education rather than in VET (Benayas et.al., 2017; Alarcón & González, 2021). Indeed, the first ever school to offer education in green skills was a higher education institute (Hernández, 2021) which to this day offers Master programmes in circular economy, sustainable development, or renewable energy (EOI, 2021).

Energy efficiency, water treatment, waste treatment, and environmental conservation are the green skills that receive the most attention. The professional family 'Energy and Water', for example, is entirely dedicated to the efficient use of water and energy. Within the 'Mechanical Manufacturing' family, the higher VET cycle 'Programming the Moulding of Metals and Polymers' (*Programación de la Producción en Moldeo de Metales y Polímeros*) features modules on environmental protection, industrial waste management, and clean energy. Similarly, the higher VET cycle 'Industrial Chemistry' (*Química Industrial*) features modules on the treatment of pollutants as well as recycling and waste minimisation (Alarcón & González, 2021).

As for trends, there has been a growing awareness of environmental concerns in the VET system over the past 20 years. This growing awareness has materialised in an increasing number of VET titles and thereby professional families that directly relate to green skills (Alarcón & González, 2021). The 'Programming the Moulding of Metals and Polymers' title, for example, was introduced only in 2011 (Ministerio de Educación, 2011), while the higher VET title 'Industrial Chemistry' was first taught in 2009 (Ministerio de Educación, 2009). By contrast, the law that regulates the VET system has been in force uninterruptedly since 2002 (Jefatura del Estado, 2002). It is important to note, however, that the generally growing environmental awareness in Spain is only slowly taking hold in the VET system due to Spain's inherently slow bureaucracy (see barriers section).

Some skill gaps do persist after formal VET provision. According to the Ministry of Education, green skills related to car manufacturing and the use of renewable energy remain. This means that there are fewer VET cycles that contain modules focussing on these topics as opposed to the above. There are initiatives aimed at closing these gaps. The Erasmus+ funded and European Innovative Teaching Award winning project EUmob, for example, is led by a Basque Country-based VET training centre and focuses on hybrid car technology (EUmob, 2021). In addition, a National Reference Centre has been established in Navarra focussing amongst other things on renewable energies (CENIFER, 2021). However, both remain isolated instances until now (Alarcón & González, 2021).

Currently, green skills delivery is module- and classroom-based. That is, green skills are taught in specific modules of specific VET titles. Teaching of these modules is primarily classroom based. There is some practical training, too. Even though classroom-based learning currently remains more prevalent, the upcoming revision of the VET law is foreseeing that all modules be taught in equal parts in theory and in practice (Alarcón & González, 2021). Box 2 below gives an example of how green skills are being taught at VET level.

Box 6-2: Training programmes of AENOR about Circular Economy

The Spanish Association for Standardisation and Certification (AENOR) which is a private, non-profit entity has been running green skills trainings. AENOR's trainings generally target companies and individuals directly. The modes of delivery include online (synchronous and asynchronous) in-person, experts' speeches, and in-company training. Thematic areas relevant to SPIRE include:

- Environmental Management (courses include Eco-management and Audit Schemes, Waste Management, and Waste, Emissions, Consumption and Noise Management)
- Energy Management (courses include Expert in Energy Management, Nearly Zero-Emissions Buildings, and Energy Efficiency in Industries)
- Circular Economy (courses include Expert in Environmental and Energetic Management and Circular Economy, Eco-labelling, and Life Cycle Assessment)

The value of AENOR's green skills-related trainings lies with its reach. Being a key standardisation and certification body, AENOR maintains close contact with all economic sectors, but especially EIIs. This means that AENOR's trainings reach more people than most other non-formal training providers could. In addition, the trainings are based on a profound understanding of green skill needs in Spain's EIIs. Hence, AENOR's training programme is uniquely placed to address those needs.

Source: Visionary Analytics based on case study sources (see References)

6.3.2 Delivery of IS and EE skills in VET at the VET school level

Following the above analysis of the broad strokes of green skills delivery in the Spanish VET system, this chapter turns its attention to specific EE and IS related programmes taught at specific schools. The key questions to be answered here are what EE and IS related skills are being taught in these programmes and how. The purpose of this exercise is to illustrate how the delivery of relevant skills works on the ground. Programmes were chosen based on four

job profiles which were, in turn, chosen from a long list of relevant job profiles provided by Work Package 3: Energy Manager, Energy Analyst, Waste Manager, Liquid Waste Treatment Technician.

This analysis features two Valencia-based VET schools: Semi-private[73] school Escuelas San José and the public IES Federica Montseny. Both schools boast significant previous knowledge on EE-related topics. Escuelas San José has been teaching EE-related contents for over nine years at the time of interviewing, with fostering energy efficiency being one of the school's key strategic objectives. Meanwhile, IES Federica Montseny maintain an energy efficiency commission which consists of volunteers from the school's teaching staff. The commission's purpose is to initiate and oversee EE-related projects at the school. Past endeavours have included the installation of solar panels and a wind turbine, as well as other miscellaneous initiatives aimed at reducing energy and resource consumption. Note, however, that the teaching staff interviewed at IES Federica Montseny considered the school's knowledge level regarding EE to be rather low overall, despite the above (Adell Sales, 2022; Camacho & Gil, 2022).

Both schools offer one IVET programme of interest each. Escuelas San José deliver the Higher VET cycle *Técnico Superior en Eficiencia Energética y Energía Solar Térmica* (TS en Eficiencia Energética), while IES Federica Montseny offer the Higher VET cycle *Técnico Superior en Química y Salud Ambiental* (TS en Química). The former explicitly covers the job profile Energy Analyst, while some modules of the latter pertain to the Liquid Waste Management Technician profile. Resources available to these programmes, however, differ. Escuelas San José dedicate two classrooms of 140m^2 each to their cycle as well as a 550m^2 industrial-style workshop facility. The workshop facility is being shared between different cycles, while the two classrooms are for exclusive use of the EE programme. Of the 2,500 students at Escuelas San José, a maximum of 30 per cohort, are working towards attaining TS en Eficiencia Energética. The school, furthermore, maintains five dedicated teaching staff for the programme. IES Federica Montseny, too, offer a laboratory and classrooms, but have not given information regarding the number of students or dedicated teaching staff (Adell Sales, 2022; Camacho & Gil, 2022).

Content of delivery

As already established, the key similarity between *TS en Eficiencia Energética* and *TS en Química* is that both cover EE-related topics only. However, the former does so more comprehensively than the latter as the entire programme covers related contents and skills. Meanwhile, *TS en Química* only comprises two modules with selective EE-focus. Table 2 below lists these modules as well as the relevant learning outcomes within those modules. Note that based on the school's statements, no other modules, including the in-company internship, which is a mandatory part of every IVET cycle, convey EE-related skills as part of *TS en Química* at IES Federica Montseny.

Table 6-1: List of EE-related modules and learning outcomes of the Técnico Superior en Química y Salud Ambiental programme

Module Name	Relevant Learning Outcomes
Water Control (*Control de Aguas*)	Identification of contamination sources of water for use and consumption, assessing its influence on the environment and on population health (*Identifica los focos de contaminación de aguas de uso y de consumo, valorando su influencia en el medio ambiente y en la salud de la población*)

[73] Semi-private in the context of the Spanish school system means that teachers' salaries are being paid by the government, while facilities, teaching materials, etc. are being financed by the school.

	Evaluation of the technical-sanitary deficiencies of the water for use and consumption, identifying the characteristic parameters and contrasting them with the applicable regulations (*Evalúa las deficiencias técnico-sanitarias de las aguas de uso y consumo, identificando los parámetros característicos y contrastándolos con la normativa de aplicación*)
Waste Control (*Control de Residuos*)	Characterisation of management systems for solid waste, applying work procedures in accordance with relevant regulations (*Caracteriza sistemas de gestión residuos sólidos, aplicando procedimientos de trabajo de acuerdo con la normativa*) Selection of action protocols to minimize the effects of pollution associated with solid waste, evaluating risks and proposing corrective measures (*Selecciona protocoles de actuación para minimizar los efectos de la contaminación asociada a los residuos sólidos, evaluando riesgos y proponiendo medidas correctoras*)

Source: Visionary Analytics based Europass, 2022b

Water Control foresees 320 hours of total teaching time, thus, equating to ten hours weekly. This makes Water Control the largest module in the programme. The first relevant learning outcome, 'Identification of Contamination Sources,' requires that measures of water conservation as well as of protection of waters are being taught. The second learning outcome, 'Evaluation of Technical-Sanitary Deficiencies,' contains knowledge on water provision, protection measures, the calculation of water consumption, and efficient water consumption (Ministerio de Educación, 2020b).

Waste Control has 96 of the cycle's 2,000 teaching hours dedicated to it, which equates to three hours weekly. Here, the first relevant element is the 'Characterisation of Management Systems for Solid Waste' learning outcome. Apart from learning about and working on waste treatment installations, waste collection and storage, and waste management, students are being taught about monitoring waste production as well as waste reduction and recovery. Finally, as part of the second relevant learning outcome, 'Selection of Action Protocols,' learners study the environmental impact of different types of waste as well as become skilled in preventing or at least controlling such impacts (Ministerio de Educación, 2020b).

Meanwhile, the focus on EE and the Energy Analyst job profile is more pronounced and more explicit in the TS en Eneficiencia Energética taught at Escuelas San José. Modules roughly divide into two categories (see also Table 3). Firstly, there are modules that specifically relate to evaluating and promoting efficient use of energy and resources. These include 'Installation's Energy Efficiency,' 'Energy Certification of Buildings,' and 'Water Use Efficiency in Constructions.' The latter two modules focus specifically on construction and buildings, thus, including lessons on, for example, projecting buildings' energy needs, determining opportunities for and limits of energy efficiency in existing developments, but also on (the impact of) energy efficiency on relevant materials, procedures, and construction techniques. 'Installation's Energy Efficiency,' by contrast, is more general in nature with learning outcomes focussing on assessing the energy efficiency of and energy savings derived from heat and cold generators, thermal distribution systems, electrical installations, energy recovery systems, and lighting installations in buildings as well as preparing proposals for improving energy efficiency. Another module which is rather general in focus is 'Energy and Water Use Efficiency Promotion.' This module is less technical in nature and, instead, aims at enabling students to develop and assess promotional materials and activities (Europass, 2022a). Such activities directly correspond to some of an Energy Analyst's main tasks such as advising on the energy efficiency of systems, analysing energy consumption, carrying out energy management, or promoting sustainable energy. What is missing to the Energy Analyst job profile, is teachings on staff management skills.

The second group of modules aims at enabling students to carry out the installation of more energy efficient solutions themselves. Some of them focus on thermal energy saving installations more generally ('Thermal Equipment and Installations,' 'Installation Fitting Processes,' 'Graphical Representation of Installations'), while the remainder doubles down exclusively on solar thermal installations ('Configuration of Solar Thermal Installations,' 'Management of Solar Thermal Installations' Fitting and Maintenance'). These modules enable students to design, visualise, and fit both types of installations (Europass, 2022a). In this aspect, the curriculum of TS en Eficiencia Energética goes beyond what is required of an Energy Analysts. That is because the job profile itself only stipulates that workers advise, identify, inform, prepare, and promote, but not build themselves. The present modules fill this gap.

'Project on Energy Efficiency and Solar Thermal Energy' is the final module of note, which requires students to combine skills learnt from the evaluation and promotion of EE-related modules with skills taken up from those related to the implementation of EE. Students need to identify a relevant need in the production sector and design a product that meets the previously identified need, followed by project implementation and the development of project monitoring and control mechanisms. The remaining modules (professional training and guidance, business and entrepreneurial initiative, on the job training) are obligatory for all degrees and are, therefore, more general in nature (Europass, 2022a). However, as the subsequent Process of Delivery section will show in greater detail, the contents of the internship, which the 'On the Job Training' module entails, do focus on EE in the TS en Eficiencia Energetica cycle.

Table 6-2: Overview of modules in *Tecnico Superior de Eficiencia Energética y Energía Solar Térmica*

Evaluation and Promotion of EE	Implementation of EE
Installation's Energy Efficiency (Eficiencia energética de instalaciones)	Thermal Equipment and Installations (Equipos e instalaciones térmicas)
Energy Certification of Buildings (Certificación energética de edificios)	Installations Fitting Processes (Procesos de montaje de instalaciones)
Water Use Efficiency in Constructions (Gestión eficiente del agua en edificación)	Graphical Representation of Installations (Representación gráfica de instalaciones)
Energy and Water Use Efficiency Promotion (Promoción del uso eficiente de la energía y del agua)	Configuration of Solar Thermal Installations (Configuración de instalaciones solares térmicas)
	Management of Solar Thermal Installations' Fitting and Maintenance (Gestión del montaje y mantenimiento de las instalaciones solares térmicas)
Project on Energy Efficiency and Solar Thermal Energy (Proyecto del uso eficiente de la energía y del agua)	
Professional Training and Guidance (Formación y orientación laboral)	
Business and Entrepreneurial Initiative (Empresa e iniciativa emprendedora)	
On the Job Training/Mandatory In-company Training (Formación en centros de trabajo)	

Source: Visionary Analytics based Europass, 2022a

A noteworthy anomaly in terms of the contents of delivery at the two schools is a discrepancy in the perceived leeway available to schools for amending the contents of delivery of the respective programmes beyond what is required by the national and, if present, the regional curriculum. IES Federica Montseny lament that the national curriculum for TS en Química – no dedicated regional curriculum for the Valencian Community exists – prescribes the vast majority of training content, including EE-related content, thus, leaving too little time to cover additional EE-related topics the teaching staff might consider relevant. Escuelas San José, by contrast, consider themselves quite flexible in terms of amending the curriculum of TS en Eficiencia Energética to their needs. That is, despite the presence of both a national and a Valencian Community-specific curriculum for the programme in question. As for TS en Eficiencia Energética, the school utilises this flexibility primarily to introduce technology-related updates. The cause of this discrepancy does not seem to have a legal basis, as the relevant legal documents, both nationally and regionally, prescribe similar degrees of autonomy (Ministerio de Educación, 2020b; Consellería de Educación, 2015). Hence, the likely reason for the difference in flexibility in terms of adjusting EE-related is the difference in priority EE takes in the two programmes, TS en Eficiencia Energética focussing specifically on EE, with TS en Química only partially covering the topic in two modules.

Process of delivery

EE-related teaching for TS en Química at IES Federica Montseny is rather classroom- and theory-based. That is because the EE-related contents of the VET cycle do not require the use of a laboratory, despite the school having a well-equipped laboratory, which is being used for other teaching for the cycle (e.g.: water and food control). Other special equipment used at the school includes sound level metres and gear for measuring air pollution. However, none of these are deployed for EE-related teaching. In addition, even though the school does maintain formalised relationships with companies as part of the mandatory internship module of the programme, none of these internships focus on EE. At the same time, the school is unaware, if any of the companies it is working with would be interested in emphasising EE specifically. All this leaves classroom- and theory-based learning as the only alternatives for EE-related teaching.

As for materials and methods, there are no pre-set textbooks or other pre-set materials available to either teachers or students for TS en Química at IES Federica Montseny. This means that any materials must be compiled by the teachers themselves. Despite there being

a demand, the school notes that there currently is no guidance or support available to teachers or in-company trainers regarding the EE-related contents. Materials most frequently include notes supported by audio-visual materials, such as documentaries, short video clips and similar resources. Hence, EE-related skills delivery occurs primarily in the form of teacher-up-front-teaching and information search activities, but also company visits and classroom debates. After all, the teaching staff at IES Federica Montseny believe that the EE related contents TS en Química does include are quite amenable to discussion and debate. Importantly, the basic style of teaching does not differ from other programmes and topics (Adell Sales, 2022).

Escuelas San José's teaching philosophy involves conveying the basics of any subjects to students and then to have them apply the theoretical basics in real-life environments. That is, EE-related skills are delivered with more practice-orientation in TS en Eficiencia Energética at Escuelas San José than in TS en Química at IES Federica Montseny. Consequently, teaching of EE-related contents utilises two dedicated classrooms, a dedicated area in the school's 550m^2 workshop facility, and a dedicated 'training house' (see Box 3 below). In addition, the school maintains formalised relationships with a pool of 40 companies for the compulsory internship component (*formación en centros de trabajo*) which occurs during the second year of the programme. Beyond this compulsory aspect of the programme, students may also attend a placement with one of these 40 companies during their first year of study. Typically, if students choose this option, the company for the voluntary first and compulsory second year placement will be the same. Students will be working exclusively on EE-related topics and contents during any placement with any of these 40 companies.

Box 6-3: Teaching house at Escuelas San José

The image to the left shows the teaching house at Escuelas San José. It has been built by students of *TS en Eficiencia Energética* in collaboration with those of other technical cycles (e.g.: Higher Technician in Electrotechnical and Automated Systems – *Técnico Superior en Sistemas Electrotécnicos y Automatizados*). The idea behind the house is to teach students how the systems and technologies they study as part of their cycles function in real life and interact with other systems and technologies outside of their own specialisation. As such, the house's systems are being installed and maintained by students themselves. Among the available and integrated systems are illumination, heating, air conditioning, and jalousie technology, as the image of the control panel on the right demonstrates.

Source: Visionary Analytics based on Camacho & Gil, 2022.

There are no prescribed teaching materials available to students or teachers for TS en Eficiencia Energética. As such, teachers at Escuelas San José are using the classroom environment to communicate with students by preparing their own materials. Such materials often include paper, videos, schematics, and similar resources. At times, instructors will also employ standard textbooks, when teaching legal requirements or industry standards. Furthermore, Escuelas San José teaches the use of software solutions that are commonly

being applied in the real world. As students will be asked to develop solutions based on authentic parameters, students are being taught the use of software that would be applied in real-life situations. One example is the use of the software KNX for controlling parameters such as pressure and temperature in heat pumps. The use of other software solutions being taught include Microsoft Word and Synco by Siemens.

Unlike at IES Federica Montseny, support for teachers and in-company trainers of EE does exist at Escuelas San José. Although teaching staff hold that guidance and support is not necessarily easy to come by, they are being provided with an official training budget as part of a continuous training curriculum for teachers. However, teachers do need to identify suitable training options themselves. Importantly, the teachers of Escuelas San José's EE department tend to work in relevant industries or teach at universities in parallel. This allows the teaching staff to remain updated on latest developments in the field continually. As for guidance for in-company trainers, they collaborate closely with school-based mentors each trainee is being assigned to monitor placement progress. These school-based mentors conduct company visits and provide advice, if needed. However, teachers at Escuelas San José do not provide guidance or training to peers at other schools (Camacho & Gil, 2022).

6.4 Barriers and drivers of green skills delivery

6.4.1 Drivers

Based on the interview with the Spanish Ministry of Education, there are two key drivers to green skills delivery in the Spanish VET system at national level (Alarcón & González, 2021).

1. In 2018, the Spanish government established a new ministry (Ministry for Ecological Transition and Demographic Challenge – *Ministerio para la Transición Ecológica y el Reto Demográfico*) that is dedicated to tackling climate change. The foundation of a new ministry which has been preceded by the introduction of a dedicated policy for green transition, has been the Spanish government's response to an increasing societal push towards environmental awareness. This is likely going to generate a push for more green skills being implemented into the formal VET system as well.
2. INCUAL – the organisation responsible for maintaining the National Catalogue for Professional Qualifications (CNCP) – continuously monitors the labour market for emerging skill needs. Even though this process is not specific to green skills, it has been and will continue to be instrumental in identifying green skills and integrating them into the formal VET system by creating new green skills-related occupational standards.

Interviews with IES Federica Montseny and Escuelas San José – both based in the City of Valencia – have further revealed that green skills delivery has been driven by strong school-level policies that promote energy efficiency and sustainability. IES Federica Montseny have established a school-wide, teacher-run energy commission, which has been introducing EE-related infrastructure to the school by identifying and drawing on relevant regional and national funding opportunities. Escuelas San José being run by the Jesuits Order is bound by the Order's internal strategy, which promotes energy efficiency and sustainable development through activities at the school. In addition, Escuelas San José maintains links, both through online and in-person activities with further students who have successfully advanced into relevant labour fields, which has allowed for knowledge transfer, especially regarding the latest technologies in use. Another driver suggested by both schools has been a general interest in EE and IS-related topics among the student body at both schools, which, in turn, drives teacher interest in the topic and, therefore, the overall quality of EE skills delivery. Escuelas San José predict that the aforementioned interest in EE-related topics will further grow with the projected

establishment of a large battery plant near Valencia (Faus, 2022; Adell Sales, 2022; Camacho & Gil, 2022.).

6.4.2 Barriers

The bureaucratic structure of the VET system is the main barrier to greater and more rapid uptake of green skills. The central government establishes the framework for the VET system and specific programmes, but Spain's autonomous communities must translate them into local law before any programme comes into effect. This translation process takes time. That is why the VET reform which has been passed in March 2022 (Ministerio de Educación, 2022) is likely going to require years until it comes into full effect (Alarcón & González, 2021).

While the interviewees of the two analysed schools were largely unaware of the ministry's plans to reform the Spanish VET system, they did mention some school-level barriers. These, as Table 5 shows, remain rather heterogeneous.

Table 6-4: School specific barriers of green skills delivery

School	Barriers
IES Federica Montseny	● Teachers struggle to find sufficient time to thoroughly familiarise themselves with EE-related course contents for the lack of pre-set textbooks and available guidance, which takes away from the teaching quality. It is often necessary for them to use their own time to adequately prepare materials and class. ● There is also a lack of time to go beyond prescribed course contents (see Contents of Delivery subsection). ● A lack of institutionalised relationships between the school and companies working on EE-related issues takes away from students' ability to discover EE skills further as part of the programme's On the Job Training module. In fact, the school is unaware of any such companies. Vice versa, any such company interested in EE-related topics seems to be unaware of the school's interest in the matter.
Escuelas San José	● Despite the school's semi-private funding model (the state covering teacher salaries and the Jesuit Order covering facilities, materials, etc.), there is at times a lack of adequate funds, thus, preventing the purchase of state-of-the-art technology needed for delivering up-to-date skills. ● The school faces difficulties expanding the programme's size. Currently, the maximum number of students per cohort is capped at 32 with unspecified bureaucratic hurdles rendering the introduction of a second cohort next to impossible.

Source: Visionary Analytics based Adell Sales, 2022; Camacho & Gil, 2022.

6.5 Conclusions

- The policy environment and strategic documents on energy efficiency and circular economy in Spain do not emphasise green skills.
- A wider rollout of green skills delivery is hindered by the Spanish administrative-territorial system, which divides responsibilities between the national and regional governments. There are also bureaucratic problems slowing down the process. As a result, green skills delivery in Spain remains rather narrow in the VET domain.
- At school level, the green skill delivery is confined to a select few professional families and professions within those families, with only two families being fully dedicated to the topic.
- The perceived leeway available to schools for amending the contents of the respective programmes beyond what is required varies from school to school, with Escuelas San José being rather flexible and IES Federica Montseny being largely driven by the prescriptions in the national curriculum of their respective programmes.

- Individual schools do generate good practices that could be picked up at either regional or national levels, such as the student-supported construction of a teaching house at Escuelas San José or teachers developing their own didactic materials for specific modules and programmes. However, these depend entirely on a VET school's level of engagement.

REFERENCES

References for Chapter 2: Germany

Interviews

Anonymous (Representative of Chemie3), interviewed by Visionary Analytics on 06.01.2021.

Head of Division at Federal Institute for Vocational Education and Training - BIBB, interviewed by Visionary Analytics on 01.12.2021.

Head of Division at Deutscher Gewerkschaftsbund – DGB, interviewed by Visionary Analytics on 02.11.2021.

Anonymous (Representatives of Hans-Schwier-Berufskolleg), written answers submitted to Visionary Analytics on 29.06.2022.

Literature

BIBB (2021a). Vier sind die Zukunft. Available at: https://www.bibb.de/dienst/veroeffentlichungen/de/publication/show/17281.

BIBB (2021b). Nachhaltigkeit im Fokus der neuen Standardberufsbildpositionen. Available at: https://www.bibb.de/de/134916.php.

BIBB (2022). Informationen zu Aus- und Fortbildungsberugen. Fachkraft für Abwassertechnik (Ausbildung). Available at: https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/profile/apprenticeship/54637768.

BMBF (2017). Nationaler Aktionsplan Bildung für nachhaltige Entwicklung. Available at: https://www.bmbf.de/bmbf/shareddocs/downloads/files/nationaler_aktionsplan_bildung_fuer_nachhaltige_entwicklung.pdf?__blob=publicationFile&v=1.

BMU (2014). Internationale Studie über Öko-Innovationspärke (Kurzfassung). Available at: https://www.bafu.admin.ch/bafu/de/home/themen/bildung/publikationen-studien/publikationen/internationale-studie-ueber-oeko-innovationspaerke.html.

BMU (2020). Deutsches Ressourceneffizienzprogramm III. Available at: https://www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Ressourceneffizienz/progress_iii_programm_bf.pdf.

BMWI (2019). Energieeffizienzstrategie 2050. Available at: https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/energieeffiezienzstrategie-2050.pdf?__blob=publicationFile&v=12.

Bundesregierung (2019). Klimaschutzprogramm 2030 der Bundesregierung zur Umsetzung des Klimaschutzplans 2050. Available at: https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/klimaschutzprogramm_2030_bf.pdf.

Bundesregierung (2021). Deutsche Nachhaltigkeitsstrategie 2021. Available at: https://www.bundesregierung.de/resource/blob/998194/1875176/3d3b15cd92d0261e7a0bcdc8f43b7839/deutsche-nachhaltigkeitsstrategie-2021-langfassung-download-bpa-data.pdf.

Cedefop (2018). Vocational Education and Training In Europe: Germany. Available at: https://cumulus.cedefop.europa.eu/files/vetelib/2019/Vocational_Education_Training_Europe_Germany_2018_Cedefop_ReferNet.pdf.

DWA (2018). DWA-Regelwerk Arbeitsblatt DWA-A 400. Grundsätze für die Erarbeitung des DWA-Regelwerks. Available at: https://de.dwa.de/files/_media/content/05_PUBLIKATIONEN/DWA-Regelwerk/DWA-A_400.pdf.

DWA (2020). Korrekturblatt: Arbeitsblatt DWA-A 113. Available at: https://de.dwa.de/files/_media/publication/errata/Korrekturblatt_DWA-A_113_2022.pdf.

DWA (2022a). Publikations-Liste. Available at: https://de.dwa.de/de/publikationen-liste.html?page_s22988=3.

DWA (2022b). Mitglied warden, Prämie sichern. Available at: https://de.dwa.de/de/Mitglied_werden_Praemie_sichern.html.

ESSA (*forthcoming*). Blueprint "New Skills Agenda Steel": Industry-driven sustainable European Steel Skills Agenda and Strategy. Deliverable 4.1 – Identification of National (Sector) VET Qualification and Skills (Regulatory) Frameworks for Steel.

GoVET (2019). Dual VET. Vocational Education and Training in Germany. Available at: https://www.bibb.de/govet/en/54880.php.

HSBK (2020a). Kollegium. Available at: https://www.hsbk-ge.de/de/Schulgemeinde/kollegium.aspx.

HSBK (2020b). Fachkraft für Abwassertechnik. Available at: https://www.hsbk-ge.de/de/Bildungsangebot/Berufsschule/Darstellung_AW.aspx.

HSBK (2020c). Berufsschule. Available at: https://www.hsbk-ge.de/de/Bildungsangebot/Berufsschule/index.aspx.

HSBK (2020d). Ausbildungsberuf: Fachkraft für Abwassertechnik. Unterrichtstermine. Available at: https://www.hsbk-ge.de/de/Service/_doc/Blockplan_AW.pdf.

KMK (2002). Rahmenlehrplan für den Ausbildungsberuf Fachkraft für Abwassertechnik. Available at: https://www.kmk.org/fileadmin/Dateien/pdf/Bildung/BeruflicheBildung/rlp/FKabwasser.pdf.

LANUV (2022). Berufsschule. UT-Berufe, Fachkraft für Wasserwirtschaft. Available at: https://www.lanuv.nrw.de/landesamt/zustaendige-behoerde-fuer-bestimmte-berufe/umwelttechnische-berufe/berufsschule.

MSB NRW (2003). Lehrplan zur Erprobung für den Ausbildungsberuf Fachkraft für Abwassertechnik. https://www.berufsbildung.nrw.de/cms/upload/_lehrplaene/a/abwassertechnik.pdf.

Statistisches Bundesamt (2019). Pressemitteilung Nr. 411 vom 22. Oktober 2019. Available at: https://www.destatis.de/DE/Presse/Pressemitteilungen/2019/10/PD19_411_325.html.

References for Chapter 3: Italy

Interviews

Assistant Professor at Scuola Superiore Sant'Anna – SSSA, interviewed by Visionary Analytics on 26.10.2021 (2021a).

Research Fellow at ADAPT, interviewed by Visionary Analytics on 22.10.2021 (2021b).

School representatives at ITS TEC, interviewed by Visionary Analytics on 12.05.2022 (2022a).

Student at ITS TEC, based on written feedback received on 01.06.2022 (2022b).

Literature

ADAPT & Confindustria Lombardia (2021). *Gli ITS lombardi e il Piano di Sviluppo nazionale Industria 4.0: Un primo bilancio.*

Camera dei Deputati (2020). Risparmio ed efficienza energetica. *Servizio Studi.*

CEDEFOP (2018). *Spotlight on VET: Italy.*

CEDEFOP (2019). *Vocational Education and Training in Europe: Italy.*

Frey, M. et al. (2021). GreenItaly 2021: Un'economia a misura d'uomo per il futuro dell'Europa. *Fundazione Symbola & Unioncamere.*

Lewis, B., Abhari, N. J., & Ali, A. (2018a). Green Skills at Vocational Education Training: Intellectual Output O1: Qualitative analysis of the perception of green skills by VET trainers, VET policymakers and employers. *Landward Research.*

Lewis, B., Abhari, N. J., & Ali, A. (2018b). Green Skills at Vocational Education Training: Intellectual Output O2: Quantitative analysis of the perception of green skills by VET trainers, VET students, and employers. *Landward Research.*

Tripoli, G. et al. (2020). GreenItaly 2020: Un'economia a misura d'uomo per affrontare il futuro. *Fundazione Symbola & Unioncamere.*

Unioncamere & ANPAL (2020). *Le competenze green: Analisi della domanda di competenze legate alla green economy nelle imprese.*

Unioncamere & ANPAL (2021). *Previsioni dei fabbisogni occupazionali e professionali in italia a medio termine (2021-2025).*

Zuccaro, A. et al. (2021). Istituti Tecnici Superiori: Monitoraggio nazionale 2021. *INDIRE*.

References for Chapter 4: Poland

Interviews

Anonymous (Polish Confederation Lewiatan), interviewed by Visionary Analytics on 26.11.2021 (2021a).

Assistant Professor, University of Łódź, interviewed by Visionary Analytics on 15.11.2021 (2021b).

Professor, University of Silesia, interviewed by Visionary Analytics on 17.11.2021 (2021c).

Anonymous (Zespół Szkół Technicznych i Ogólnokształcących Nr 2 w Katowicach), interviewed by Visionary Analytics on 25.05.2022 (2022).

Literature

Babiarz, M., & Garbuzik, P. (2017). Edukacja ekologiczna jako priorytet w nauczaniu dzieci i młodzieży. *Edukacja – Technika – Informatyka, 4(22),* 160-165.

Batorczak, A., & Klimska, A. (2020). Edukacja na rzecz zrównoważonego rozwoju–refleksje przed ogłoszeniem nowej Dekady na rzecz Zrównoważonego Rozwoju (2020-2030). *Studia Ecologiae et Bioethicae*, *18*(2).

CEDEFOP (2019). *Vocational education and training in Europe: Poland.* [From Cedefop; ReferNet. Vocational education and training in Europe database]. https://www.cedefop.europa.eu/en/tools/vet-in-europe/systems/poland

EC (2019). *PISA 2018 and the EU: Striving for social fairness through education.* Publications Office of the European Union.

Guzy, A, & Ochwat, M. (2021). *Poloniści wobec zmian klimatu.* Interdyscyplinarne Centrum Badań nad Edukacją Humanistyczną.

Kacak, I. (2015). Analiza oferty edukacyjnej doskonalącej kompetencje proekologiczne pracowników. *Polish Journal of Continuing Education 4/2015*, 116-124.

Kozar, Ł. (2019). *Zielone miejsca pracy: uwarunkowania – identyfikacja – oddziaływanie na lokalny rynek pracy*. Wydawnictwo Uniwersytetu Łódzkiego.

Mróz, A., & Ocetkiewicz, I. (2019). Co nauczyciele wiedzą o edukacji dla zrównoważonego rozwoju? Analiza wyników badań. *Problemy Opiekuńczo-Wychowawcze*, *582*, 38-51.

Ocetkiewicz (2020). *Edukacja na rzecz zrównoważonego rozwoju – potrzeba czy obowiązek? Analiza w kontekście szkoły, nauczyciela, podstawy programowej i kształtowania kompetencji ucznia.* Małopolskie Centrum Doskonalenia Nauczycieli.

Siekiera, A., & Luck, A. (2016). *Key competences in vocational education and training: Poland.* Cedefop ReferNet.

Tuszyńska, L. (2017). Edukacja ekologiczna w perspektywie zrównoważonego rozwoju. *Studies in Global Ethics and Global Education*, (7), 43-56.

UN (2021). *Edukacja klimatyczna w Polsce.* UN Global Compact Network Poland.

References for Chapter 5: Portugal

Interviews

Interview with **Externato Santa Clara representative** (Programme in focus: Operador/a de Tratamento de Águas, level 2)

Interview with **ATEC representative** (Programme in focus: Técnico especialista em gestão e controlo de energia, level 5)

Interview with **CICCOPN – Centro de Formação Profissional representative** (Programme in focus: Técnico especialista em gestão e controlo de energia, level 5)

Literature

Afonso, M.C. & Ferreira, F. (2007). O Sistema de Educação e Formação Profissional em Portugal: Descrição sumária. *CEDEFOP Panorama Series*, 142. https://www.cedefop.europa.eu/files/5177_pt.pdf.

ANQEP. ANQEP. Available at: https://www.anqep.gov.pt/np4/home.html. Cedefop (2018). Spotlight on vocational education and training in Portugal. Luxembourg: Publications Office. http://www.cedefop.europa.eu/files/8119_en.pdf.

Cedefop (2020). *Developments in vocational education and training policy in 2015-19: Portugal.* Cedefop monitoring and analysis of VET policies. https://www.cedefop.europa.eu/en/publications-and-resources/country-reports/developments-vocational-education-and-training-policy-2015-19-portugal

Cedefop (2020). Skills forecast 2020: Portugal. Cedefop skills forecast. Available at: https://www.cedefop.europa.eu/en/publications-and-resources/country-reports/portugal2020-skills-forecast.

Cedefop; Directorate-General of Employment and Industrial Relations (2019). Vocational education and training in Europe: Portugal [From Cedefop; ReferNet. Vocational education and training in Europe database]. https://www.cedefop.europa.eu/en/tools/vet-ineurope/systems/portugal.

Cedefop (2021). *Vocational education and training in Portugal: short description*. Luxembourg: Publications Office of the European Union. http://data.europa.eu/doi/10.2801/251891

CNE (2021). *Recomendação. Perspetivar o futuro do Ensino Profissional.* Lisboa: Conselho Nacional de Educação.

Cristo, Alexandre & Pereira, Inês (n.d.). Guia para empresas: Como apostar na formação dos seus trabalhadores? Fundação José Neves. https://brighterfuture.joseneves.org/BrighterFuture/BF_GuiasDetalhe?GuideEntry=4jQ4JhkKVG4QzbjBHiKtEZ&isFromHomepage=false

DGE (2022). Missão e Atribuições. Available at: https://www.dge.mec.pt/missao-e-atribuicoes.

DGERT (2019). Vocational education and training in Europe – Portugal. Cedefop ReferNet VET in Europe reports 2018. http://libserver.cedefop.europa.eu/vetelib/2019/Vocational_Education_Training_Europe_Portug al_2018_Cedefop_ReferNet.pdf.

DGERT. Enquadramento da Formação Profissional. Available at: https://www.dgert.gov.pt/enquadramento-da-formacao-profissional.

The environmental inter-ministerial group (2017). Leading the transition: Action Plan for Circular Economy in Portugal 2017-2020. Available at: https://circulareconomy.europa.eu/platform/sites/default/files/strategy_-_portuguese_action_plan_paec_en_version_3.pdf

European Commission (2020). *Education and training monitoring 2020*. Available at: https://op.europa.eu/webpub/eac/education-and-training-monitor2020/countries/portugal.html

Eurydice. Available at: https://eacea.ec.europa.eu/national-policies/eurydice/content/portugal_pt-pt.

Fundação Belmiro de Azevedo (2019). *Caracterização do Ensino e Formação Profissional em Portugal - Análise de dados secundários, 2015-2019*. https://www.edulog.pt/storage/app/uploads/public/5ee/94a/b74/5ee94ab7440cb365019630.

Guimarães, Paula (2019). Adult Learning Statistical Country Report. – Portugal. Brussels: European Commission. https://anqep.gov.pt/np4/?newsId=528&fileName=PT_Statistical_Report.pdf

IEFP (n.d.). A Instituição. Available at: https://www.iefp.pt/instituicao.

Instituto Nacional de Estatística (2018). *Estatísticas da Produção Industrial*. Lisboa: INE.

Martins, Guilherme d'Oliveira (Coord.) (2017). Perfil dos alunos à saída da escolaridade obrigatória. Lisboa: Ministério da Educação. http://dge.mec.pt/sites/default/files/Curriculo/Projeto_Autonomia_e_Flexibilidade/perfil_dos_alunos.pdf

OECD (2018). *Skills Strategy Implementation Guidance for Portugal: Strengthening the Adult-Learning System, OECD Skills Studies*. Paris: OECD Publishing. http://dx.doi.org/10.1787/9789264298705-en.

OECD (2020). Strengthening the Governance of Skills Systems. Lessons from Six OECD Countries. https://doi.org/10.1787/3a4bb6ea-en

OECD (2021). *Strengthening Quality Assurance in Adult Education and Training in Portugal: Implementation Guidance*. Paris: OECD. https://www.oecd.org/skills/centre-for-skills/Strengthening-Quality-Assurance-in-Adult-Education-and-Training- in-Portugal-Implementation-Guidance.pdf

Pedroso, José Vítor (Coord.) (2018). *Referencial de Educação Ambiental para a Sustentabilidade para a Educação Pré-Escolar, o Ensino Básico e o Ensino Secundário.* Lisboa: Ministério da Educação.

Público (23 june, 2022). Universidades abrem poucas vagas para estudantes do ensino profissional. https://www.publico.pt/2022/06/23/p3/noticia/universidades-abrem-vagas-estudantes-ensino-profissional-2011072

República Portuguesa, XXI Governo Constitucional (2018). *Programa Nacional de Reformas 2016-2022*. http://www.portugal.gov.pt/upload/ficheiros/i007132.pdf.

References for Chapter 6: Spain

Interviews

Representative of IES Federica Montseny, interviewed by Visionary Analytics on 09.06.2022

Representatives of the Spanish Ministry of Education, interviewed by Visionary Analytics on 19.11.2021.

Representatives of Escuelas San José, Interviewed by Visionary Analytics on 28.06.2022.

Literature

Benayas, Javier et.al. (2017). Educación para la Sostenibilidad en España. Reflexiones y propuestas. Available at: https://www.unirioja.es/servicios/os/pdf/Informe_Educacion_Sostenibilidad_Espana.pdf.

CEDEFOP (2018). Vocational Education and Training in Europe – Spain. Available at: https://www.cedefop.europa.eu/de/publications-and-resources/country-reports/vocational-education-and-training-europe-spain-2018.

CENIFER (2021). Centro de Referencia Nacional en Energías Renovables y Eficiencia Energética. Available at: https://www.cenifer.com/.

Consellería de Educación (2015). Orden 60/2015, de 27 de mayo de la Consellería de Educación, Cultura y Deporte, por la que se establece para la Comunitat Valenciana el currículo del ciclo formativo de grado superior correspondiente al título de Técnico Superior en Energías Renovables. Available at: https://todofp.es/dam/jcr:2d9d15a2-98bf-43c7-bcd3-fe90c511be47/valenergias-renovables-pdf.pdf

EOI (2021). MBAs & Masters. Available at: https://www.eoi.es/es/programas/mbas-masters.

EUmob (2021). EUmob. Available at: http://eumob.sde.dk/.

Europass (2022a). Europass Diploma Supplement. Técnico Superior en Energías Renovables. Available at: https://todofp.es/dam/jcr:6df80416-dcf4-4e84-89b4-465e63a223b8/n-tsenergiasrenovablesen-pdf.pdf.

Europass (2022b). Suplemento Europass al Título Técnico Superior en Química y Salud Ambiental. Available at: https://todofp.es/dam/jcr:4703b58b-31de-49ec-8c26-e55ab08f142c/n-ts-quimica-y-salud-ambiental.pdf.

Faus, Joan (2022). VW plans to open Spanish battery plant near Valencia in 2026. Available at: https://www.reuters.com/business/autos-transportation/vw-says-its-spanish-battery-cell-plant-will-be-located-near-valencia-2022-03-23/.

Gobierno de España (2021). Plan estratégico de impulso de la Formación Profesional. Available at: https://www.lamoncloa.gob.es/temas/fondos-recuperacion/Documents/16062021-Componente20.pdf.

Hernández, I. (2021). La formación se tiñe de verde para adaptarse al futuro. Available at: https://elpais.com/sociedad/2021-05-24/la-formacion-se-tine-de-verde-para-adaptarse-al-futuro.html.

IDEA (2011). Plan de Ahorro y Eficiencia Energética 2011-2020. Available at: https://www.idae.es/uploads/documentos/documentos_11905_PAEE_2011_2020._A2011_A_a1e6383b.pdf.

Jefatura del Estado (2002). Ley Orgánica 5/2002, de 19 de junio, de las Cualificaciones y de la Formación Profesional. Available at: https://www.boe.es/buscar/act.php?id=BOE-A-2002-12018.

Ministerio de Educación (2009). Orden EDU/2227/2009, de 3 de julio, por la que se establece el currículo del ciclo formativo de Grado Superior correspondiente al título de Técnico Superior en Química Industrial. Available at: https://www.boe.es/diario_boe/txt.php?id=BOE-A-2009-13394.

Ministerio de Educación (2011). Orden EDU/3153/2011, de 11 de noviembre, por la que se establece el currículo del ciclo formativo de Grado Superior correspondiente al título de Técnico Superior en Programación de la Producción en Moldeo de Metales y Polímeros. Available at: https://www.boe.es/buscar/doc.php?id=BOE-A-2011-18197.

Ministerio de Educación (2020a). Plan de Modernización de la Formación Profesional. Available at: https://www.todofp.es/dam/jcr:5d43ab06-7cdf-4db6-a95c-b97b4a0e1b74/220720-plan-modernizacion-fp.pdf.

Ministerio de Educación (2020b). Orden EFP/249/2020, de 11 de marzo, por la que se establece el currículo del ciclo formativo de grado superior correspondiente al título de Técnico

Superior en Química y Salud Ambiental. Available at: https://www.boe.es/eli/es/o/2020/03/11/efp249/dof/spa/pdf.

Ministerio de Educación (2021). Anteproyecto Ley Orgánica de Ordenación e integración de la Formación Profesional. Available at: https://www.lamoncloa.gob.es/consejodeministros/resumenes/Documents/2021/150621-texto-anteproyecto.ley-fp.pdf.

Ministerio de Educación (2022). Información sobre la nueva Ley de Formación Profesional. Available at: https://www.educacionyfp.gob.es/destacados/nueva-ley-fp.html.

Ministerio de Energía (2017). Plan Nacional de Acción de Eficiencia Energética 2017-2020. Available at: https://www.asociacion3e.org/documento/plan-nacional-de-accion-de-eficiencia-energetica-2017-2020.

Ministerio para la Transición Ecológica (2020). España Circular 2030 – Estrategia Española de Economía Circular. Available at: https://www.miteco.gob.es/es/calidad-y-evaluacion-ambiental/temas/economia-circular/estrategia/.

Ministerio para la Transición Ecológica (2021). Plan de acción de economía circular 2021-2023. Available at: https://www.giec.es/doc/i_plan_accion_eco_circular_2021_2023.pdf.

ANNEX 1: LIST OF ANALYSED VET SCHOOLS AND THEIR PROGRAMMES AND RELEVANT JOB PROFILES

Region	Name of School	Name of Programme(s) taught)	Relevant job profile(s)	Type	Link to Programme Site
Germany					
North Rhine-Westphalia	Hans-Schwier-Berufskolleg	Specialist for recycling and waste management	Waste Manager	Explicit	Link
North Rhine-Westphalia	Hans-Schwier-Berufskolleg	Specialist for sewage technology	Liquid Waste Treatment Technician	Explicit/ Implicit	Link
North Rhine-Westphalia	Hans-Schwier-Berufskolleg	Specialist for water disposal technology	Liquid Waste Treatment Technician	Implicit	Link
Italy					
Emilia Romagna	ITS TEC - Territorio Energia Costruire	Waste Management 4 Energy & Environment	Waste Manager	Explicit	Link
Emilia Romagna	ITS TEC - Territorio Energia Costruire	Renewable Energy Development	Energy Manager	Explicit	Link
Poland					
Katowicy	Zespół Szkół Technicznych i Ogólnokształcących Nr 2 w Katowicach (and others)	Energy Technician	Energy Analyst	Implicit	Link
Portugal					
Lisbon	ATEC	Specialist Technician in Energy Management and Control	Energy manager	Explicit	Link
Norte	CICCOPN - Centro de Formação Profissional da	Technician Specialist in Energy Management and Control	Energy manager	Explicit	Link

Region	Name of School	Name of Programme(s) taught)	Relevant job profile(s)	Type	Link to Programme Site
	Indústria e Obras Públicas do Norte				
Norte	EP Régua	Water Treatment Systems Technician; Operator of Solid Waste Management Systems; Operator of Water Treatment Systems	Liquid waste management technician; Waste management supervisor	Explicit	Link
Spain					
Valencia	Escuelas San Jose	Tecnico Superior Eficiencia energetica y Energya solar termica	Energy Manager, Energy Analyst	Explicit	Link
Valencia	IES Federica Montseny de Burjassot	Tecnico Superior en Quimica y Salud Ambiental	(Liquid) Waste Management Technician	Implicit	Link

Source: Visionary Analytics

ANNEX 2: LIST OF IS- AND EE-RELATED TRAINING UNITS IN THE NATIONAL QUALIFICATIONS CATALOGUE

Name of the short training unit	Qualifications where it can be found
Environmental management and sustainability - concepts and principles	Solid Waste Management Systems Operator Water Treatment Systems Operator Water Treatment Systems Technician
Environmental management	Solid Waste Management Systems Operator Water Treatment Systems Operator Fish Transformation Operator Quality Technician Laboratory Analysis Technician Ceramics Technician Distribution Technician Food Industries Technician Ceramic Laboratory Technician Logistics Technician Civil Protection Technician Technician of Industrial Planning of Metallurgy and Metalworking Water Treatment Systems Technician Industrial Chemistry Technician Glass Technician
Safety, hygiene and health at work applied to solid waste management	Safety, hygiene and health at work applied to solid waste management
Solid waste management – framework Waste management and final destination	Solid Waste Management Systems Operator Environmental Management Technician
Solid waste treatment systems - operation and control	Solid Waste Management Systems Operator
Solid waste - conditioning	
Solid waste - collection, sorting and transportation	
Sorting and recycling solid waste	
Storage, preparation and dispatch of hazardous waste	
Solid waste containment - landfill	
The integrated electronic waste registration system	
Incineration of solid waste - operations	
Quality, environment, health and safety - metallurgy and metalworking	Mechanical Construction Design Technician Drawing and Die Cutting Technician Moulds/frames Design Technician
Environmental laboratory techniques	Ceramics Laboratory Technician
Industrial ceramic waste	
Energy management techniques	
Environment, safety, hygiene and health at work - extractive industry	Mining Operator Occupational Safety Technician
Waste management, collection and classification	Parts Procurement and Sales Technician
Industrial waste management	Aeronautical Production Technician - Special Processes Aeronautical Production Technician - Production and Transformation of Composites Aeronautical Production Technician - Quality and Industrial Control
Analysis methods for solid waste	Environmental Management Technician
Energy efficiency - general	Network Electrician Electrical Network Technician Supervisor Technician of Network and Gas Appliances
Energy efficiency and renewable energies	3D Digital Design Technician Installer Technician of Thermal Systems for Renewable Energies
Energy	Polymer/Production Processes Transformation Technician Technician Installer of Wind Systems Technician Installer of Photovoltaic Solar Systems Technician Installer of Thermal Systems for Renewable Energies

Name of the short training unit	Qualifications where it can be found
Renewable energies	Electrical Network Technician
Sustainable construction and nZEB	Civil Construction Painter
Sustainable development and cooperation	Creative Ceramics Technician Ceramic Painting Technician
Eco-design and sustainable design	Furniture and Wood Design Technician Specialist Technician in Product Design and Development - Ceramics
Environment, Safety, Hygiene and Health at Work	Found in 110 Qualifications

Source: Visionary Analytics and ISQ based on National Qualifications Catalogue, https://catalogo.anqep.gov.pt.

ANNEX 3: KEY DEFINITIONS

Industrial Symbiosis: The term "industrial symbiosis" in SPIRE-SAIS project refers to cross-industry use of recycled products and transformed materials and cross-industry transaction services offering new (common) market solutions, business and cooperation models (for reducing production costs, implementing new jobs, and including external customers).

Energy Efficiency: 'Energy efficiency' technically means the ratio of output of performance, service, goods or energy, to input of energy.[74] The term "energy efficiency" in SPIRE-SAIS project refers to cross-sectoral developments focusing on new technologies, systems and synergies among companies to optimise energy consumption and production and to reduce the use of fossil fuels and the carbon footprint of industry as well as investment, maintenance, and management costs of the energy infrastructure.

Energy intensive (or process) industry: Includes companies that extract, transport and process raw materials to manufacture semi-finished or high-quality end products by means of physical, mechanical and/or chemical processes[75]. Process industry is comprised of the following ten sectors: cement, ceramics, chemicals, engineering, minerals, non-ferrous metals, pulp and paper, refining, steel and water.[76]

Skill, Competence, Knowledge, Attitude, Task, Qualification*:* According to the European qualifications Framework (EQF) and European e-Competence Framework (e-CF), skills, knowledge and attitudes are components of competences. Competences are therefore defined as the ability to use skills, knowledge and attitudes to achieve results. Skills and knowledge are mainly regarded separately, even though some sources define skills as the ability to apply knowledge, describing skills as a synonym for competences.

Skills (e.g. reading position coordinates, following the air route)	**Knowledge** (e.g. knowing emergency procedures or equipment malfunctions)	**Attitudes** (e.g. perceptions about the climate change)
Competences (e.g. combining above knowledge and skills required to work as energy manager')		
Qualification (e.g. energy manager's license formally certifying energy manager's skills, knowledge, and competences)		

Source: https://ec.europa.eu/esco/portal/escopedia/Skill

Skills: In general, skills are capabilities needed to complete a task. ILO (International Labor organization) defines 'skill' as the ability to carry out the tasks and duties of a given job. ESCO, European Qualifications Framework (EQF), and CEDEFOP share one definition: "skill means the ability to apply knowledge and use know-how to complete tasks and solve problems". Skills can be described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).[77]

Knowledge: CEDEFOP defines knowledge as the „interaction between intelligence (capacity to learn) and situation (opportunity to learn). [This] includes theory and concepts and tacit knowledge gaines as a result of the experience of performing certain tasks." CEDEFOP, furthermore, contrasts knowledge which they consider ‚know-that' with understanding which

[74] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC
[75] https://www.ipa.fraunhofer.de/en/industry-solutions/process-industry.html
[76] https://www.aspire2050.eu/aspire/the-association
[77] https://ec.europa.eu/esco/portal/escopedia/Skill

they understand as knowledge about processes and contexts, or ‚know-why' [Typology of Knowledge, Skills and Competences, CEDEFOP, 2006]. Similarly, the e-CF (European e-Competence framework) considers knowledge as the set of know-what, such as programming languages or design tools, The EQF describes knowledge (theoretical and factual) as the assimilation of information (body of facts, theories, practices and principles) through learning. ESCO uses the same definition as EQF.[78]

Attitude: With skills and knowledge being the main components of competences, attitudes can be regarded as the glue that keeps them together. Attitudes are described as the cognitive and relational capacity as well as the motivation to do something. For example, the person who perceives the climate change as an important challenge will be more likely to be willing to apply EE practices.

Qualifications: Qualifications are understood as "the formal outcome of an assessment and validation process, which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards".[79]

Competences: In e-CF, Competences are defined as demonstrated ability to apply knowledge, skills and attitudes for achieving observable results. ESCO applies the same definition of "competence" as the European Qualification Framework (EQF): "competence means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development". They are described in terms of responsibility and autonomy.[80]

Green skills: the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society.[81] Examples include pollution and waste prevention, renewable energy generation, energy management, environmental auditing or sustainable procurement.

Learning outcomes: CEDEFOP defines learning outcomes as set of knowledge, skills and/or competences an individual has acquired and/or is able to demonstrate after completion of a learning process, either formal, non-formal or informal. Alternatively, CEDEFOP also defines learning outcomes as statements of what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and competence.[82]

Vocational education and training (VET)[83]: Education and training which aims to equip people with knowledge, know-how, skills and/or competences required in particular occupations or more broadly on the labour market. VET is usually differentiated in the following two major categories:

- Initial or continuing education and training:
  - Initial education and training: education and training carried out in the initial education system, usually before entering working life.
  - Continuing education and training: education or training after initial education and training – or after entry into working life aimed at helping individuals to:
    - improve or update their knowledge and/or skills;
    - acquire new skills for a career move or retraining;

[78] https://ec.europa.eu/esco/portal/escopedia/Knowledge
[79] https://www.cedefop.europa.eu/node/11256
[80] https://ec.europa.eu/esco/portal/escopedia/Competence
[81] https://www.oecd.org/cfe/leed/Greener%20skills_Highlights%20WEB.pdf
[82] https://www.cedefop.europa.eu/files/4064_en.pdf
[83] Ibid.

        - continue their personal or professional development.
- Formal or non-formal learning:
    - Formal learning: learning that occurs in an organised and structured environment (such as in an education or training institution or on the job) and is explicitly designated as learning (in terms of objectives, time or resources). It typically leads to certification or qualification.
    - Non-formal learning: learning embedded in planned activities not explicitly designated as learning (in terms of learning objectives, learning time or learning support). non-formal learning is intentional from the learner's point of view.